

EUROSOIL 2012 Scientific Session Planning

MONDAY 2		SPACE 7					
08.30-10.00	OPENING CEREMONY - WELCOMING ADDRESSES						
10.30-12.00	3 PLENARY LECTURES: SPARKS D. L., HORN R., MONTANARELLA L.						
MONDAY 2	BLOCKS	ACERO	OLMO	LECCIO	BIANCOSPINO	ALLORO	MIRTO
13.30-15.00	III	S03.01a	S10.01a	W12.01a	S11.01a	S07.05	S06.02
15.30-17.00	IV	S03.01b	S10.01b	W12.01b	S11.01b	S04.04	S11.08
17.00-18.30	POSTER PRESENTATIONS	POSTER AREAS					
		S03.01-P	S07.05-P	S12.04-P	S11.01-P	S11.08-P	S11.04-P
		S10.01-P	S06.02-P	S13.05-P	W12.01-P	S04.04-P	S07.04-P
18.30-20.00	WELCOME RECEPTION						
TUESDAY 3	BLOCKS	ACERO	OLMO	LECCIO	BIANCOSPINO	ALLORO	MIRTO
08.30-10.00	I	S03.01c	S10.01c	S06.04	S10.03a	S08.01a	S07.02
10.30-12.00	II	S12.07a	S05.01a	S03.02a	S10.03b	S08.01b	S06.03
13.30-15.00	III	S12.07b	S05.01b	S03.02b	S10.03c	S02.04	W06.01a
15.30-17.00	IV	S12.07c	S05.01c	S03.02c	S13.02	W11.01	W06.01b
17.00-18.30	POSTER PRESENTATIONS	POSTER AREAS					
		S12.07-P	S02.04-P	S08.01-P	S10.03-P	S13.02-P	W06.01-P
		S05.01-P	W11.01-P	S07.02-P	S06.04-P	S03.02-P	S06.03-P
18.30-20.00	SPECIAL EVENTS	ACERO	OLMO	LECCIO	BIANCOSPINO	ALLORO	MIRTO
			TM01	BM04	BM03	R01	R04
WEDNESDAY 4	BLOCKS	ACERO	OLMO	LECCIO	BIANCOSPINO	ALLORO	MIRTO
08.30-10.00	I	S07.04	S06.01a	S08.02a	S01.01a	S04.05a	S03.03
10.30-12.00	II	S11.02a	S06.01b	S08.02b	S01.01b	S04.05b	W03.01
13.30-15.00	III	S11.02b	S06.01c	S01.04	S02.05a	S04.06	S11.05
15.30-17.00	IV	S11.02c	S12.02	S11.07	S02.05b	W05.01	S11.06
17.00-18.30	POSTER PRESENTATIONS	POSTER AREAS					
		W05.01-P	S01.01-P	S01.04-P	S11.07-P	S11.05-P	S11.06-P
		S06.01-P	S04.05-P	S02.05-P	W03.01-P	S12.02-P	S03.03-P
		S08.02-P	S11.02-P	S04.06-P			
18.30-20.00	SPECIAL EVENTS	ACERO	OLMO	LECCIO	BIANCOSPINO	ALLORO	MIRTO
		BM07	BM01	BM08/AIP	SC02	R02	R03
THURSDAY 5	BLOCKS	ACERO	OLMO	LECCIO	BIANCOSPINO	ALLORO	MIRTO
08.30-10.00	I	S02.02	S02.03	S11.09a	S07.03a	S11.04	S08.04a
10.30-12.00	II	S05.03a	S04.01a	S11.09b	S07.03b	S04.07	S08.04b
13.30-15.00	III	S05.03b	S04.01b	S07.01a	S09.02	S02.01	S01.02
15.30-17.00	IV	S05.03c	S04.01c	S07.01b	S09.01	S01.03	S05.02
17.00-18.30	POSTER PRESENTATIONS	POSTER AREAS					
		S02.02-P	S07.01-P	S09.02-P	S02.01-P	S08.04-P	S05.02-P
		S05.03-P	S11.09-P	S04.07-P	S04.01-P	S09.01-P	S01.03-P
		S02.03-P	S07.03-P	S01.02-P			
18.30-20.00	SPECIAL EVENTS	ACERO	OLMO	LECCIO	BIANCOSPINO	ALLORO	MIRTO
		BM06	BM02	BM05	TD01	OD01	
FRIDAY 6	BLOCKS	ACERO	OLMO	LECCIO	BIANCOSPINO	ALLORO	MIRTO
08.30-10.00	I	S04.02a	S12.01	S07.06a	S13.04	S04.03	S13.01a
10.30-12.00	II	S04.02b	S07.07a	S07.06b	S12.06a	S10.02	S13.01b
13.30-15.00	III	S11.03a	S07.07b	S12.04a	S12.06b	S12.03	S13.03
15.30-17.00	IV	S11.03b	S07.07c	S12.04b	S08.03	S12.05	S13.05
17.00-18.30	POSTER PRESENTATIONS	POSTER AREAS					
		S11.03-P	S12.05-P	S12.06-P	S12.03-P	S13.03-P	S08.03-P
		S12.01-P	S13.04-P	S10.02-P	S04.02-P	S07.06-P	
		S07.07-P	S13.01-P	S04.03-P			
18.30-19.00	CLOSING REMARKS						



S01.01a - SOILS AND SEDIMENTS AS NATURAL ARCHIVES

Chair Persons:

Daniela Sauer, Hohenheim - Germany

Alexander Makeev, Moscow - Russian Federation

Wednesday 04 July 2012 from 08:30 to 10:00. Room Biancospino

S01.01a -1

ANCIENT DUNES AND PALEOSOLS OF THE SAHEL AND SAHARA IN EAST NIGER AS ARCHIVES OF PLEISTOCENE AND HOLOCENE CLIMATE CHANGES

Peter Felix-Henningsen, Giessen - Germany

S01.01a -2

LATE PLEISTOCENE-HOLOCENE TEPHRA AND VOLCANIC SOILS IN THE VESUVIUS FOOTHILL, SOUTHERN ITALY: RECONSTRUCTION OF TIME SPANS OF SOIL FORMATION AND CLIMATIC CHANGES

Fabio Scarciglia, Arcavacata di Rende (CS) - Italy

S01.01a -3

POLYGENETIC PODZOLS DEVELOPED OF SLOPE COVER-BEDS IN THE SUDETES MOUNTAINS (SW POLAND)

Cezary Kabala, Wroclaw - Poland

S01.01a -4

IDENTIFICATION AND QUANTIFICATION OF POSTSEDIMENTARY ROOT-DERIVED OM IN LOESS-PALEOSOL SEQUENCES USING LIPID MOLECULAR PROXIES

Martina Gocke, Bayreuth - Germany

S01.01a -5

SOIL WEATHERING AND ACCUMULATION RATES OF POORLY CRYSTALLINE PHASES DERIVED FROM A 1MA CHRONOSEQUENCE

Markus Egli, Zürich - Switzerland

S01.01a -6

DO SMOULDERING FIRES ALONG PEAT COLUMNS AFFECT PALEOENVIRONMENTAL RECONSTRUCTIONS?

Claudio Zacccone, Foggia - Italy



S01.01a -1

ANCIENT DUNES AND PALEOSOLS OF THE SAHEL AND SAHARA IN EAST NIGER AS ARCHIVES OF PLEISTOCENE AND HOLOCENE CLIMATE CHANGES

Felix-Henningsen Peter*^[1]

^[1]Justus Liebig University ~ Institute of Soil Science and Soil Conservation ~ Giessen ~ Germany

Fossil and relict paleosols found in extremely arid to semiarid climatic regions of the Sahara desert can provide evidence of past humid climatic periods. These soils developed in eolian sands and can be used to indicate dry climatic phases that occurred prior to humid periods. Three generations of ancient dunes with paleosols were found along a SW-NE traverse covering 20 study sites from the southern Sahel of East Niger to the Ténéré desert and Tchigai mountainous region, and up to the southern border of Libya. OSL dating revealed that the accumulation of Upper Pleistocene ancient dunes began at 29.3 BP and ended at 9.5 BP. A second dune generation, in NE Niger mainly preserved in the wind shadow positions of escarpments and inselbergs, developed under arid conditions with an end in dune sedimentation between 5.2 and 3.5 ka. Paleosols on these dunes indicate a further humid period after 3.5 ka. During this humid period, weak Cambisols also developed on the younger dune generation. The continuously increasing aridity during Upper Holocene found a maximum at about 1.2 – 1.8 ka, indicated by the sedimentation of a further area-wide dune generation in NE Niger. The dunes in the Central Sahara were stabilized by weak weathering and covered by rock debris in a subsequent humid interval of short (possibly only several 10 - 100 a) duration.



S01.01a -2

LATE PLEISTOCENE-HOLOCENE TEPHRA AND VOLCANIC SOILS IN THE VESUVIUS FOOTHILL, SOUTHERN ITALY: RECONSTRUCTION OF TIME SPANS OF SOIL FORMATION AND CLIMATIC CHANGES

Scarciglia Fabio^[1], Zumpano Veronica^[1], Sulpizio Roberto^[2], Terribile Fabio^[3], Pulice Iolanda^[1]

^[1]Università della Calabria ~ Dipartimento di Scienze della Terra ~ Arcavacata di Rende (CS) ~ Italy ^[2]Università di Bari ~ Dipartimento Geomineralogico ~ Bari ~ Italy ^[3]Università di Napoli "Federico II" ~ DISSPAPA ~ Portici (NA) ~ Italy

In this work we present the main results of a multidisciplinary study of late Pleistocene to mid-Holocene primary tephra and interlayered volcanic soils as indicators of terrestrial ecosystem responses to late Quaternary climatic changes. We focused on a pedostratigraphic succession of soils developed on and/or buried by well-known volcanic layers of different ages, sourced from the Somma-Vesuvius volcano (Campania region, southern Italy). Five tephra give detailed chronological constraints to the stratigraphic record: the Pomici di Base tephron at the bottom (22 ka BP), followed upward by the Pomici Verdoline (19 ka BP), the Agnano Pomici Principali (APP) (12.26 ka BP), the Mercato (8.9 ka BP) and Avellino eruption (3.9 ka BP) pumice deposits at the top. Four pedons interlayered between each subsequent couple of tephra were studied in detail in terms of physical, chemical, mineralogical and micromorphological features, with special emphasis on (i) reconstructing dominant pedogenetic processes and corresponding (paleo)environmental/climatic conditions, along with (iii) degree of soil development and associated time spans. SEM-EDS analyses performed on two further tephra identified within two of above pedons but up to now unknown in the Vesuvius stratigraphy (referred to the Soccavo 4-5 and the Tufi Biancastri eruptions from the near Phlegrean Fields) permitted to fix further age constraints for more detailed assessment of rates of soil formation. Major climatic phases coherent with Last Glacial Maximum to Lateglacial and early- mid-Holocene climatic optimum are evidenced by varying degree of expression of andic properties, soil microstructure, carbonate accumulation, iron-oxide staining and silt-clay illuviation.



S01.01a -3

POLYGENETIC PODZOLS DEVELOPED OF SLOPE COVER-BEDS IN THE SUDETES MOUNTAINS (SW POLAND)

Kabala Cezary^[1], Waroszewski Jaroslaw^[1], Malkiewicz Malgorzata^[2]

^[1]Wroclaw University of Environmental and Life Sciences ~ Institute of Soil Science ~ Wroclaw ~ Poland ^[2]University of Wroclaw ~ Department of Paleobotany ~ Wroclaw ~ Poland

Soils having a morphology of typical Podzols, e.g. whitish eluvial horizon over a dark brown illuvial horizon, are widely extended in the upper forest zone of the Sudety Mountains, on granite, gneiss, and sandstone saprolites. Large differences in organic matter and iron/aluminium content was found among E and B horizons, followed by contrasts in base saturation, macro- and microelement concentrations etc. However, an arrangement of skeletal fragments is variable in the successive horizons of soil profile indicating a slope cover-bed to be a proper parent material rather than the homogenous saprolite. E and B horizons differ in soil texture (mostly sand over loam) and in both, the content and distribution of heavy minerals in a sand fraction. Moreover, plant pollen spectra in Bh and A (or AE) horizons differ significantly, indicating an influence of various, but always a Holocene vegetation. It was concluded finally, based on above mentioned arguments and soil micromorphology, that present-day Bh horizons are in many cases the former surface horizons ABw buried under a cover sand (or loamy-silty sand) layer. These cover-beds do not meet a German model of periglacial (Pleistocene) cover series due to the lack of an eolian silt addition or layer. The sand covering the soils under study is of local origin, however, the conditions and process of sand layer formation are not fully understood and still under discussion.



S01.01a -4

IDENTIFICATION AND QUANTIFICATION OF POSTSEDIMENTARY ROOT-DERIVED OM IN LOESS-PALEOSOL SEQUENCES USING LIPID MOLECULAR PROXIES

Gocke Martina^[1], Wiesenberg Guido L.b.^[1]

^[1]University of Bayreuth ~ Department of Agroecosystem Research ~ Bayreuth ~ Germany

Loess-paleosol sequences are one of the most important terrestrial archives for studying paleoenvironmental conditions. Initial organic matter (OM) in loess is supposed to derive from aboveground biomass of vegetation prevailing during loess deposition. Recent studies show, however, that significant portions of loess OM can derive from roots and associated microbial biomass, entailing uncertainties for paleoenvironmental research. This study aims to decipher the effect of postsedimentary deep-rooting plants on original composition of loess OM, as well as its extent. Calcification of roots, leading to formation of rhizoliths, entails improved preservation of root and rhizomicroorganism remains accumulated during the lifespan of former roots. At Nussloch (SW Germany), rhizoliths, surrounding loess (rhizoloess) up to a distance of 10 cm and root-free loess were sampled at different depths and analysed for Corg and lipid composition. Molecular proxies of alkane and fatty acid (FA) fractions argue for the presence of root and rhizomicroorganism derived OM in the vicinity of rhizoliths. High amounts of strongly degraded and microbial biomass, resulting in low average chain length and carbon preference index of alkanes and FAs in rhizoloess, suggested the presence of a former rhizosphere. Mono- and polyunsaturated FAs as indicators for microbial and plant biomass, as well as di-carboxylic acids as root-specific markers were used to quantify postsedimentary incorporated OM in loess. Several proxies suggest an extension of the former rhizosphere of at least 8 cm. Due to the high rhizolith abundance at Nussloch (up to 190 m⁻²), significant overprint of loess OM can be expected.



S01.01a -5

**SOIL WEATHERING AND ACCUMULATION RATES OF POORLY CRYSTALLINE PHASES
DERIVED FROM A 1MA CHRONOSEQUENCE**

Egli Markus^[1], Dahms Dennis^[2]

^[1]University of Zürich ~ Dept. of Geography ~ Zürich ~ Switzerland ^[2]University of Northern Iowa ~ Department of Geography ~ Cedar Falls ~ United States

In this study we compare published and new weathering data from soils developed along chronosequences of glacial deposits of the European Alps and the Rocky Mountains (Wind River Range, USA). This procedure enabled us to present comprehensive datasets over a time period of >1 Ma. We describe weathering of main elements using several weathering indices such as the (K+Ca)/Ti ratio, the weathering index B of Kronberg and Nesbitt and the open mass transport function. In addition, we show the accumulation of Al, Fe, Si and Mn oxyhydroxides as a function of time and derive the corresponding accumulation rates. The pedogenetically formed oxyhydroxides were calculated using an approach based on immobile elements. For one of the first times, overall formation rates of these phases can be plotted as a function of soil age (up to 1 Ma). These formation rates distinctly decreased with increasing age of the soil. After 1 Ma, about four order of magnitudes lower rates were determined. The datasets suggest that the older soils may be reaching a steady state for these chemical properties in their present environments. The decrease of the accumulation rate is not only influenced by the factor Time but also by the factor Climate (higher precipitation rates lead to a slower rate decrease). A power function (index B, (K+Ca)/Ti) or an 'exponential decay model function' (accumulation of pedogenetically formed weakly and poorly crystalline phases, relative losses using the open-system mass transport function) best explained the measured trends.



S01.01a -6

DO SMOULDERING FIRES ALONG PEAT COLUMNS AFFECT PALEOENVIRONMENTAL RECONSTRUCTIONS?

Zaccone Claudio*^[1], Rein Guillermo^[2], D'orazio Valeria^[3], Hadden Rory^[2], Belcher Claire^[2], Miano Teodoro M.^[4]

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Smouldering is a flameless form of combustion, deriving its heat from heterogeneous oxidation on the porous surface of a solid fuel. Smouldering fires of peatlands represent a large perturbation of the atmospheric chemistry; when active, the burning of ground layers can last for long periods of time (months or years). The propagation depth depends on moisture and inert content of the peat. Most studies on smouldering to date focused on ignition, C losses or emissions, but the literature still lacks understanding of the evolution of organic matter (OM) following smouldering fires. This topic is extremely important especially for paleoenvironmental reconstructions, because peat soils are often used as natural archives of climatic and vegetational changes reaching. For example, previous studies have generally interpreted peaks in ash content as ascribed to an increase of either dust depositions or mineralization, whereas variations in C/N to changes in either vegetational or humification degrees. The present work proposes that these could be signatures of ancient peat fires. In particular, we show preliminary data about changes in OM features along three Sphagnum peat columns (25cm deep) having different initial moisture contents (MC): 50%MC, 100%MC, and 200%MC. Results underlined significant variations in terms of ash content, pH, elemental composition, main atomic ratios (C/N, C/H, O/C) and spectroscopic features across the interface between burn residue and undisturbed peat. At the same time, some of observed trends (e.g., TC, TN, C/N and C/H) were quite reproducible in the experiments, thus suggesting some "proxies" to reconstruct ancient smouldering events.



S01.01b - SOILS AND SEDIMENTS AS NATURAL ARCHIVES

Chair Persons:

Claudio Zaccone, Foggia - Italy

Sylvie Quideau, Edmonton - Canada

Wednesday 04 July 2012 from 10:30 to 12:00. Room Biancospino

S01.01b -1

BRANCHED TETRAETHER LIPIDS IN A FRENCH PEATLAND : APPLICATION TO THE RECONSTRUCTION OF PAST TEMPERATURES AND PH

Arnaud Huguet, Paris - France

S01.01b -2

NEW MULTI-PROXY APPROACH TO RECONSTRUCT VEGETATION DYNAMICS FROM TERRESTRIAL ARCHIVES IN THE ECUADORIAN ANDES

Boris Jansen, Amsterdam - Netherlands

S01.01b -3

POTENTIAL OF $^{236}\text{U}/^{238}\text{U}$ AND $^{240}\text{Pu}/^{239}\text{Pu}$ ISOTOPIC RATIOS AS CHRONOLOGICAL MARKERS FOR PEAT BOGS COMPLEMENTING THE CLASSICAL ^{210}Pb METHOD.

Francesca Quinto, Karlsruhe - Germany

S01.01b -4

CARBON DISTRIBUTION ALONG THE PROFILE OF A COMPOST-AMENDED ANTHROPOGENIC SOIL: EVIDENCE FROM A CHRONOSEQUENCE STUDY

Daniel Said-Pullicino, Turin - Italy

S01.01b -5

MULTI-SCALE APPROACH OF THE STRUCTURE EVOLUTION OF CONSTRUCTED TECHNOSOLS DURING EARLY PEDOGENESIS

Séré Geoffroy, Vandoeuvre-Lés-Nancy - France

S01.01b -6

ZONAL SOIL PATTERN IN RELATION TO GLACIAL HISTORY OF THE RUSSIAN PLAIN

Alexander Makeev, Moscow - Russian Federation



S01.01b -1

BRANCHED TETRAETHER LIPIDS IN A FRENCH PEATLAND : APPLICATION TO THE RECONSTRUCTION OF PAST TEMPERATURES AND PH

Huguet Arnaud^[1], Fosse Céline^[2], Laggoun-Défarge Fatima^[3], Derenne Sylvie^[1]

^[1]BioEMCo ~ CNRS/UPMC UMR 7618 ~ Paris ~ France ^[2]Chimie ParisTech (ENSCP) ~ Laboratoire de Spectrométrie de masse ~ Paris ~ France ^[3]Institut des Sciences de la Terre d'Orléans ~ Université d'Orléans/CNRS ~ Orléans ~ France

Over the last years, branched glycerol dialkyl glycerol tetraethers (GDGTs) were increasingly used for the reconstruction of past air temperatures and soil pH through the application of the MBT /CBT proxies (methylation and cyclisation ratio of branched GDGTs). Nevertheless, only a few studies were interested in the application of these proxies in peatlands. In this work, the applicability of the MBT/CBT in peat was examined by analyzing branched GDGTs in a 4 m peat core collected in the French Jura Mountains and covering the last 6 000 years. Branched GDGTs present as core (CLs; derived from dead biomass) and intact polar lipids (IPLs; markers for living cells) were analyzed. A significant proportion of GDGTs was derived from extant biomass (ca. 20-30%) in both the top and down parts of the bog. The MBT/CBT proxies were shown to overestimate temperature and pH. Thus, in the top part of the bog, MBT/CBT-derived temperature (ca. 10 °C) was higher than measured annual air temperature (ca. 6°C) and was more consistent with spring and summer temperature, suggesting that branched GDGT-producing bacteria might be more active during the warmest months of the year. At 2.5 m depth, reconstructed temperature and pH showed a pronounced shift, likely reflecting both a change in the composition of the peat and in climatic conditions. Interestingly, CBT-derived and measured pH records showed similar variations with depth. Our data suggest that, as shown in other environments, a specific calibration is required to apply the MBT/CBT proxies with confidence in peat.



S01.01b -2

NEW MULTI-PROXY APPROACH TO RECONSTRUCT VEGETATION DYNAMICS FROM TERRESTRIAL ARCHIVES IN THE ECUADORIAN ANDES

Jansen Boris^{*[1]}, De Boer Erik^[1], Hooghiemstra Henry^[1], Kalbitz Karsten^[1]

^[1]University of Amsterdam ~ Institute for Biodiversity and Ecosystem Dynamics ~ Amsterdam ~ Netherlands

Centuries of human influence have led to large scale reduction of montane forests in the northern Ecuadorian Andes. As a result the natural position of the upper forest line in the area is now subject of scientific debate, which is hindering sustainable reforestation efforts. Uncertainty is fuelled by insufficient precision of fossil pollen spectra to reconstruct the natural upper forest line position. We recently developed the Vegetation Reconstruction Helped by Inverse modelling and Biomarkers (VERHIB) model; a biomarker application based on plant species specific patterns of n-alkanes and n-alcohols preserved in sediments in chronological order. The model unravels the mixed biomarker signal into the plant species composition. We used the new biomarker application to reconstruct past vegetation patterns from several soil profiles in the Guandera Biological Reserve in the northern Ecuadorian Andes. Changes in biomarker-based vegetation composition in the last 3500 yrs BP were directly compared to changes in pollen-based vegetation composition from the same profiles. Both proxies proved to be highly complementary and allowed for reconstructions of past vegetation change with great detail. We found that the upper forest line in the study area has not been significantly depressed by human interference and was at 3650 m maximally during Holocene times. The combined pollen-biomarker approach in soil profiles theoretically allows for an unlimited number of reconstructions to be made along an altitudinal transect, and is not dependent on the presence of peat archives in depressions in the landscape.



S01.01b -3

POTENTIAL OF $^{236}\text{U}/^{238}\text{U}$ AND $^{240}\text{Pu}/^{239}\text{Pu}$ ISOTOPIC RATIOS AS CHRONOLOGICAL MARKERS FOR PEAT BOGS COMPLEMENTING THE CLASSICAL ^{210}Pb METHOD.

Quinto Francesca^{*[1]}, Hrncek Erich^[1], Krachler Michael^[1], Shotyk William^[2], Steier Peter^[3]

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^[2]University of Alberta ~ Renewable Resources ~ Edmonton ~ Canada ^[3]University of Vienna ~ VERA Laboratory, Faculty of Physics ~ Vienna ~ Austria

Ombrotrophic peat bogs represent reliable archives for the atmospheric deposition of several elements. Furthermore, since mosses have a high interception potential for aerosols in precipitation, peat bogs may exhibit enrichment in fallout elements and radionuclides such as ^{210}Pb , ^{210}Po , ^{236}U and plutonium isotopes. The ^{210}Pb method is widely used for dating peats and sediment layers. The obtained ^{210}Pb depth profiles are usually compared with independent chronological markers, such as the ^{137}Cs activity. However, ^{137}Cs derived data may be not reliable since caesium shows post-depositional mobility in reducing environments. In this contribution, the use of $^{236}\text{U}/^{238}\text{U}$ and $^{240}\text{Pu}/^{239}\text{Pu}$ isotopic ratios as complementary time markers is evaluated. For this, characteristic isotopic composition related to global fallout from the atmospheric weapons tests (with maximum in 1963) and the Chernobyl accident (1986) can be used. This concept is applied to an undisturbed ombrotrophic peat core collected at the Northern Black Forest, Germany.



S01.01b -4

CARBON DISTRIBUTION ALONG THE PROFILE OF A COMPOST-AMENDED ANTHROPOGENIC SOIL: EVIDENCE FROM A CHRONOSEQUENCE STUDY

Said-Pullicino Daniel^[1], Gigliotti Giovanni^[2]

^[1]University of Turin ~ DiVaPRA - Agricultural Chemistry and Pedology ~ Turin ~ Italy ^[2]University of Perugia ~ Department of Agricultural and Environmental Science ~ Perugia ~ Italy

Soil fertility and C stocks of anthropogenic soils formed during land reclamation activities may be enhanced by amendment with municipal waste compost (MWC). Although the positive effects of compost application to arable soils is well recognized, little is known on how land rehabilitation practices effect C dynamics in such relatively young soil systems. Within the framework of a long-term experiment, this work aims at evaluating temporal and spatial dynamics of compost-derived organic matter (OM) with respect to the major processes involved in OM cycling in an anthropogenic landfill covering soil amended with MWC. We investigated long-term C dynamics in such systems by collecting landfill covering soil samples at different depths, from a 10 year chronosequence. Compost application enhanced the C stocks of amended topsoils, and $\delta^{13}C$ values showed that compost-derived organic matter was distributed throughout the soil profile. The addition of compost to the superficial layer resulted in a significant input of soluble organic compounds subject to leaching. Sorption isotherms for compost-derived water-extractable OM onto mineral materials used for landfill covering as well as the accumulation of lignin-derived phenolic biomarkers suggest that sorptive preservation contributed to increasing C content of deeper soil horizons with time. Nevertheless, changes in the content of non-cellulosic carbohydrates in soils and their respective water-extractable fractions suggest that a proportion of compost-derived, labile organic matter fraction is leached through the soil profile and potentially lost from the soil system, particularly in the years immediately after compost application.



S01.01b -5

MULTI-SCALE APPROACH OF THE STRUCTURE EVOLUTION OF CONSTRUCTED TECHNOSOLS DURING EARLY PEDOGENESIS

Geoffroy Séré^[1], Françoise Watteau^[1], Stéphanie Ouvrard^[1], Christophe Schwartz^[1], Jean Louis Morel^[1]

^[1]Nancy-Université / INRA ~ Laboratoire Sols et Environnement ~ Vandoeuvre-Lés-Nancy ~ France

Constructed soils are Technosols resulting from the deliberate combination of various technogenic materials to restore derelict lands. The efficiency of the brownfield reclamation relies on the sustainability of the constructed Technosols and therefore requires studying their early pedogenesis. The present work focuses on the evolution of their structure at different scales. Two soils were constructed in lysimetric plots (10 x 10m x 1 m depth), using a soil engineering process by the association of paper-mill sludge, thermally treated soil material, and green-waste compost. The evolution of the soil profiles was studied in situ for 3 years. It consisted in the confrontation of i) the observation and description of the macro-structure organization, ii) the texture, iii) the stability of aggregates, iv) indirect measurement of the porosity thanks to pressure-plate methods and v) observation at ultrastructural scale of 0-50 μ m organo-mineral fractions. The first result is the horization of both soil profiles with the differentiation of the initial layers in new soil horizons. Then, the structure of the soils evolved by global compaction and by the change of the porosity distribution. At a smaller scale, mechanical and biological aggregates formation was described and an increase of the aggregate stability with time was measured. Intrinsic reasons relating to the technogenic parent materials origins inevitably induce a remarkable intensity in the pedogenic processes of constructed Technosols. Disequilibria between the parent materials and the environmental forcing factors lead to a fast and original pedogenesis, certainly peculiar to Technosols.



S01.01b -6

ZONAL SOIL PATTERN IN RELATION TO GLACIAL HISTORY OF THE RUSSIAN PLAIN

Makeev Alexander*^[1], Yakusheva Tatyana^[1]

^[1]Moscow State University ~ Institute of Ecological Soil Science ~ Moscow ~ Russian Federation

Since Dokuchaev Russian plain is known as a classic model of bioclimatic zonal soil sequence. But soil geographic pattern correlates also to glacial history where earlier glaciations were more extensive than most recent one. Three conspicuous belts follow the pattern of glacial and periglacial sediments and corresponding paleocryogenic and relic soil features. The area south of Late Saalian limits is characterized by extensive loess mantles. Polygenetic features in Faeozomes and Chernozems are determined by loess stratification, marked by paleocryogenesis, paleohydromorphism and relic soil features (i.e. buried humus horizons). An area within Late Saalian limits is characterized by a diverse set of sediments (separate bodies of loess, glacial till, fluvioglacial sand, etc.) as a result of complex glacio-dynamic structure of cover glacier and high dissection of relief. The key to understanding relic soil features is the fact that day surfaces on different types of relief are heterochronous. The E/Bt horizonation of Glossisols and Luvisols on loess and glacial till is largely inherited from stratified sediments. Within Weichselian limits high flooding prevented extensive loess accumulation. Soils inherited specific layering of sediments (laminated clays, fluvioglacial sands and glacial till with veneer of fluvial sand; on higher ground till with thin veneer of cover sand, sometimes of loess; etc.). Relic features in relation to glacial history need to be further investigated. On glacial and periglacial plains they allow re-evaluating not only soil genetic models but zonal soil pattern, with bioclimatic gradient being superimposed on zonal sequence of sediments and paleocryogenic features.



S01.02 - WETLAND, FLOODPLAIN, RIPARIAN SOILS: PROPERTIES, PROCESSES AND ECOLOGICAL FUNCTIONS

Chair Persons:

Jörg Luster, Birmensdorf - Switzerland

Claire Guenat, Lausanne - Switzerland

Thursday 05 July 2012 from 13:30 to 15:00. Room Mirto

S01.02 -1

WETLAND, FLOODPLAIN, RIPARIAN SOILS: THE EFFECT OF NITROGEN LOADING ON THEIR ECOLOGICAL FUNCTIONS.

Mariet Hefting, Utrecht - Netherlands

S01.02 -2

PROPERTIES, CLASSIFICATION, AND DYNAMICS OF FLOODPLAIN SOILS

Jörg Rinklebe, Wuppertal - Germany

S01.02 -3

AGGREGATE FORMATION IN RIPARIAN SOILS

Markus Graf, Berlin - Germany

S01.02 -4

NITRATE LEACHING FROM SHORT-HYDROPERIOD FLOODPLAIN SOILS

Elisabeth Graf Pannatier, Birmensdorf - Switzerland

S01.02 -5

FOOD WEBS AND ECOSYSTEM SERVICES IN CALIFORNIA RIPARIAN OAK WOODLANDS

Amanda Hodson, Davis - United States

S01.02 -6

SOIL BIOTA AND ECOLOGICAL PROCESSES IN RIPARIAN HABITATS

Matthieu Chauvat, Rouen - France



S01.02 -1

WETLAND, FLOODPLAIN, RIPARIAN SOILS: THE EFFECT OF NITROGEN LOADING ON THEIR ECOLOGICAL FUNCTIONS.

Hefting Mariet*^[1]

^[1]Utrecht University ~ Biology ~ Utrecht ~ Netherlands

Due to their position at the interface between terrestrial and aquatic ecosystems, riparian zones are hot-spots for biogeochemical cycling and are at the same time of crucial importance to conserve biodiversity. However, there is concern about enhanced greenhouse gas emissions, reduced carbon sequestration and loss of biodiversity, where riparian zones have become overloaded with N-rich surface water or groundwater. This paper gives a general overview of nitrogen loading effects on the ecological functions of riparian areas. We studied denitrification activity and N₂O emissions from riparian zones and floodplains at different stream orders assuming that increased connectivity between N-loaded stream water and floodplain would lead to a significant increase in denitrification activity and N₂O emission. Results demonstrate that significant N₂O emissions were restricted to soils with pH values below 5, mostly occurring in stream headwater areas only. Locally, denitrification and N₂O emissions are also extremely variable showing a hotspot pattern. We used a hotspot-coldspot approach, to identify the driving forces of these hotspots. Soil incubations showed N₂O emissions from hotspots are caused by reduced N₂O consumption, mainly in acidic soils. The effect of N-loads on soil carbon sequestration tested in fertilised riparian soils in a geothermally heated riparian wetland in Iceland. This study provides evidence that interaction effects between N-loading and global warming maintain the carbon storage in wetland soils due to suppressed decomposition of SOC. Finally N-effects on biodiversity will be illustrated with results from long-term fertilisation experiments in floodplains and preliminary results of flooding and drought experiments



S01.02 -2

PROPERTIES, CLASSIFICATION, AND DYNAMICS OF FLOODPLAIN SOILS

Rinklebe Jörg*^[1]

^[1]University of Wuppertal ~ D, Soil- and Groundwater-Management ~ Wuppertal ~ Germany

In comparison to terrestrial soils floodplain soils are less studied. They are influenced by groundwater, static water, return seepage, and flood water. Based on our 15 years experiences with soils along various rivers in Germany this presentation will provide a detailed insight into the properties and dynamics of floodplain soils. Thereby the spatial distribution of floodplain soils in the landscape, typical soil profiles, their classification and characteristics will be demonstrate. Particularly we will emphasize the dynamics of those soils with view to the water level, soil matrix potential (?), temperature, redox potential (EH), and pH as well as matter fluxes such as dissolved organic carbon (DOC), Fe²⁺, NO₃⁻, PO₄³⁻, SO₄²⁻, and trace metals. To monitor those parameters in a high temporal resolution we have used well-equipped soil-hydrological monitoring stations in the field. Additionally, a new approach for a specific floodplain soil classification system based on objective, measurable soil parameters will be presented. For the first time the soil classification and empirically derived grouping according to the German Soil Classification have been statistically proved. The Canonical Discriminant Analysis (CDA) as an innovative multivariate statistical procedure has been used for this purpose. Floodplain soils can be distinguished by using CDA and they can be predicted by using β -glucosidase activity, total titanium, nickel, zinc and iron levels as well as protease activity. Our approach is potentially suitable for developing a soil classification system based on measurable parameters what has direct implications for soil mapping and the implementation of practical soil research findings.



S01.02 -3

AGGREGATE FORMATION IN RIPARIAN SOILS

Graf Markus*^[1], Friederike Lang^[1]

^[1]Berlin Institute of Technology ~ Department of Soil Science ~ Berlin ~ Germany

The sequestration potential of riparian soils for organic carbon is in the centre of recent discussions. Up to now, knowledge on aggregate formation and associated stabilisation of organic matter by aggregate-occlusion in riparian soils is lacking. Aim of our study is to analyse the influence of sedimentation dynamics on the architecture of aggregates and the content of occluded soil organic matter (SOM). We analysed the mobilisation of SOM due to sequential aggregate disruption by ultrasound application from soil samples and freshly deposited sediments taken at various sites of a floodplain of the Danube River near Vienna, Austria. In addition, SEM imaging was used to characterise the aggregates. In soils developed under dynamic sedimentation conditions, which are characterised by periods without any sedimentation, more SOM is stabilised within aggregates than in freshly deposited sediment. Furthermore, hierarchically constituted aggregates are formed with progressing soil formation. Static sedimentation conditions (characterised by continuous flooding) obviously impair the formation of hierarchical aggregate structure and the occlusion of SOM, even though the sediment deposited on these sites consists of hierarchical structured aggregates. In soils which were not subjected to flooding since 120 years (but show similar properties than soils of static sites) hierarchical aggregates are formed and show slightly increased amounts of SOM stabilised by occlusion. Summarising, our results indicate that flooding and input of sediment interfere with the development of aggregates with hierarchical structure. The influence of aggregate architecture on SOM stabilisation is subject of ongoing experiments.



S01.02 -4

NITRATE LEACHING FROM SHORT-HYDROPERIOD FLOODPLAIN SOILS

Benjamin Huber^[1], Luster Jörg^[1], Stefano M Bernasconi^[2], Juna Shrestha^[1], Graf Pannatier Elisabeth^{*[1]}

^[1]Swiss Federal Institute for Forest, Snow and Landscape Research WSL ~ Forest soils and Biogeochemistry ~ Birmensdorf ~ Switzerland ^[2]ETHZ ~ Geological Institute ~ Zurich ~ Switzerland

Numerous studies have shown the importance of riparian zones to reduce nitrate contamination coming from adjacent agriculture lands. However, most of these studies were performed in floodplains with long-hydroperiods (week to months of inundation) or permanently inundated water bodies with strongly reducing conditions, facilitating nitrate removal. Much less is known about nitrogen (N) transformation in riparian soils with short-hydroperiods (1-3 days of inundation). In this study, we measured nitrate concentrations in soil solutions in three succession vegetation zones (grass, willow bush and mixed forest) within a restored section of the Thur River in NE Switzerland. We quantified input (atmospheric deposition and sedimentation) and output (leaching) of nitrogen in the three zones to assess the N balance and the risk of nitrate leaching from the unsaturated soil to groundwater. Our results lead to the following conceptual model: in early successional stages (grass and willow bush), the dominant process is N sedimentation increasing the self-cleaning capacity of the river (N sink). With increasing distance from the river, in the mature mixed forest, soils are less hydrologically linked to the river and N sedimentation is reduced. Depending on soil type (low C/N ratio, high clay content) and soil environmental conditions (soil moisture at field capacity), high amounts of nitrogen are released by mineralization of organic matter accumulated in earlier successional stages and by subsequent nitrification. As a consequence nitrate leaching from the unsaturated zone into groundwater occurs (N source) and can lead to significant nitrate contribution during flood events and in winter.



S01.02 -5

FOOD WEBS AND ECOSYSTEM SERVICES IN CALIFORNIA RIPARIAN OAK WOODLANDS

Hodson Amanda*^[1], Jackson Louise^[1], Ferris Howard^[1]

^[1]University of California Davis ~ Land Air Water Resources ~ Davis ~ United States

The structure and complexity of riparian soil food webs in California can decline with increasing agricultural intensification, causing corresponding decreases in nitrogen retention and carbon sequestration. We explored undisturbed riparian soils for complex soil food webs and assessed indicators of associated ecosystem functions on a nature reserve near the ecotone where the Central Valley and Coast Range merge. To examine ecological patterns of soil biodiversity, nematode communities were used as indicators of the complexity of the soil food web, and were related to plant communities and indicators of ecosystem functions such as carbon storage and soil nutrient loading. Metabolic footprints, based on the size-dependent metabolic costs of different functional guilds of nematodes, were calculated to estimate their activity and potential role in ecological processes. Woody shrubs in these riparian ecosystems harbored particularly high levels of fungal feeding and bacterial nematodes, suggesting a role of biodiversity in the provision of ecosystem services for regulating soil and water quality.



S01.02 -6

SOIL BIOTA AND ECOLOGICAL PROCESSES IN RIPARIAN HABITATS

Chauvat Matthieu^[1], Chockri Mchergui^[1], Fabrice Bureau^[1], Estelle Langlois^[1]

^[1]University of Rouen ~ Ecodiv EA 1293 - FED SCALE ~ Rouen ~ France

Riparian habitats are among the most ecologically important systems, not only in terms of their intrinsic conservation value, but also because of the ecosystem goods and services that they provide (the regulation of hydrologic fluxes, maintenance of water quality...). Therefore, one goal of present rehabilitation measures along large lowland rivers is to reinstate and improve the natural dynamics of river banks which has very often been strongly impaired by river regulation. However, few studies have focused on soil biodiversity in such systems, despite their fundamental in controlling soil ecological processes. In riparian habitats inundation is an iterative and irregular phenomena. It represents a natural disturbance for the soil biocoenoses, causing their successional development to be completely or partially reset until the next flooding event. Along the Seine River in France and close to the estuary, soil biota assemblages and ecological processes were spatially described from a mudflat until an alluvial forest according to a gradient of flooding duration. Results showed a higher species diversity in the intermediate inundation duration compared to both lower and higher topographical habitats. Our results fit the intermediate disturbance hypothesis. This model predicts that at some intermediate level of disturbance species richness will be maximum mainly because an intermediate degree of disturbance reduces the intensity of competition between species and hence the competitive exclusion of species. Furthermore, relationships between soil biota assemblages and ecological processes were depicted at different scales highlighting to need to take into account the belowground system when measuring ecosystem services.



S01.03 - EVOLUTION AND PROPERTIES OF PADDY AND WETLAND SOILS

Chair Persons:

Arwyn Jones, Ispra - Italy

Bernd Lennartz, Rostock - Germany

Ingrid Kögel-Knabner, Muenchen - Germany

Thursday 05 July 2012 from 15:30 to 17:30. Room Alloro

S01.03 -1

CANADIAN PEATLANDS AND THEIR ROLE IN CLIMATE CHANGE

Charles Tarnocai, Ottawa - Canada

S01.03 -2

EFFECT OF IRON AND ALUMINUM BASED COAGULANTS ON METHANE EMISSION AND PATHWAYS IN A WETLAND SOIL.

Yumiko Henneberry, Davis - United States

S01.03 -3

LIGNIN DECOMPOSITION UNDER ALTERNATING REDOX CONDITIONS

Chiara Cerli, Amsterdam - Netherlands

S01.03 -4

VARIATION OF SOIL MICROBIAL COMMUNITY STRUCTURE AND RHIZODEPOSIT CARBON ASSIMILATION IN PADDY FIELDS

Pascal Boeckx, Gent - Belgium

S01.03 -5

NITROGEN IMMOBILIZATION IN PADDY SOILS AS AFFECTED BY REDOX CONDITIONS AND RICE STRAW INCORPORATION

Daniel Said-Pullicino, Grugliasco - Italy

S01.03 -6

LONG TERM BLACK CARBON SEQUESTRATION IN CHINESE PADDY-WHEAT ROTATION SYSTEMS

Eva Lehndorff, Bonn - Germany



S01.03 -7

EFFECTS OF SCALE ON SOIL STRUCTURE AND SPATIAL PATTERNS OF SOIL PROPERTY DISTRIBUTION IN PADDY SOILS IN SOUTHEAST CHINA

Rainer Duttmann, Kiel - Germany

S01.03 -8

PHASES OF PADDY SOIL EVOLUTION FROM MARSHLANDS (ZHEJIANG PROVINCE, CHINA)

Angelika Kölbl, Freising - Germany



S01.03 -1

CANADIAN PEATLANDS AND THEIR ROLE IN CLIMATE CHANGE

Tarnocai Charles*^[1]

^[1]Agriculture and Agri-Food Canada ~ Research Branch ~ Ottawa ~ Canada

Peatlands in Canada cover about 1136 x 103 km² (12% of the soil area). They occur under temperate, oceanic, boreal and arctic climates with the largest concentration of peatlands (97%) occurring in the Boreal and Subarctic Regions. These peatlands began to develop between 5500 and 9400 yr BP with an annual carbon accumulation of approximately 6.4 x 10⁶ to 9.8 x 10⁶ tC/yr. Canadian peatlands contain approximately 147.11 Gt of organic carbon with about 30% (44.18 Gt) of this carbon occurring in perennially frozen peatlands. Climate change predictions suggest that average annual air temperatures in northern Canada will increase by 3-5o C before the end of this century. A model for peatland sensitivity to climate change suggests that a large part of these peatlands, especially those that are perennially frozen, will be severely to extremely severely affected by climate warming. Peatlands were affected by climate change in the past, but these changes occurred at a slower rate than is predicted for the near future. This accelerated warming could have a severe impact on these peatlands with the southern peatlands being affected by drying and, consequently, by wildfires, the perennially frozen peatlands by severe thermal degradation and the coastal peatlands by flooding. Canadian peatlands play an important role in the global carbon balance. They store and sequester large amounts of carbon under the present climate but, under a warmer climate these peatlands could become a carbon source and could trigger very strong feedback mechanisms that would further increase climate warming.



S01.03 -2

EFFECT OF IRON AND ALUMINUM BASED COAGULANTS ON METHANE EMISSION AND PATHWAYS IN A WETLAND SOIL.

Henneberry Yumiko^{*[1]}, Assa Yacov^[1], Kraus Tamara^[2], Horwath William^[1]

^[1]University of California, Davis ~ Land, Air, Water Resources ~ Davis ~ United States ^[2]United States Geological Survey ~ California Water Science Center ~ Sacramento ~ United States

Wetlands have been identified as significant sources of greenhouse gases. This study assessed the extent of methane (CH₄) suppression upon addition of iron or aluminum based coagulants to wetland soils. Metal based coagulants are used in the water industry to remove constituents of concern from solution, such as dissolved organic carbon (DOC). Currently, the addition of coagulants to degraded wetland environments to improve water quality and restore soils is under investigation. We also examined ¹³C signature shifts of CO₂ and CH₄ to assess changes in the pathways of methane production. Filtered water collected from an agricultural drain in the Sacramento-San Joaquin Delta, California, USA was treated with ferric chloride, ferric sulfate, and polyaluminum chloride. The resulting DOC-metal complex was then added to soil collected from the same area and incubated anoxically for 120 days. All three coagulants suppressed CH₄ and CO₂ emissions compared to the control. The ¹³C signature of the CO₂ remained relatively stable for all treatments (-18‰ to -21‰). Initial CH₄ from all treatments were enriched in ¹³C compared to the control (-62‰ to -67‰ compared to -77‰, respectively). The shifts in treatment CH₄ signature are similar to experiments where CH₃F is added to inhibit acetoclastic methanogenesis. Results imply addition of metal coagulants may repress CH₄ production in addition to sequestering C and improve water quality. Additional studies are required under field conditions to validate the results and to determine long-term impacts of adding metal coagulants to wetland soils.



S01.03 -3

LIGNIN DECOMPOSITION UNDER ALTERNATING REDOX CONDITIONS

Cerli Chiara^{*[1]}, Liu Qin^[2], Hanke Alexander^[1], Kaiser Klaus^[3], Kalbitz Karsten^[1]

^[1]University of Amsterdam ~ IBED - ESS ~ Amsterdam ~ Netherlands ^[2]Chinese Academy of Sciences ~ Institute of Soil Science ~ Nanjing ~ China ^[3]Martin Luther University Halle-Wittenberg ~ Soil Sciences ~ Halle (Saale) ~ Germany

In wet soils, lignin constitutes a major portion of the total organic matter (OM) because of hampered degradation under anoxic conditions. Paddy soils management involves alternating redox cycles with periodic changes in soil solution chemistry and microbial metabolism. Such an environment might promote either degradation or preservation of lignin, affecting the overall composition and reactivity of total and dissolved OM. We sampled two paddy soils used for submerged rice growing since 700 and 2000 years and two corresponding non-paddy soils. We incubated suspended material of the A horizons, under oxic and anoxic conditions, for 3 months, reversing the redox conditions for three weeks during the incubation. At day 2, 21, 42, 63, and 84 we analysed the suspension for lignin-derived phenols (by CuO oxidation) and phospholipids fatty acids. We aimed to determine effects of alternating redox conditions on lignin decomposition and microbial community. In paddy soils the relative short changes in redox conditions caused a decrease in the total microbial biomass but did not affect its composition. Under any redox condition, the abundance of fungi was low, explaining the lack of lignin breakdown or side chain oxidation during the entire incubation period. However, we found decreasing amounts of phenols during the incubation, especially after reversing redox conditions. The trend was same for paddy and non-paddy soils. Redox conditions appear to affect the extractability but not composition or degradation state of lignin, likely by inducing dissolution of mineral phases and/or changing their surface properties.



S01.03 -4

VARIATION OF SOIL MICROBIAL COMMUNITY STRUCTURE AND RHIZODEPOSIT CARBON ASSIMILATION IN PADDY FIELDS

Balasooriya Wajira K.^[1], Rajapakse R.m.c.p.^[2], Boeckx Pascal^{*[1]}

^[1]Ghent University ~ Department of Applied analytical and Physical Chemistry ~ Gent ~ Belgium ^[2]University of Peradeniya ~ Department of Soil Science ~ Peradeniya ~ Sri Lanka

*Paddy fields undergo fluctuations between flooded and drained soil conditions regulating the availability of soil oxygen and affecting the aerobic and anaerobic processes, including nitrification, methanogenesis and methane oxidation. These processes are mostly driven by microbial activity. In this study, in situ phospholipid fatty acids based stable isotope probing (PLFA-SIP) using $^{13}\text{CO}_2$ was used in a tropical lowland paddy field in Sri Lanka to assess the effect of variety and fertilizer type on microbial community structure and activity. Soil microbial community structure significantly varied between BG (an improved variety) and KH (a traditional variety) with either mineral or organic fertilizers. The high relative abundance of 16:1 ω 7c and 18:1 ω 7c, and lack of 18:1 ω 8c suggest that the methanotrophic bacteria *Methylosinus sporium* (Bodelier et al., 2009) is present associated especially with BG grown with organic fertilizers. In addition, the temporal variation of soil microbial community at vegetative, flowering and mature growth stages of BG covering both flooded and drained soil conditions was investigated. Approximately 4-5 cm of standing water level was maintained during the early crop growth until drainage of soil just after the end phase of flowering. A significant temporal variation of in situ soil microbial community structure and activity at different growth stages was evident. Reference: Bodelier, P.L.E., M.B. Grillisen, K. Hordijk, J.S.S.D. Damste, W.I.C. Rijpstra, J.A.J. Geenevasen, P.F. Dunfield. 2009. A reanalysis of phospholipid fatty acids as ecological biomarkers for methanotrophic bacteria. The International Society for Microbial Ecology Journal 3:606-617.*



S01.03 -5

NITROGEN IMMOBILIZATION IN PADDY SOILS AS AFFECTED BY REDOX CONDITIONS AND RICE STRAW INCORPORATION

Said-Pullicino Daniel^[3], Birk Jago^[2], Cucu Maria Alexandra^[3], Sodano Marcella^[3], Glaser Bruno^[2], Celi Luisella^[3]

^[1]University of Turin ~ DiVaPRA - Agricultural Chemistry and Pedology ~ Turin ~ Italy ^[2]Martin Luther Universität Halle-Wittenberg ~ Institute of Soil Science, Biogeochemistry ~ Halle (Saale) ~ Germany ^[3]University of Turin ~ Soil Biogeochemistry Team, Rice Agroecosystem & Environmental Research Group ~ Grugliasco ~ Italy

N immobilization may represent one of the most critical aspects affecting long-term soil fertility and fertilizer efficiency. Redox processes play an important role in N availability and cycling in rice agro-ecosystems. Detailed information on the driving processes and factors controlling N immobilization in paddy soils is however, highly necessitated. This work aims at providing knowledge on the changes in fertilizer-N immobilization as a function of soil redox conditions and rice straw incorporation. A paddy soil collected from an ongoing long-term crop residue management trial (Vercelli, NW Italy) was treated with enriched ammonium-15N and incubated for five months under flooded or non-flooded conditions, with or without the addition of rice straw. Distribution of immobilized N among SOM fractions was assessed by combining aggregate-size and density fractionation, while microbial utilization of applied N was evaluated by compound-specific d15N analysis of amino sugars, important constituents of microbial cell walls. Fast immobilization of applied N (c. 37% applied N) was observed in both anoxic and oxic soils, however in the latter most of this N was released during incubation. The finer soil fractions in both macro- and microaggregates served as the greatest sink of immobilized N, sequestering 60-85% of the total immobilized N. Straw addition enhanced immobilization, particularly under anoxic conditions, with 12% of total immobilized N associated with the light fraction. The increasing incorporation of 15N into amino sugars also suggested that incorporation of straw to paddy soils may lead to the effective microbial-mediated immobilization and stabilization of significant portions of N inputs.



S01.03 -6

LONG TERM BLACK CARBON SEQUESTRATION IN CHINESE PADDY-WHEAT ROTATION SYSTEMS

Lehndorff Eva^{*[1]}, Roth Philipp^[2], Zhuang Shunyao^[7], Cao Zhi-Hong^[6], Amelung Wulf^[5]

^[1]Bonn University ~ INRES- Soil Science ~ Bonn ~ Germany ^[2]Bonn University ~ INRES - Soil Science ~ Bonn ~ Germany ^[3]Chinese Academy of Sciences ~ Institute of Soil Science ~ Nanjing ~ China ^[4]Chinese Academy of Sciences ~ Institute of Soil Science ~ Nanjing ~ China ^[5]Bonn University ~ INRES - Soil Science ~ Bonn ~ Germany ^[6]Chinese Academy of Sciences ~ Institute of Soil Science ~ Nanjing ~ China ^[7]Chinese Academy of Sciences ~ Institute of Soil Science ~ Nanjing ~ China

Many paddy soils are regularly burnt, thus leaving behind black carbon (BC) as the residue of incomplete combustion processes. This study aimed at elucidating the amount and rate at which BC contributes to the stable soil organic matter (SOM) pool after prolonged paddy management. For this purpose, soil depth profiles were sampled along a chronosequence of 0–2000 years of rice-upland crop rotation and adjacent upland systems (50–700 years) in the Bay of Hangzhou, Zhejiang province, China. The BC and its degree of condensation were assessed using benzene-polycarboxylic acids (BPCA) as geochemical markers. The results showed that despite regular burning SOM comprised only 8-10% of BC. Absolute BC contents were 60% higher in paddy than in non-paddy topsoils; the BPCA pattern resembled that of burnt straw on the fields. Between 2 and 60% of subsoil BC was stored in buried A horizons of the P700, P1000, and P2000 year old paddy fields. Throughout the chronosequence, SOC stocks increased until 300 years of paddy cultivation while BC stocks reached a maximum of 14 t ha⁻¹ after 700 years. In non-paddies, BC stocks were highest after 100 years of cropping and did not increase thereafter (9 t ha⁻¹). Hence, there is a slow and sustainable sequestration of C in charred forms upon prolonged management, but the contribution of BC to total C is smaller than found for other ecosystems of the world.



S01.03 -7

EFFECTS OF SCALE ON SOIL STRUCTURE AND SPATIAL PATTERNS OF SOIL PROPERTY DISTRIBUTION IN PADDY SOILS IN SOUTHEAST CHINA

Duttmann Rainer^[1], Gerke Horst^[2], Horn Rainer^[3], Lennartz Bernd^[4], Blaschek Michael^[1], Janssen Manon^[4]

^[1]Christian-Albrechts-University (CAU) ~ Geography: Landscape Ecology and Geoinformation Science ~ Kiel ~ Germany

^[2]Institute of Soil Landscape Research (ZALF) ~ Leibniz-Centre for Agricultural Landscape Research ~ Muencheberg ~ Germany ^[3]Christian-Albrechts-University (CAU) ~ Institute for Plant Nutrition and Soil Science ~ Kiel ~ Germany

^[4]University Rostock ~ Institute for Land Use ~ Rostock ~ Germany

The paper presents the scale depending structures and processes in terraced paddy fields in southeast China. It focuses on the regularities of the spatial distribution of soil chemical and physical properties and on soil structural processes related to vertical and lateral water losses and solute leaching. The analysis of selected physical and chemical soil parameters on the catenary and catchment scale confirmed that even in old terraced landscapes, the original structures of catenary soil property distributions persist. The application of digital soil mapping techniques such as regression kriging and artificial neural networks revealed that the incorporation of topographical attributes is suited to characterize soil property distribution on both scales. Field scale investigations showed that paddy soils exhibit a dynamic soil water system which is driven by the mechanical seed bed preparation and the drying and wetting cycles, including flooded periods. It was found that the hydraulic properties mainly depend on the duration of cultivation as a rice paddy. Pedon and aggregate scale investigations demonstrated the dual porosity nature of paddy soils with a macropore network consisting of cracks and biopores penetrating the plough pan and the bunds. The shrinkage potential of the puddle layer was higher in older paddy fields than in younger ones while it was the opposite in the plough pan. In addition to newly proposed management strategies with recurrent wetting and drying cycles, we suggest maintaining (saturated) equilibrium conditions over longer periods to reduce the risks of water losses and chemical leaching involved with preferential flow.



S01.03 -8

PHASES OF PADDY SOIL EVOLUTION FROM MARSHLANDS (ZHEJIANG PROVINCE, CHINA)

Kölbl Angelika^[1], Amelung Wulf^[2], Cao Zhihong^[3], Fiedler Sabine^[4], Jahn Reinhold^[5], Kalbitz Karsten^[6], Roth Philipp^[2], Schad Peter^[1], Schloter Michael^[7], Vogelsang Vanessa^[5], Wissing Livia^[1], Kögel-Knabner Ingrid^[1]

^[1]Lehrstuhl für Bodenkunde (Soil Science) ~ Ecology and Ecosystem Management ~ Freising ~ Germany ^[2]Institute of Crop Science and Resource Conservation ~ Soil Science and Soil Ecology ~ Bonn ~ Germany ^[3]The Institute of Soil Science ~ Chinese Academy of Sciences ~ Nanjing ~ China ^[4]Institut für Bio- und Geowissenschaften ~ Forschungszentrum Jülich GmbH ~ Jülich ~ Germany ^[5]Soil Sciences ~ Martin Luther University Halle-Wittenberg ~ Halle (Saale) ~ Germany ^[6]Earth Surface Science ~ Institute for Biodiversity and Ecosystem Dynamics ~ Amsterdam ~ Netherlands ^[7]Research Unit Environmental Genomics ~ Helmholtz Zentrum München ~ München ~ Germany

In the Zhejiang province (P.R. China), during the past 2000 years new farmland was created through consecutive land reclamation. The soils were partly used for paddy rice, or, adjacently, for a variety of non-irrigated crops. This unique chronosequence allowed quantifying rates of paddy soil formation in direct comparison with soils under non-paddy management. Our present data indicate that three fundamental phases of paddy soil development can be delineated from essential soil chronosequence properties: During the first phase after land embankment (several decades), soil formation was driven by short-term biogeochemical processes like desalinisation, formation of paddy-specific microbial communities, and the development of a dense plough pan, which partly decoupled soil development in topsoil from subsoil processes. During the next two centuries (intermediate phase), development processes are related to the dissolution of carbonates. Frequent flooding and drainage accelerated this process compared to soil development under non-paddy agricultural management. Soil organic matter contents still rise in the topsoils. Within the paddy soil profile, we identified two time domains above and below the plough pan: while processes in topsoils are accelerated due to management, decalcification and related processes are considerably slower in the subsoils. After decalcification of the entire soil profile, long-term processes start, which are partly related to mineral transformations (final phase). Mn and Fe oxides, which are reduced in the topsoil, pass the plough pan in the long run and accumulate in the subsoil, where they crystallise in the interiors of the aggregates. Concurrently, accumulation of organic matter reaches saturation in topsoils.



S01.04 - SOIL RESEARCH FOR EUROPEAN CITIES

Chair Persons:

Wolfgang Burghardt, Duisburg, Essen - Germany

Jean-Louis Morel, Nancy - France

Wednesday 04 July 2012 from 13:30 to 15:00. Room Leccio

S01.04 -1

PROTECTIVE EFFECT OF SOIL SEALING - HEAVY METALS AND POLYCYCLIC AROMATIC HYDROCARBONS CONTENT IN EKRANIC TECHNOSOLS

Przemyslaw Charzynski, Torun - Poland

S01.04 -2

TRAFFIC SOILS OF SAINT-PETERSBURG

Evgeny Abakumov, Saint-Petersburg - Russian Federation

S01.04 -3

DIFFERENCES IN CARBON AND NITROGEN STOCKS AND ISOTOPIC COMPOSITIONS REGARDING THE EXPOSURE TIME OF SOILS TO URBAN CONDITIONS: THE CASE OF STREET TREE-PIT SOILS FROM THE CITY OF PARIS

Aleksandar Rankovic, Paris - France

S01.04 -4

TECHNOLOGICAL MATERIALS IN (URBAN) SOILS: A NEW WAY OF IDENTIFICATION USING FT-MIR SPECTROSCOPY

Britta Stumpe, Bochum - Germany

S01.04 -5

TOOLS FOR RATIONAL PLANNING AND URBAN SOIL MANAGEMENT

Borut Vrscaj, Ljubljana - Slovenia

S01.04 -6

INFLUENCE OF SOIL AERATION ON ROOTING AND GROWTH OF THE BEUYS-TREES IN KASSEL, GERMANY

Katharina Weltecke, Göttingen - Germany



S01.04 -1

PROTECTIVE EFFECT OF SOIL SEALING - HEAVY METALS AND POLYCYCLIC AROMATIC HYDROCARBONS CONTENT IN EKRANIC TECHNOSOLS

Charzynski Przemyslaw*^[1], Michal Dabrowski^[2]

^[1]Nicolaus Copernicus University ~ Department of Landscape Geography ~ Torun ~ Poland ^[2]Nicolaus Copernicus University ~ Department of Soil Science ~ Torun ~ Poland

Sealing is one of the major problems of soil degradation. It is a phenomenon occurring in all urban areas as well, though on a smaller scale, in rural areas, especially in Western world. Aim of the study was to evaluate protective effect of soil sealing on Ekranic Technosols. There were selected 2 study sites in Torun, Poland located in close proximity of a busy thoroughfares. In both study sites 3 soil profiles were made – under asphalt sidewalk, under concrete paving slabs and reference one, on the lawn. All was situated at a distance of 5-10 meters from the road. In the samples taken from topsoil the content of lead, copper, zinc and cadmium was determined using Atomic Absorption Spectrophotometry (AAS) after mineralization in a mixture of HF + HClO₄. The analysis of 17 polycyclic aromatic hydrocarbons was performed by gas chromatography/mass spectrometry (GC/MS) after extraction with dichloromethane. Results show that sealed soils contain much smaller amounts of Pb, Cu, Zn, Cd and PAHs in comparison with reference ones. The content of most dangerous PAH - benzo(a)pyrene was 4 times smaller under concrete paving and more than 10 times lower under the asphalt surface than in unsealed soil. Similar trend can be observed in the case of other PAHs and analyzed heavy metals. It seems that the sealing, in addition to the negative effects, may bring also some benefits isolating the soil from contaminants. The research was financed by the Polish Ministry of Science and Higher Education (project N N306 4637380).



S01.04 -2

TRAFFIC SOILS OF SAINT-PETERSBURG

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^[1] Saint-Petersburg State University ~ Soil science and soil ecology ~ Saint-Petersburg ~ Russian Federation

Traffic areas is very important part of big cities, they occupies a huge areas and affect on soil and ground cover very intensively. The history of soil formation and construction discussed in details for ring road in southern part on Saint-Petersburg city. Soil history here has 4 stages. The first was a change of typical sod-gleyic soil by ground drainage during the railway constructions. Later, soils were covered by building garbage for 20-40 years. Material of waste shows the evident features of soils formation: humus accumulation, losses of carbonates, formation of fine earth due to weathering and structure formation. Finally, in the beginning of XXI century these soils were partially destroyed, construction of road affects the surface relief and reclamation of soil by fertilized grounds, imported from Leningrad region. On the last, modern stage, these constructed soils, show an evident features of surface erosion and fine earth consolidation. Chemical and physical properties of soils, as well as its morphological characteristics are discussed in report.



S01.04 -3

DIFFERENCES IN CARBON AND NITROGEN STOCKS AND ISOTOPIC COMPOSITIONS REGARDING THE EXPOSURE TIME OF SOILS TO URBAN CONDITIONS: THE CASE OF STREET TREE-PIT SOILS FROM THE CITY OF PARIS

Rankovic Aleksandar^[1], Izac Benjamin^[2], Lata Jean-Christophe^[1], Leloup Julie^[1], Zanella Augusto^[3], Barot Sébastien^[4], Abbadie Luc^[1]

^[1]Université Pierre et Marie Curie - Paris VI ~ UMR (CNRS) 7618 Bioemco ~ Paris ~ France ^[2]Université Paris-Sud ~ UMR (CNRS) 7618 Bioemco ~ Orsay ~ France ^[3]Università degli Studi di Padova ~ TeSAF ~ Padova ~ Italy ^[4]Institut de Recherche pour le Développement ~ UMR (CNRS) 7618 Bioemco ~ Paris ~ France

*When "new" soils, mostly deprived of technogenic materials, are imported into urban from peri-urban areas, an important question is to understand how these soils will evolve when exposed to urban environmental conditions. The soils of street tree-pits in Paris could be an interesting subject for such investigations. Indeed, when the city of Paris plants a new tree, it removes all the previous soil from the pit and replaces it by a newly imported soil from peri-urban agricultural areas. Since there are no artificial nutrient inputs during the tree's life, whilst its fallen leaves are removed from the soil, it can be expected that soil carbon and nitrogen stocks would decrease with time. Furthermore, due to specific urban isotopic signatures of atmospheric carbone and nitrogen (strongly negative $\delta^{13}\text{C}$, strongly positive $\delta^{15}\text{N}$), we can respectively expect a decrease and an increase of soil $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ with the aging of trees. The presentation will show the results of a campaign realized in the summer of 2011 in Paris, where the soils (at 10-30 cm and 30-40 cm depths) and leaves (4 on the lower canopy) of 79 silver lindens (*Tilia tomentosa*) were sampled. The sites were chosen according to three dbh (diameter at breast height) classes : 7-15 cm ($n = 28$) ; 32-43 cm ($n = 29$) ; 56-73 cm ($n=22$). The results will be discussed regarding our hypotheses and other upcoming analyses on soil microbial communities and their activities.*



S01.04 -4

TECHNOLOGICAL MATERIALS IN (URBAN) SOILS: A NEW WAY OF IDENTIFICATION USING FT-MIR SPECTROSCOPY

Stumpe Britta^{*[1]}, Michaelis Xandra^[1], Engel Thomas^[1], Marschner Bernd^[1]

^[1]Geographical Institute/ Ruhr-University Bochum ~ Soil Science & Soil Ecology ~ Bochum ~ Germany

Technological substrates like slags or ashes are an elementary part of (urban) soils. The identification of these substrates in the field is often very difficult since they may have a similar appearance (grain size, colour) like natural soil substrates. Since technological substrates can be highly contaminated with heavy metals and affect the soil functions – such as water storage capacity or filter function – a reliable identification of slags and ashes is important. We determined spectra of 180 different soils and over 100 spectra of technological materials via FT-MIR spectroscopy. Within one group of substrates, e.g. blast furnace slag, the spectra were very similar, whereas clear differences were found between different groups of technological materials (for example between blast furnace slag and different slags from metallurgical processes) and also clear differences to the spectra of the soils. The spectra of the technological substrates were subjected to statistical analysis using the SIMCA (Soft Independent Modeling of Class Analogy) method which now allows us to identify an unknown slag material exactly. In a next step we mixed different technological substrates with twelve selected soil samples in various concentrations and determined the spectra of these mixtures. The difference between the soil samples and the soil samples with technological additions were smaller than in the first experiment so that we had to transform the data into a new form for further statistical analysis. This procedure provides an opportunity for the rapid characterisation of soils regarding their content of technological substrates.



S01.04 -5

TOOLS FOR RATIONAL PLANNING AND URBAN SOIL MANAGEMENT

Vrscaj Borut^[1], Vernik Tomaž^[1], Sinkovec Marjan^[1], Bergant Janez^[1]

^[1]A ~ Centre for Soil and Environment Research ~ Ljubljana ~ Slovenia

Proportionate soil information is of major importance for rational urban planning and more sustainable urban development. In general we are facing a lack of soil information for urban/suburban areas. However, when available these are difficult to efficiently interpret and use by non-soil experts -mainly planners and city administrations. Focused soil information such as soil quality, contamination, soil suitability..., should that for be available within effective and end-user oriented web-based system equipped with evaluation and risk assessment tools. EU-Central UrbanSMS project joined the partners from Stuttgart, Vienna, Prague, Bratislava, Pulawy, Milano, Torino and Celje. Main project goals were to set strategies and to develop tools for lowering soil consumption and improving planning and soil management decisions. The soil information should be structured and spatial soil evaluation tools developed for non-expert use. A special attention should be paid to the flexibility of tools in order to meet different data quality, availability and threshold values. The presentation gives an overview of the web GIS portal with predefined planning and soil management tools. The system is used for visualization, analysis, and interpretation of soil and related data. The tool results steer planers towards lowering soil consumption of high quality soils and more sustainable planning decisions. Several tools will be presented: Loss of Soil Resource to assist the planning decisions and to protect best quality soils; Ecosystem Soil Quality to assess the environmental importance of soils; Water Drainage to estimate the potential water logging and Agricultural Soil Quality to preserve best agricultural land.



S01.04 -6

INFLUENCE OF SOIL AERATION ON ROOTING AND GROWTH OF THE BEUYS-TREES IN KASSEL, GERMANY

Weltecke Katharina*^[1], Gaertig Thorsten^[1]

^[1]HAWK-HHG ~ Fakultät Ressourcenmanagement ~ Göttingen ~ Germany

Soil aeration is one important factor for tree growth. Oxygen must be taken from the atmosphere for root respiration, and carbon dioxide must be discharged reversely. At urban sites several soil cover types with different aeration conditions alternate on a small scale, competing with the natural function of soil as living space for roots. During documenta 7 in 1982, the artist Joseph Beuys initiated the spectacular landscape art project "7.000 Oaks". 7.000 nearly even-aged trees were planted across the city of Kassel, Germany, offering ideal conditions to investigate the influence of specific site factors on root and tree growth. At 8 different sites featuring 36 Beuys-oaks and 15 Beuys-planes, top soil gas diffusivity, soil CO₂ concentration and soil respiration of different soil cover types were measured and correlated with root and tree growth. Soil gas diffusivity as well as soil respiration depended on the degree of sealing. The lowest gas diffusivities and respiration rates were found at sealed sites and the highest values were measured at vegetated sites. Soil respiration was primarily controlled by soil gas diffusivity. Soil CO₂ concentration was not strictly linked to the coverage type. Rooting and growth of oaks were decisively shaped by the gas diffusivity of the soil cover. Rooting, height and diameter of oaks decreased significantly with decreasing gas diffusion coefficients. In contrary, this correlation was not detectable for planes. Vitality of urban trees can be controlled by the design of the tree site and the choice of the species.



S02.01 - INITIAL SOILS – FORMATION, PROPERTIES AND THE ROLE OF STRUCTURES

Chair Persons:

Wolfgang Schaaf, Cottbus - Germany

Horst H. Gerke, Müncheberg - Germany

Thursday 05 July 2012 from 13:30 to 15:00. Room Alloro

S02.01 -1

MODELLING THE INTERACTION BETWEEN PEDOGENESIS AND CLIMATE DYNAMICS

Garry Willgoose, Callaghan - Australia

S02.01 -2

*ALTERATION OF SOIL ORGANIC MATTER DURING INITIAL MARSH SOIL DEVELOPMENT
AT THE SOUTHERN NORTH SEA COAST*

Luise Giani, Oldenburg - Germany

S02.01 -3

*MECHANISMS OF ORGANIC MATTER ACCUMULATION ON GLACIER FOREFIELDS AND
INLAND SAND DUNES DURING INITIAL SOIL FORMATION*

Alexander Dümig, Freising-Weihenstephan - Germany

S02.01 -4

*EVOLUTION AND TRANSFORMATION OF MINERAL MATERIALS OF COAL-MINE SPOIL
HEAPS: INDICATORS OF PEDOGENESIS*

Arnaud Gauthier, Villeneuve d'Ascq - France

S02.01 -5

*VISUALIZATION OF SOIL STRUCTURE MODIFICATIONS AND INFILTRATION PATTERNS BY
GROUND-DWELLING BEETLE LARVAE AND MOSS VEGETATION*

Annika Badorreck, Cottbus - Germany

S02.01 -6

TRANSFORMATION OF ¹³C-LABELLED LITTER IN SANDY, INITIAL SOILS

Claudia Zimmermann, Cottbus - Germany



S02.01 -1

MODELLING THE INTERACTION BETWEEN PEDOGENESIS AND CLIMATE DYNAMICS

Cohen Sagy^[2], Willgoose Garry*^[1], Hancock Gregory^[3]

^[1]The University of Newcastle ~ Civil, Surveying and Environmental Engineering ~ Callaghan ~ Australia ^[2]University of Colorado ~ INSTAAR ~ Boulder ~ United States ^[3]The University of Newcastle ~ Earth Sciences ~ Callaghan ~ Australia

Soil erosion and weathering rates can vary significantly in both time and space. Therefore the interaction between erosion and weathering has a complex spatio-temporal effect on soil properties. However, so far, our ability to quantitatively describe the erosion-weathering dynamics has been extremely limited. Our mARM3D soil-landscape model explicitly calculates three-dimensional soil evolution as a function of surface erosion and profile weathering. Here we discuss simulations of the affect of long-term (Quaternary) climate fluctuations on the spatial distribution of evolving soils. A simple assumption is made about the impact of climate on weathering and erosion rates. Hillslope and catchment-scale soil evolution were simulated over a 400,000 year period using the Vostok (Antarctica) ice-core data as a climatic input. The results consistently show that: (1) The effect of climatic forcing on soil evolution varies in space to the point where different parts of a hillslope have opposite trends in grading distribution with cooling/warming. (2) Soil evolution continues long after a sharp climatic change so there is a lag in adjustment to the changing climate. (3) The timescale of the soil adjustment lag to changing climate changes varies in space. These findings have significant implications to our understanding of the pedogenic system and demonstrate the attractiveness of using mARM3D as a virtual-laboratory, that is a tool for desktop studies of erosion and weathering dynamics.



S02.01 -2

**ALTERATION OF SOIL ORGANIC MATTER DURING INITIAL MARSH SOIL DEVELOPMENT
AT THE SOUTHERN NORTH SEA COAST**

Giani Luise^{*[1]}, Marie Spohn^[2]

^[1]University of Oldenburg ~ Department of Soil Science ~ Oldenburg ~ Germany ^[2]University of Goettingen ~ Dept. of Soil of Temperate Ecosystems ~ Göttingen ~ Germany

Marshes constitute a transition between marine and terrestrial ecosystems in which soils develop from marine sediments. The question we address in this paper is how organic matter (OM) and the relationship between mineral skeleton and OM are altered during initial soil development in saltmarshes. For this purpose young soils in the lower, higher and upper zone of saltmarshes at six sites on the southern North Sea coast were studied. It was found that organic carbon (OC) and nitrogen (N) contents increased significantly with increasing age of the soils. The $\delta^{13}\text{C}$ signature of the OC strongly decreased from lower to upper marsh indicating a decrease in the proportion of marine-derived OC. The decrease of sea-derived OC was associated with an increase in the C/N ratio, which can be attributed to the difference in C/N ratio between sea- and land-derived OM inputs. Increases in OC and N contents during soil development were due to increases in the coarse size fraction ($>200\ \mu\text{m}$) and went along with increases in the content of hot water extractable C and N (Chwe and Nhwe). Clay contents and hence the proportion of OM found in the fraction ($<2\ \mu\text{m}$) decreased with soil development due to sedimentation dynamics. The ^{13}C signature of the OC stored in this fraction was higher as the signature of the bulk OC, indicating that in this fraction OM is relatively stable and is mainly of terrestrial origin sorbed to the clay minerals before they were transferred into the sea.



S02.01 -3

MECHANISMS OF ORGANIC MATTER ACCUMULATION ON GLACIER FOREFIELDS AND INLAND SAND DUNES DURING INITIAL SOIL FORMATION

Dümig Alexander^[1], Kögel-Knabner Ingrid^[1]

^[1]Technische Universität München ~ Lehrstuhl für Bodenkunde ~ Freising-Weihenstephan ~ Germany

We used chronosequences after glacier retreat and on sand dunes to identify processes of organic matter (OM) accumulation during initial soil development. The OM chemistry was assessed by ¹³C NMR spectroscopy and acid hydrolysis. Mineral phases were characterized by X-ray diffraction, N₂ adsorption, oxalate and dithionite extraction. In the glacier forefield, we found rapid OM accumulations in bulk soils within 100 yrs of soil formation. Similarly, the amount of poorly crystalline Fe and Al phases increased reflecting the growing potential for OM stabilization. Clay fractions showed strongly increasing OC loadings with age resulting in decreasing specific surface area (SSA) of minerals. The SSA of H₂O₂-treated clays was strongly related to oxalate soluble Fe which was strongly correlated with OC. Clay-bound OC of 15-year-old soils was of refractory nature owing to high proportions of carboxyl and aromatic C may due to inherited OM. With increasing age, these functional groups decreased associated with increasing contents of microbial-derived carbohydrates and proteins. Accumulation of alkyl C was detected in older soils. The colonization of biological soil crusts resulted in higher concentrations of OC and Fe oxides compared to parent materials. Vegetation succession was combined with specific signatures of microbial-derived carbohydrates which were the major OC input to the soils. Initial soil formation and SOM accumulation is fast. The accumulation of SOM is linked with weathering and formation of Fe oxides leading to specific accumulations of carbohydrate-C. The sequential accumulation of different organic compounds indicates layering of OM during the evolution of organo-mineral associations.



S02.01 -4

**EVOLUTION AND TRANSFORMATION OF MINERAL MATERIALS OF COAL-MINE SPOIL
HEAPS: INDICATORS OF PEDOGENESIS**

Gauthier Arnaud^{*[1]}, Michel Dubois^[1], Mathieu Thevenot^[1]

^[1]Laboratoire de Génie-Civil et géo-Environnement ~ Université Lille1 ~ Villeneuve d'Ascq ~ France

As a result of coal mining activity, many waste disposal sites were created in the Nord-Pas-de-Calais landscape during the two last centuries. More than three hundred spoil heaps have been referenced in this region. Natural and anthropogenic processes considerably affect their evolution, such as natural combustion, weathering and colonisation by plants. Revegetalisation can be due either to natural processes or to reconversion for touristic use or landscaping. The aim of this work is to constraint the successive steps of soil development on spoil heap surface, in order to understand their evolution for the next decades. The first step of natural soil formation is mineral transformation during weathering. Initial rock fragments, mostly black shales, were investigated using Raman microspectroscopy and compared to the altered fraction. Concomitant with the disaggregation, neoformation and dissolution/precipitation processes lead to the appearance of new minerals, such as clay fractions and amorphous phases. Thus, an evolution of the mineralogy, but also of the texture and structure of the spoil heaps was observed. In the case of anthropogenic reconversion of the spoil heaps, evolution is largely affected by adjustment policy that modify the kinetic and intensity of alteration processes. Different tests have to be done as a function on the nature of vegetation used during reconversion.



S02.01 -5

VISUALIZATION OF SOIL STRUCTURE MODIFICATIONS AND INFILTRATION PATTERNS BY GROUND-DWELLING BEETLE LARVAE AND MOSS VEGETATION

Badorreck Annika*^[1], Gerke Horst H.^[2]

^[1]Brandenburg University of Technology ~ Research Centre Landscape Development and Mining Landscapes (FZLB) ~ Cottbus ~ Germany ^[2]Leibniz-Centre for Agricultural Landscape Research (ZALF) ~ Institute of Soil Landscape Research ~ Müncheberg ~ Germany

An artificial catchment was constructed to study initial soil and ecosystem development. As a key process, the pore structure dynamics in the soil at the surface strongly influences erosion, infiltration, matter dynamics, and vegetation establishment. This presentation focuses on observations of soil structure modifications from ground beetles and moss vegetation and its effect on water flow at the surface. The surface soil with beetle burrows was sampled in plastic rings in two replicates along a vegetation gradient from dense moss cover to bare soil, and was scanned with micro-X-ray computed tomography. Infiltration dynamics were visualized with neutron radiography on two slab-type soil samples in 2D. The burrowing activity leads to mostly vertical channels with a locally compacted wall. Also isolated vesicular macro pores were found in the bottom part of the moss covered sample, more evenly distributed in the sparsely vegetated sample. A dense moss cover seems to stabilize the first centimeter of the soil. Also layer of erosion sediment was only visible in samples from non-vegetated patches. The neutron radiograph series showed preferential flow. Water drop penetration time tests on air dry subsoil revealed water repellency, what probably contributes to the observed bypass flow. A water repellent bottom part of the soil acted as internal barrier for water movement and water entered the burrow from the sides after a moisture saturation threshold was exceeded. The observations demonstrate relatively high abiotic and biotic dynamics of soil pore structure in the soil surface even during the very early development stages.



S02.01 -6

TRANSFORMATION OF ¹³C-LABELLED LITTER IN SANDY, INITIAL SOILS

Zimmermann Claudia*^[1], Wolfgang Schaaf^[1]

^[1]BTU Cottbus ~ Soil Protection and Recultivation ~ Cottbus ~ Germany

Soils from the artificial catchment Chicken Creek were studied in microcosm experiments. 50 soil columns were filled with two textural variations of the catchment soils (pure sand and loamy sand) and ¹³C-labelled litter of two plant species (*Calamagrostis epigejos* and *Lotus corniculatus*) was added. The soil columns were placed in a climatic chamber with controlled temperature, gas and water fluxes. CO₂, DOC and nitrogen fluxes were measured over 80 weeks. CO₂ and DOC were analyzed for isotopic composition. Litter addition increased the decalcification of the soil substrates. Lotus litter decomposed faster due to the lower C/N ratio. Nitrification and leaching of dissolved nitrogen was only found for the Lotus treatments. DOC leaching was higher for the loamy sand compared to the pure sand columns. The highest leaching of litter-derived DOC was found for the pure sand and leaching of soil-derived DOC only for the loamy sand treatments.



S02.02 - EARLY ECOSYSTEM AND SOIL DEVELOPMENT

Chair Persons:

Stefano Bernasconi, Zurich - Switzerland

Jörg Luster, Birmensdorf - Switzerland

Michael Scholter, Neuherberg - Germany

Thursday 05 July 2012 from 08:30 to 10:00. Room Acero

S02.02 -1

**SOIL MICROBIAL COMMUNITY DEVELOPMENT AND PLANT-MICROBE INTERACTIONS
ALONG A GLACIAL CHRONOSEQUENCE**

Aria Hahn, Edmonton - Canada

S02.02 -2

**MICROBIAL FOOD WEB DYNAMICS ALONG A SOIL CHRONOSEQUENCE OF A GLACIER
FOREFIELD**

Jean Charles Munch, Neuherberg - Germany

S02.02 -3

**REACTIONS OF MICROBIAL COMMUNITIES AFTER THE TRANSPLANTATION OF SOILS
ALONG A CLIMATIC GRADIENT IN A GLACIER FOREFIELD**

Anita Zumsteg, Birmensdorf - Switzerland

S02.02 -4

**ORGANIC MATTER ACCUMULATION AND MICRO-AGGREGATE FORMATION IN SOIL
CHRONOSEQUENCES IN AUSTRIA, ICELAND AND SWITZERLAND**

Georg J. Lair, Vienna - Austria

S02.02 -5

**BIOLOGICAL ACTIVITIES OF SOILS DEVELOPING ON A 50-YEAR-OLD COAL-WASTE HEAP
OF THE MINING BASIN OF PROVENCE (SOUTH-EAST OF FRANCE)**

Mélanie Clouard, Aix en Provence - France

S02.02 -6

**SPATIAL CARBON AND NITROGEN DISTRIBUTION AND ORGANIC MATTER
CHARACTERISTICS OF BIOLOGICAL SOIL CRUSTS IN THE NEGEV DESERT (ISRAEL)
ALONG A RAINFALL GRADIENT**

Sylvie Drahorad, Giessen - Germany



4th International Congress **EUROSOIL 2012**

Soil Science for the Benefit of Mankind and Environment
Fiera del Levante, Bari Italy - 2-6 July 2012



S02.02 -1

**SOIL MICROBIAL COMMUNITY DEVELOPMENT AND PLANT-MICROBE INTERACTIONS
ALONG A GLACIAL CHRONOSEQUENCE**

Hahn Aria^{*[1]}, Quideau Sylvie^[1]

^[1]University of Alberta ~ Renewable Resources ~ Edmonton ~ Canada

*Despite previous research into primary succession in terms of vegetation development, soil formation and microbial functional diversity, the processes by which newly exposed ecosystems undergo succession are still relatively poorly understood. We aimed to measure soil microbial community composition and functional diversity, as well as determine the influence of Engelmann spruce (*Picea engelmannii* Parry) and yellow mountain avens (*Dryas drummondii* Rich.) on soil microbial community succession along a Canadian glacier chronosequence. Soil microbial composition and functional diversity were assessed using phospholipid fatty acid (PLFA) analysis, substrate induced respiration and enzyme activity analysis. To the best of our knowledge, this is the first study to include peroxidase and phenol oxidase activities of soil microbial communities along any glacial chronosequence. Increased microbial biomass, enzyme activity and substrate respiration along the chronosequence, as well as significant correlations between the microbial respiration of N-acetyl-glucosamine, protocatechuic acid, glucose and percent soil N indicated that the soil microbial community was responding to changes in the soil environment. Plant-microbe interactions changed after 40 since deglaciation, as yellow mountain avens had a measurable effect on microbial biomass only in the mid-successional stage. Low β -glucosidase activity rates and glucose respiration rates in the early successional stage soils, along with a significant correlation between these two measures, indicated that the early successional stage soil microbial communities were not readily able to utilize glucose. Thus, alternative or multiple substrates should be used in place of glucose when soil microbial analyses are being performed on early successional stage soils.*



S02.02 -2

MICROBIAL FOOD WEB DYNAMICS ALONG A SOIL CHRONOSEQUENCE OF A GLACIER FOREFIELD

Jürgen Esperschütz^[2], Alfredo Pérez-De-Mora^[3], Karin Schreiner^[3], Gerhard Welzl^[3], Franz Buegger^[1], Josef Zeyer^[4], Frank Hagedorn^[5], Munch Jean Charles^{*[1]}, Michael Schlöter^[3]

^[1]Helmholtz Zentrum München ~ Soil Ecology ~ Neuherberg ~ Germany ^[2]Technical University Munich ~ Soil Ecology ~ Neuherberg ~ Germany ^[3]Helmholtz Zentrum München ~ Environmental Genomics ~ Neuherberg ~ Germany ^[4]Eidgenössische Technische Hochschule ~ Institute of Biogeochemistry and Pollutant Dynamics ~ Zürich ~ Switzerland ^[5]Swiss Federal Institute for Forest, Snow and Landscape Research ~ WSL ~ Birmensdorf ~ Switzerland

Microbial food webs are basis for functional and stable ecosystems. However, the development of microbial food webs and their role in "young" ecosystems is unclear. Due to a continuous glacier retreat since the middle of the 19th century, glacier forefields have expanded offering an excellent opportunity to study food web dynamics different developmental stages. In this study, litter degradation and the corresponding C fluxes into microbial communities were investigated along the forefield of the Damma glacier (Switzerland). ¹³C enriched litter of the pioneering plant *Leucanthemopsis alpina* (L.) Heywood was incorporated into the soils that have been free from ice for approximately 10, 60, 100 and more than 700 years. The structure and function of microbial communities were identified by ¹³C analysis of phospholipid fatty acids (PLFA) and phospholipid ether lipids (PLEL). Results showed increasing microbial diversity and biomass, and enhanced proliferation of bacterial groups as ecosystem development progressed. Initially, litter decomposition proceeded faster at the more developed sites, but at the end of the experiment loss of litter mass was similar at all sites, once the more easily-degradable litter fraction was processed. Incorporation of ¹³C into microbial biomass was evident during the first weeks of litter. ¹³C enrichments of both PLEL and PLFA biomarkers following litter incorporation occurred at all sites, suggesting similar microbial foodwebs at all stages of development. Nonetheless, the contribution of bacteria, especially actinomycetes to litter turnover became more pronounced as soil age increased in detriment of archaea, fungi and protozoa, more prominent in recently deglaciated terrain.



S02.02 -3

**REACTIONS OF MICROBIAL COMMUNITIES AFTER THE TRANSPLANTATION OF SOILS
ALONG A CLIMATIC GRADIENT IN A GLACIER FOREFIELD**

Zumsteg Anita*^[1], Gerhard Furrer^[2], Josef Zeyer^[2], Beat Frey^[1], Erland Bååth^[3]

^[1]Federal Institute of Forest, Snow and Landscape Research WSL ~ Forest Soils and Biogeochemistry ~ Birmensdorf ~ Switzerland ^[2]ETH Zürich ~ Environmental Sciences ~ Zürich ~ Switzerland ^[3]Lund University ~ Department of Ecology ~ Lund ~ Sweden

Most of the glaciers in the Alps are currently retreating due to climate change. The newly formed soil is composed of granitic sand and rocks, where harsh conditions with large temperature and soil moisture shifts prevail. This makes these environments ideal for studying microbial adaptation. It is known that altering microclimatic conditions influence microbial biomass and activity. The aim of the present study was to investigate the extent of these changes in relation to microclimatic shifts. To achieve this, we chose three sites for transplantation of granite sand with a defined soil age (approx. 10 years) in front of the Damma glacier in Switzerland. The sites differed in the amount of sunlight hours they receive due to the shading of the nearby mountains. At these three sites, 15 pots per site were filled with local granitic sand and five transplanted to each of the other two sites, five pots remained at the original site. During the vegetation period, we continuously monitored soil temperature and moisture. The dynamics of the bacterial and fungal community structure was analyzed with T-RFLP analyses. Activities of enzymes involved in the breakdown of glucose, proteins and chitin were also determined. The activity of bacteria and fungi were determined using the leucine incorporation and acetate-in-ergosterol incorporation methods. Our results suggest that the communities react to the transplantation of soil along a temperature gradient, but to a lesser extent than expected. Furthermore it seems that the seasonal influence is more significant for the microbial communities than the transplantation.



S02.02 -4

ORGANIC MATTER ACCUMULATION AND MICRO-AGGREGATE FORMATION IN SOIL CHRONOSEQUENCES IN AUSTRIA, ICELAND AND SWITZERLAND

Lair Georg J.*^[1], Lehtinen Taru^[4], Gísladóttir Gudrun^[2], Bernasconi Stefano^[3], Blum Winfried E.h.^[1]

^[1]University of Natural Resources and Life Sciences (BOKU) ~ Institute of Soil Research ~ Vienna ~ Austria ^[2]University of Iceland ~ Faculty of Life and Environmental Sciences ~ Reykjavik ~ Iceland ^[3]ETH Zürich ~ Geological Institute ~ Zürich ~ Switzerland ^[4]University of Natural Resources and Life Sciences (BOKU)/University of Iceland ~ Institute of Soil Research ~ Vienna ~ Austria

Soil organic matter (SOM) is a main driver for the build-up of soil structure and is therefore governing the main physical and chemical processes of soil development. However, SOM dynamics in the initial stages of soil development as well as the stability of SOM within micro-aggregates (<250 μm) and/or by sorption on soil mineral surfaces are still poorly understood. Even less is known about the impact of different plant covers on these short to medium-term processes. In the present study we assess SOM quantity and its chemical composition within micro-aggregates of genetic soil horizons, developed under forest and natural grassland. The studied soils comprise an age gradient of approximately 5000 years in the former floodplain area of the Marchfeld (Austria) and hundreds of years in glacial forefields at the Skaftafellsjökull Glacier (Iceland) and at the Damma Glacier (Switzerland). This allows for investigating the influence of SOM on soil micro-structure build-up on different parent material and under different climates. Results of our study show that ecosystems progressively evolve through the biogeochemical processes of SOM accumulation and soil structure formation.



S02.02 -5

BIOLOGICAL ACTIVITIES OF SOILS DEVELOPING ON A 50-YEAR-OLD COAL-WASTE HEAP OF THE MINING BASIN OF PROVENCE (SOUTH-EAST OF FRANCE)

Clouard Mélanie*^[1]

^[1]Aix-Marseille Université ~ CEREGE - IMEP ~ Aix en Provence ~ France

The coal mining industry in Provence (France) left scattered coal-waste heaps that are a mixture of various materials extracted from the mine (marno-calcareous shales, lignite). Some of these heaps have been left unattended for more than 50 years and early ecosystems have developed. Microbial processes are responsible for the turnover of organic matter, but little is known on microbial activity of these newly formed soils, as well as the impact of lignite on it, especially under Mediterranean climate. The study aims at 1) highlighting differences in microbial properties according to heap topography, lignite and organic matter enrichment; 2) comparing with natural soils developed under similar geomorphological and bioclimatic conditions. Soils were sampled on the South hillside at 355m NGF (top), 350m, 345m and 340m (bottom). Seven enzymatic activities involved in the main biogeochemical cycle of CNPS, are measured on 30 soil composite samples collected at 0-5 cm and 15-30 cm depth. Moreover respirometric measurements performed with OxitopTM system and catabolic profiles of microbial communities (measured by Biolog[®]) were performed. Additionally to biological measurements, physico-chemical properties and SOM quality characterisation by ¹³C SS CPMAS NMR were performed. The results show a gradient of the soil properties according to topography and presence of lignite. Increase in recalcitrant compounds (aromatic C) is shown in soils where lignite is present. Enzymatic activities also vary according to topography and lignite content, and are larger than in natural soils. Thus lignite seems to affect significantly biological functions involved in pedogenetic processes of such early ecosystems.



S02.02 -6

**SPATIAL CARBON AND NITROGEN DISTRIBUTION AND ORGANIC MATTER
CHARACTERISTICS OF BIOLOGICAL SOIL CRUSTS IN THE NEGEV DESERT (ISRAEL)
ALONG A RAINFALL GRADIENT**

Drahorad Sylvie^{*[2]}, Peter Felix-Henningsen^[2], Kai-Uwe Eckhardt^[3], Peter Leinweber^[3]

^[1]Justus Liebig University ~ Institute for Soil Science and Soil Conservation, Research Centre for Biosystems, Landuse and Nutrition (IFZ) ~ Giesen ~ Germany ^[2]Justus Liebig University ~ Institute for Soil Science and Soil Conservation, Research Centre for Biosystems, Landuse and Nutrition (IFZ) ~ Giessen ~ Germany ^[3]University of Rostock ~ Soil Science, Faculty of Agricultural and Environmental Sciences ~ Rostock ~ Germany

In the NW Negev the sand dunes are restabilized by biological soil crusts (BSC) since 1983. These BSC influence surface stability and are important contributors of organic matter. Because a multivariate examination of the spatial distribution of organic carbon (OC) and nitrogen (N) and a characterization of crust organic matter composition is missing, we examined BSC and topsoils at three depths and three contrasting relief positions along a rainfall gradient (90 mm a⁻¹ to 170 mm a⁻¹). To test the impact of soil moisture on BSC organic matter composition, selected samples were analysed by pyrolysis-field ionization mass spectrometry (Py-FIMS) to characterize differences in the molecular composition of organic matter in relation to depth and rainfall gradient. Topcrusts (0-2 mm) showed higher concentrations of OC and N and a relative enrichment in bacteria, as indicated by proportionally larger contents in N-acetylmuramic acid (m/z 167+276) than the subcrusts (2-40 mm). The subcrust had more thermally stable organic matter compounds and a relative enrichment in cyanobacteria, as indicated by proportionally larger contents of hexadecadienoic acid (m/z 252). With increasing rainfall the m/z signal intensities of pentoses and N-acetylmuramic acid increased, implying an enrichment of plant material and bacteria. We conclude that the spatial distribution of OC and N is characterized by factors such as depth, relief and rainfall that are closely linked to the amount of available moisture. Moreover Py-FIMS characterized the BSC organic matter composition and enabled us to identify main biomass contributors changing with BSC composition and stage of development.



S02.03 - PEDODIVERSITY IN SPACE AND TIME: CONCEPTS, MEASUREMENTS, APPLICATIONS

Chair Persons:

Juan Josè Ibanez, Valencia - Spain

Giuseppe Lo Papa, Palermo - Italy

Thursday 05 July 2012 from 08:30 to 10:00. Room Olmo

S02.03 -1

A QUALI-QUANTITATIVE EVALUATION APPROACH TO PEDODIVERSITY BY MULTIVARIATE ANALYSIS. INTRODUCTION TO THE CONCEPT OF "PEDOCHARACTER".

Andrea Buondonno, Caserta - Italy

S02.03 -2

CHRONOSEQUENTIAL ALTERATIONS OF PROPERTIES OF POST-AGROGENIC STAGNIC ALBELUVISOLS IN THE TAIGA OF RUSSIA UNDER SELF-RESTORATION.

Olga Kalinina, Oldenburg - Germany

S02.03 -3

CARTOGRAPHIC AND CLASSIFICATION MODELS FOR REPRESENTATION OF THE TERRITORY PEDODIVERSITY

Nikolay Khitrov, Moscow - Russian Federation

S02.03 -4

PEDODIVERSITY IN A TROPICAL HIGHLAND COUNTRY. THE CASE OF RWANDA.

Ann Verdoodt, Gent - Belgium

S02.03 -5

PEDODIVERSITY ANALYSIS: STATE OF THE ART AND NEW CHALLENGES

Juan-José Ibáñez, Valencia - Spain

S02.03 -6

PEDOSITES AS AN ELEMENT IN ASSESSMENT OF SOILSCAPE AND ECOTOURISM POTENTIAL: A STUDY IN A DESERT ECOSYSTEM OF NORTHERN CHILE.

Alejandra Sepúlveda-Varas, Temuco - Chile



S02.03 -1

A QUALI-QUANTITATIVE EVALUATION APPROACH TO PEDODIVERSITY BY MULTIVARIATE ANALYSIS. INTRODUCTION TO THE CONCEPT OF "PEDOCHARACTER".

Buondonno Andrea^{*[1]}, Odierna Pierclaudio^[1], Capra Gianfranco^[2], Coppola Elio^[1], Grilli Eleonora^[1], Vacca Sergio^[2]

^[1]Seconda Università degli Studi di Napoli ~ Dipartimento di Scienze Ambientali ~ Caserta ~ Italy ^[2]Università degli Studi di Sassari ~ Dipartimento di Scienze Botaniche, Ecologiche e Geologiche ~ Nuoro ~ Italy

A model has been developed for the interpretation of the complexity of pedological systems; this is referred to as "pedocharacter". The main aim of the model was to reduce the variables able to define soils and their relationships with the environment through the following quali-quantitative approach: i) definition of a fair number of qualitative characters; and ii) development of an analytic function, defined as "Land Relevance of the Factor". This enables a quantitative estimation of complexity aimed at analyzing, understanding and mapping pedological system variability. On this basis, an investigation was carried out on topsoil and subsoil characterizing the Sele River Plain (Campania, Italy), with the aim of assessing the differences between surface and sub-surface horizons by means of a comparative estimation prepared through the use of a "pedocharacter" index. In the study area, topsoil pedodiversity (range = -1.31 to 4.50) generally showed higher intensity than in the subsoil (-1.16 to 4.2). In these terms, the numbers and types of variables used for "pedocharacter" characterization were higher in the topsoil. Additionally, plant cover appeared equally important for the definition of topsoil (mainly herbaceous cover) and subsoil (mainly woodland cover) characters. The results obtained have led to the development of an integrated pedometric model for the quali-quantitative assessment of "pedocharacter" and, consequently, of pedodiversity. This result is important for basic and applied pedology, suggesting the need for a general refinement of qualitative diagnostic and taxonomic tools, with a view to defining quantitative aspects that are not strictly connected with pedogenic processes.



S02.03 -2

CHRONOSEQUENTIAL ALTERATIONS OF PROPERTIES OF POST-AGROGENIC STAGNIC ALBELUVISOLS IN THE TAIGA OF RUSSIA UNDER SELF-RESTORATION.

Kalinina Olga^[1], Sergey Goryachkin^[2], Dmitriy Lyuri^[2], Luise Giani^[1]

^[1]C.-v.-O. University of Oldenburg ~ Department of Soil Science ~ Oldenburg ~ Germany ^[2]Russian Academy of Sciences ~ Institute of Geography ~ Moscow ~ Russian Federation

This chronosequential study focuses on the vegetation succession, pedogenesis, soil nutrient dynamics, carbon stocks, and functionally different carbon pools of post-agrogenic Stagnic Albeluvisols under self-restoration in the taiga zone of the European part of Russia. The durations of agricultural abandonment were 4, 12, 17, and 68 years. During self-restoration, the vegetation developed towards spruce forest with grass and the soils towards natural Stagnic Albeluvisols. Pedogenesis resulted in the formation of moder cover layers, Ah horizons, and eluvial features within the Ap horizons. The chronosequence showed a decline of stocks of plant available phosphorus and potassium, pH decrease from 5.6 to 3.9, and a decrease of base saturation from 100 to 32% in the upper mineral topsoils. Soil organic carbon (SOC) content increased in the soil depth 0-8cm but decreased slightly in the soil depth 8-20cm. The carbon stocks increased from 2.2 to 4.4 kg C m⁻² in the upper 20cm because of the carbon sequestration within the mineral topsoil and cover layer. Carbon sink functioning is larger in self-restorated Stagnic Albeluvisol than in natural ones. The organic carbon of the clay fraction showed no quantitative alterations. Free particulate organic matter (POM) increased from 6.7 to 33.3% of SOC in the soil depth 0-2cm and from 5.6 to 12.1% of SOC in the soil depth 2-20cm. Occluded POM decreased by approximately 10% of SOC in the upper 20cm of mineral topsoil. The results of the study show no full self-restoration of Stagnic Albeluvisols within the investigated time-scale of 68 years.



S02.03 -3

CARTOGRAPHIC AND CLASSIFICATION MODELS FOR REPRESENTATION OF THE TERRITORY PEDODIVERSITY

Khitrov Nikolay^[1], Cheverdin Yuri^[2], Chizhikova Natalya^[3], Rogovneva Ludmila^[1]

^[1]V.V.Dokuchaev Soil Science Institute ~ Department of genesis and reclamation of saline and sodic soils ~ Moscow ~ Russian Federation ^[2]Voronezh Research Institute of Agriculture ~ Department of agricultural soil science ~ Talovaya ~ Russian Federation ^[3]V.V.Dokuchaev Soil Science Institute ~ Laboratory of soil mineralogy and micromorphology ~ Moscow ~ Russian Federation

To characterize and estimate pedodiversity at the territory of agroforestlandscape in Kamennaya Steppe (Talovaya district, Voronezh region, Russia) located in the centre of the East-European Plain the map of soil cover pattern was compiled (scale 1:25000). It shows 95 contours represented by 61 soil combinations with unique composition and environmental conditions that are characterized by detailed soil maps (scale 1:1000) and soil catena. Soil diversity is associated here with the following soil processes: humus accumulation, zoogenic mixing, migration and accumulation of soluble salts and carbonates, solonetz process, vertigenesis, redox processes due to the groundwater impact and/or seasonal surface water stagnation, erosion, soil transformation caused by plough and tillage. Three soil classification systems (soil classification of the USSR, 1977; soil classification of Russia, 2004, 2008; WRB, 2006) were used to estimate the pedodiversity at the studied territory. The soils are represented by 5 WRB reference soil groups (Chernozems, Phaeozems, Solonetz, Vertisols, Stagnosols) or 6 soil types according to the soil classification of the USSR (1977) or 15 soil types according to the soil classification of Russia. The latest soil classification of Russia (2004, 2008) reveals the greatest pedodiversity (127 taxonomic classes) at the given territory taking into consideration diagnostic criteria for anthropogenic transformation of soils. WRB (2006) allows estimating approximately the same pedodiversity (71 classes) as compared to that (77 classes) determined by the soil classification of the USSR (1977). The study was carried out at the support of Russian Foundation for Basic Research, projects no. 06-04-08323, 08-04-01195, 11-04-00710.



S02.03 -4

PEDODIVERSITY IN A TROPICAL HIGHLAND COUNTRY. THE CASE OF RWANDA.

Verdoodt Ann*^[1], Peter Finke^[2], Geert Baert^[3], Eric Van Ranst^[2]

^[1]Ghent University ~ Department of Soil Management ~ Gent ~ Belgium ^[2]Ghent University ~ Department of Geology and Soil Science ~ Gent ~ Belgium ^[3]University College Gent ~ Department of Plant Production ~ Gent ~ Belgium

Rwanda, even though being a small landlocked country, hosts a great diversity in climatic, geologic, and geomorphic conditions. This diversity is also reflected in its soil resources. A complex pattern of soil mapping units was deployed to characterise the Rwandan soilscape, which has been surveyed and mapped at a scale of 1:50,000. In this study, the taxonomic pedodiversity was quantified. Taxonomic richness, Shannon's entropy and quadratic entropy have been determined at the WRB reference group level. The indices have been calculated at national, regional and local scales. Regional values have been determined for the 43 soil map sheets and 26 agro-bioclimatic zones of the country, and reveal regional differences in pedodiversity. The local pedodiversity has been determined using a moving window of 11 cells after rasterizing the soil map to a resolution of 90m. Rwanda is characterized by a large overall pedodiversity with the occurrence of 18 soil reference groups. Shannon's entropy (2.05) and evenness index (0.71) suggest a moderate pedodiversity. The average normalized taxonomic distance is quite high (0.69), reflecting the presence of reference groups that are taxonomically quite distant, whereas quadratic entropy reduces to 0.50. The relationship between aerial extent of the region under consideration and various pedodiversity indices, as reported by other authors, has been tested in Rwanda using the regionalized pedodiversity data. These regional differences in local pedodiversity are studied in more detail since insights in the spatial variation in pedodiversity within the country can be used to efficiently target further soil research activities.



S02.03 -5

PEDODIVERSITY ANALYSIS: STATE OF THE ART AND NEW CHALLENGES

Ibáñez Juan-José^{*[1]}

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In the last years several researches have proposed different concepts and mathematical tools in the frame of pedodiversity (a neologism of soil diversity) studies. Some of them fail to defend their proposals when claiming that their suggestions are better than the previous ones. Along the 1960ies and 1970ies, ecologists also published several novel indices and definitions of “ecological diversities”. Recently, theoretical ecologist auto-criticized this plethora of indices and definitions as it generated big confusion and issues when comparing different studies. Similar problems, due to the proliferation of indices and concepts, begin to affect pedodiversity studies. The soil cover is very complex (as biocenoses, ecosystems, etc.) to have a unique definition and index in order to measure its diversity. As matter of fact, in pedodiversity studies several approaches, definitions and mathematical tools, with their respective pros and cons, are present, as well it occurs in biodiversity studies. Definitions do not say anything if they are not operationalized using robust scientific mathematical tools. Often the definitions and indices more complex are no better than the simplest. Different objectives demand different approaches. If the results obtained in different studies can not be compared, it will be impossible any progress in assessing pedodiversity patterns and regularities of the pedosphere.



S02.03 -6

**PEDOSITES AS AN ELEMENT IN ASSESSMENT OF SOILSCAPE AND ECOTOURISM
POTENTIAL: A STUDY IN A DESERT ECOSYSTEM OF NORTHERN CHILE.**

Sepúlveda-Varas Alejandra^{*[1]}, Muñoz-Pedrerros Andrés^[1]

^[1]Universidad Católica de Temuco ~ School of Environmental Sciences ~ Temuco ~ Chile

The highland (Puna) of northern Chile, Atacama region, is an ecosystem located over 4.000 m.a.s.l.; in the high peaks and with a history of active volcanism. The lagoon Lejía is in a depression desert, with a high steppe climate (low temperatures and strong daily oscillation, rainfall concentrated in summer, high evaporation and low relative humidity). The area in which it is inserted lagoon Lejía is near one of the three sites of international interest for tourism in Chile. The objective of this study was to evaluate the potential of the lagoon Lejía for the development of ecotourism activities with particular relevance in the identification and assessment of pedosites, generating information with multicriteria GIS cartographic expression (including geodiversity, pedodiversity, landscape and biodiversity). Pedosites were identified and evaluated as part of soilscares and fragile environments associated with initial development, using criteria adapted from those used for geosites. The visual landscape quality was evaluated by direct assessment of representative subjectivity and indirect analysis using a standardized panel of evaluators. The flora and vegetation was evaluated with phytosociological surveys describing 29 species of two plant associations. The fauna is evaluated using a variety of field census methods (traps, camera traps, and acoustic surveys) recorded 39 species of vertebrates. Finally, we generated a geodatabase which was integrated in GIS to generate categories of use of the landscape with ecotourism potential.



S02.04 - SOIL CLASSIFICATION: USING WRB FOR PROVIDING SOIL INFORMATION AND MAKING HARMONIZED MAPS ON A EUROPEAN LEVEL

Chair Persons:

Seppe Deckers, Leuven - Belgium

Peter Schad, München - Germany

Tuesday 03 July 2012 from 13:30 to 15:00. Room Alloro

S02.04 -1

MAKING SOIL MAPS WITH WRB: THE GUIDELINES (2010)

Peter Schad, Freising - Germany

S02.04 -2

*CONVERTING THE LEGEND OF THE SOIL MAP OF BELGIUM INTO THE WORLD
REFERENCE BASE FOR SOIL RESOURCES: (II) STRENGTH AND CONSTRAINTS OF USING
WRB AS A MAP LEGEND*

Stefaan Dondeyne, Leuven - Belgium

S02.04 -3

USING WRB TO MAP THE SOIL SYSTEMS OF ITALY

Edoardo Costantini, Firenze - Italy

S02.04 -4

*SOIL CLASSIFICATION AS A TOOL TO PRODUCE USER-FRIENDLY THEMATIC SOIL MAPS
IN NORWAY*

Aage Nyborg, - Norway

S02.04 -5

*WEAK POSITION OF SOIL TROPHIC STATUS IN WRB MAKE DIFFICULT A CLASSIFICATION
AND CARTOGRAPHY OF CAMBISOLS*

Cezary Kabala, Wroclaw - Poland

S02.04 -6

*IRISH SOIL INFORMATION SYSTEM – VALIDATION OF DIGITAL SOIL MAPPING USING
TRADITIONAL SOIL SURVEY.*

Brian J Reidy, Wexford - Ireland



S02.04 -1

MAKING SOIL MAPS WITH WRB: THE GUIDELINES (2010)

Schad Peter^[1], Spaargaren Otto^[2], Micheli Erika^[3], Eberhardt Einar^[4]

^[1]TU München ~ Soil Science ~ Freising ~ Germany ^[2]ISRIC ~ ISRIC ~ Wageningen ~ Netherlands ^[3]Szent Istvan University ~ Soil Science and Agricultural Chemistry ~ Gödöllő ~ Hungary ^[4]Federal Institute for Geosciences and Natural Resources ~ Groundwater and Soil Science ~ Hannover ~ Germany

The 2007 edition of the international soil classification system WRB (World Reference Base for Soil Resources) is focused on pedon classification. WRB has two hierarchical levels. The upper level comprises 32 Reference Soil Groups (RSG). At the lower level, adjectives called qualifiers are added to the RSG name. To classify a pedon, all applying qualifiers have to be added. Their sequence is fixed by rules following practical reasons without a hierarchy of importance. This is inappropriate for creating map units. In 2010, the IUSS Working Group WRB published electronically the „Guidelines for constructing small-scale map legends using the WRB“: http://www.fao.org/fileadmin/templates/nr/images/resources/pdf_documents/WRB_Legend.pdf.

Without changing definitions, the qualifiers were arranged differently. For every RSG, there is a small number of Main Map Unit Qualifiers which are ranked. All others are Optional Map Unit Qualifiers which are listed alphabetically. The number of qualifiers in the map units depends on the scale. At very small scales, only the RSGs are shown. If the scale is larger, the first applying qualifier of the main list is added, at the next larger scale the first two, etc. They are placed before the name of the RSG. At every scale, additional qualifiers may be added in brackets behind the name of the RSG. They may stem from the main list (not yet used for that map unit) or from the optional list. Besides the dominant soil, co-dominant and associated soils can be shown. Example maps at different scales of the sheet Flensburg (Germany) will be presented.



S02.04 -2

CONVERTING THE LEGEND OF THE SOIL MAP OF BELGIUM INTO THE WORLD REFERENCE BASE FOR SOIL RESOURCES: (II) STRENGTH AND CONSTRAINTS OF USING WRB AS A MAP LEGEND

Dondeyne Stefaan*^[1], Antoine Bouhon^[2], Xavier Legrain^[3], Geert Baert^[10], Karen Vancampenhout^[5], Carole Ampe^[6], Nathalie Cools^[7], Patrick Engels^[8], Roger Langohr^[9], Eric Van Ranst^[11], Jean Chapelle^[2], Jozef Deckers^[1]

^[1]Catholic University of Leuven ~ Department Earth and Environmental Sciences ~ Leuven ~ Belgium ^[2]Haute École Charlemagne ~ Soil Science Unit ~ Liège ~ Belgium ^[3]Gembloux Agro-Bio Tech, University of Liège ~ Soil Science Unit ~ Gembloux ~ Belgium ^[4]Catholic University College ~ Department of Applied Bio-engineering Sciences ~ Gent ~ Belgium ^[5]University College Kempen ~ Biosciences department ~ Geel ~ Belgium ^[6]Flemish Land Agency ~ VLM ~ Brugge ~ Belgium ^[7]Research Institute for Forest and Nature ~ INBO ~ Geraardsbergen ~ Belgium ^[8]Ministry of the Walloon Region ~ ~ Namur ~ Belgium ^[9]Association for the Diffusion of Sciences ~ ~ Brussels ~ Belgium ^[10]University College Ghent ~ Department of Applied Bio-engineering Sciences ~ Gent ~ Belgium ^[11]Ghent University ~ Laboratory of Soil Science ~ Gent ~ Belgium

Within the European Union, there is a general interest to prepare joint soil maps at a 1:250000 scale in order to harmonise agricultural and environmental policies. The World Reference Base for Soil Resources (WRB) has been adopted as the common soil classification system within the EU. As soil surveys in most member states were conducted independently, the challenge is now to convert the national legends into a common WRB legend. Based on our experiences from converting the legend of the Soil Map of Belgium to WRB, we discuss the strengths and constraints of using WRB for both large scale (1:50000) and small scale (1:250000) maps. By using WRB Reference Soil Groups with one or two main qualifiers, the principal soil information of the original 1:20000 scale Soil Map of Belgium can be represented. Inevitably the conversion to WRB leads to some loss of information as details on soil texture, drainage and substratum get generalised into broader categories in WRB. This generalisation however can be neatly presented on 1:50000 scale maps. Being less complex than the original maps, these maps have the advantage to provide better insights into the regional soil geography. Moreover, as they are built on international classification concepts, the historical soil maps are made accessible to a wider audience. The conversion into WRB units also allowed for a straightforward generalisation and production of small scale maps (1:250000) which should be suitable for producing a soil map at European level.



S02.04 -3

USING WRB TO MAP THE SOIL SYSTEMS OF ITALY

Costantini Edoardo*^[1], Magini Simona^[1], Barbetti Roberto^[1], Labate Giovanni^[1], Fantappiè Maria^[1]

^[1]CRA-ABP ~ Centro di ricerca per l'agrobiologia e la pedologia ~ Firenze ~ Italy

Aim of this work was to test the 2010 version of the WRB soil classification for compiling a map of the soil systems of Italy at 1:500,000 scale. The source of data was the national geodatabase storing information on 1,414 Soil Typological Units (STUs). Though, basically, we followed WRB criteria to prioritize soil qualifiers, however, it was necessary to work out an original methodology in the map legend representation to reproduce the high variability inside each delineation meanwhile avoiding any loss of information. Each map unit may represent a combination of three co-dominant STUs at the most. Dominant STUs were assessed summing up the occurrence of STUs in the Land Components (LCs) of every soil system, where each LC is a specific combination of morphology, lithology and land cover. STUs were classified according to the WRB soil classification system, at the third level, that is, reference soil group and first two qualifiers, when possible. Since the large number of delineations, map units grouping was needed to make the map more legible. Legend colours were organized according to soil regions groups firstly, then by considering the highest level of soil classification, so resulting a nidificated legend. The map showed 3,357 polygons and 704 map units. The most common STU were Calcaric Cambisols, by far followed by Calcaric Regosols, Eutric Cambisols, Haplic Calcisols, Vertic Cambisols, Cutanic Luvisols, Leptic Pheozems, Chromic Luvisols, Dystric Cambisols, Fluvic Cambisols, and others STUs belonging to almost all the WRB soil references. Keywords: geodatabase, soil systems



S02.04 -4

SOIL CLASSIFICATION AS A TOOL TO PRODUCE USER-FRIENDLY THEMATIC SOIL MAPS IN NORWAY

Nyborg Aage^[1], Solbakken Eivind^[1], Svendgård-Stokke Siri^[1]

^[1]Norwegian forest and landscape institute ~ Soil section ~ Norway

The soil mapping program in Norway started in the early 1980s. The purpose was to provide detailed and standardized data on soils as a resource, to enable the optimal utilization of the cultivated land and to be able to evaluate the environmental costs of modern agriculture. All soil maps are accessible on the internet at no cost. An adapted version of WRB, adjusted for Norwegian soil conditions, has been used as a basis for soil mapping in Norway since the turn of the millennium. Older soil maps have also been correlated into this soil classification system, which uses WRB-qualifiers that are important for Norwegian agriculture. The WRB-qualifiers proved to be a good starting point for deriving thematic soils maps. The qualifiers were given values from 0 to 1 according to the degree of limitation they represented for different uses of the soil. Different indexes were calculated for each soil type depending on soil use, with 100 as top score (no limitations). Suitability maps were then derived using the indexes and other information from the soil map signatures. The resulting thematic soils maps ranges from a general suitability for agriculture to suitability maps for different crop types. Other thematic maps focus on specific limiting factors such as soil drainage and risk of draught. All maps are user-friendly with easy to understand legends. They also serve the purpose to provide users outside the soil science profession with the useful information which is hidden in soil classification.



S02.04 -5

WEAK POSITION OF SOIL TROPHIC STATUS IN WRB MAKE DIFFICULT A CLASSIFICATION AND CARTOGRAPHY OF CAMBISOLS

Kabala Cezary^[1], Bozena Smreczak^[2]

^[1]Wroclaw University of Environmental and Life Sciences ~ Institute of Soil Science ~ Wroclaw ~ Poland ^[2]Institute of Soil Science and Plant Cultivation ~ Department of Soil Science ~ Pulawy ~ Poland

Base saturation is now inconsistently used as a diagnostic feature in WRB classification. On one hand it serves to separate the key diagnostic horizons (e.g. mollic and umbric), and to identify (e.g. Phaeozems) or distinguish the reference soil groups (e.g. Luvisols versus Alisols). At the same time, however, the eutric and dystric qualifiers are located not among “prefixes”, but in distant places on the list of “suffixes”, which significantly diminishes their rank in the RSG name. Meanwhile, in the weakly-developed soils, especially in Cambisols and Arenosols, but also in Fluvisols, Gleysols and Histosols, the trophic status is strongly related to the conditions of soil formation and determines their environmental functions and productivity (e.g. in forestry). It is therefore of primary importance for the correct classification of soils and proper delimitation of soil variability on the soil map. We postulate, therefore, to place the eutric and dystric qualifiers in the list of “prefixes” directly before haplic qualifier. The presentation will be illustrated with the results of two case studies on Cambisols developed in different geochemical environments of the southern Poland.



S02.04 -6

IRISH SOIL INFORMATION SYSTEM – VALIDATION OF DIGITAL SOIL MAPPING USING TRADITIONAL SOIL SURVEY.

Creamer Rachel^[1], Constanje Ron^[2], Schulte Rogier^[1], Reidy Brian J*^[1]

^[1]Teagasc ~ Soils, Environment and Land Use ~ Wexford ~ Ireland ^[2]Cranfield University ~ National Soil Resources Institute ~ Bedford ~ United Kingdom

The Irish Soil Information System project is a national soil mapping programme to assess the distribution of soil types for Ireland and construct a soil map, at 1:250,000 scale. This is in response to national requirements to address the need to provide soil with a level of protection similar to for water and air and, at international level. The work being undertaken in this project moves a National soil classification system into a new digital generation. This work is ground-breaking, as no other country has adopted such a complementary approach of combining novel digital techniques with groundtruthing using traditional soil survey methodologies at a National scale. Digital physiographic models have been applied to generate soil-landscape models to allow the development of a predictive soils map for areas not previously surveyed in Ireland. This map has been interrogated using traditional field soil survey techniques, since 2010 and detailed field assessment will continue until November 2012. Validation of the digital soil maps using the augerbore records (>5,000) from 6 counties allows for the comparison of digital soil maps and traditional soil survey techniques in assessing key features such as 1) recognition of diagnostic features in a landscape, 2) landscape attributes in determining soil sub-groups 3) the divergence of that seen in the field compared to that predicted using spatial landscape models. The outcomes of this validation exercise will provide a robust assessment of the application of digital soil mapping techniques compared to soil survey at understanding soil-landscape relationships.



S02.05a - BIOLOGICAL WEATHERING AND CYCLING OF IRON, SILICON AND OTHER MAJOR AND TRACE ELEMENTS IN SOIL

Chair Persons:

Ales Kapicka, Prague - Czech Republic

Neli Jordanova, Sofia - Bulgaria

Wednesday 04 July 2012 from 13:30 to 15:00. Room Biancospino

S02.05a -1

ANTHROPOGENIC IRON OXIDES IN SOILS - A BASIS FOR POLLUTION STUDY IN ORE MTS, CZECH REPUBLIC

Ales Kapicka, Prague - Czech Republic

S02.05a -2

CHARACTERIZATION OF PEDOGENIC FE/MN CONCRETIONS AND COATINGS IN REDOXIMORPHIC SOILS

Matthias Händel, Jena - Germany

S02.05a -3

IRON(III) (HYDR)OXIDE-ORGANIC COPRECIPITATES – FROM STRUCTURE TO REACTIVITY

Anja Freund, Hannover - Germany

S02.05a -4

INVESTIGATIONS ON THE STABILITY OF SUPERPARAMAGNETIC MINERALS IN SOILS AND ROCKS

Holger Preetz, Hannover - Germany

S02.05a -5

MERCURY MOBILIZATION IN FERRALITIC SOILS UNDER REDUCTIVE CONDITIONS

Nouredine Bousserhine, Créteil - France

S02.05a -6

PATTERNS OF ORGANIC ACID EXUDATION OF PIONEERING FUNGI FROM A GLACIER FOREFIELD

Ivano Brunner, Birmensdorf - Switzerland



S02.05a -1

ANTHROPOGENIC IRON OXIDES IN SOILS - A BASIS FOR POLLUTION STUDY IN ORE MTS, CZECH REPUBLIC

Kapicka Ales^[3], Lukesova Veronika^[2], Petrovsky Eduard^[3], Grison Hana^[3]

^[1] ~ geomagnetic ~ Prague ~ Czech Republic ^[2] Czech University of Life Sciences Prague ~ Soil Science and Soil Protection ~ Prague ~ Czech Republic ^[3] Institute of Geophysics ASCR ~ geomagnetic ~ Prague ~ Czech Republic

We have investigated magnetic properties of depth soil profiles from Ore Mountains (Czech Republic) which belong to a highly contaminated, so called Black Triangle in central Europe. Emission level is strongly affected by considerable concentration of big sources of pollution (power plants burning fossil fuel, metallurgical and chemical industry). Average annual concentration of PM₁₀ (35-46 µg/m³) in the area of Ore Mts foothills belongs to the highest within the Czech Republic. In localities across the investigated region, increased values of magnetic susceptibility (25 – 200 x 10⁻⁵ SI) were clearly identified in the top-soil layers. At the same time, other magnetic parameters such as frequency dependent magnetic susceptibility k_{FD} and IRM acquisition or AC demagnetization curves indicate that the accumulated anthropogenic ferrimagnetics dominate these layers. Magnetic enhancement is limited to depths of 4-7 cm below the soil surface, usually in F-H or top of Ah soil horizons, deeper soil horizons are characterized by much lower values of susceptibility (up to 30 x 10⁻⁵ SI). We will show that significant magnetic parameters (hysteresis parameters, k_{FD}, T_c) and SEM results of contaminated topsoils are comparable with magnetic parameters of atmospheric dust, collected (in high volume dust samplers) at the same localities. In situ measurements of topsoil magnetic susceptibility were used to compile a 2-D map, which represents distribution of atmospheric dust deposition in the Ore Mountains region and outlines areas of increased soil contamination, resulting from local pollution sources.



S02.05a -2

CHARACTERIZATION OF PEDOGENIC FE/MN CONCRETIONS AND COATINGS IN REDOXIMORPHIC SOILS

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Secondary Mn minerals play an important role in many soil chemical processes such as sorption of metal ions and degradation of organic contaminants. Redoximorphic soils such as Gleysols and Stagnosols are characterized by spatially separated enrichment and depletion zones of pedogenic (hydrous) Fe and Mn oxides, which appear as a result of the periodic change between reducing and oxidizing conditions. We investigated stagnic and gleyic subsoil horizons developed from loess, Early Triassic sandstone, calcareous gravel and Middle Jurassic loamy sediments with pH values from 3.7 to 7.3. The concretions, coatings and parts of the surrounding matrix were characterized by electron microprobe analysis and polarizing microscopy on thin sections, XRD, FTIR spectroscopy and analyzed for their total element contents and their oxalate- and dithionite-extractable fractions. Diffractograms and FTIR spectra exhibited showed a signal overlap of clay and Mn minerals. Nevertheless, birnessite was detected in a gleyic horizon (pH 7.3). Backscattered electron images and EDX measurements showed that Mn phases in stagnic horizons always occur together with clay minerals in a matrix. Iron precipitates are partly present in a clay matrix like Mn phases and also as pure Fe precipitates at the edges of pores inside the concretions. Concretions formed in Middle Jurassic sediments showed a shell-like structure, which suggests periodic formation processes. In contrast, concretions developed in stagnic horizons from sandstone were formed by the flow of the soil solution into the interior of aggregates, where Mn phases precipitated. All pedogenic Mn precipitates were enriched in Co, Ni, and As.



S02.05a -3

IRON(III) (HYDR)OXIDE-ORGANIC COPRECIPITATES – FROM STRUCTURE TO REACTIVITY

Freund Anja*^[1], Mikutta Robert^[1], Guggenberger Georg^[1]

^[1]University of Hannover ~ Soil Science ~ Hannover ~ Germany

Iron(III)(hydr)oxide-organic-matter associations (FHO-OM) in soils play an important role in the biogeochemical cycling of iron (Fe), carbon (C), and of nutrients. Such associations are assumed to result from adsorption of organic matter to Fe oxides. However, a second, often neglected pathway involves the precipitation of Fe(III) hydrolysis products in the presence of natural dissolved organic matter and other solutes such as aluminum (Al). Thus, FHO-OM complexes might differ from pure FHO-phases in their structure, composition, and consequently in their biogeochemical reactivity. At present, it is unknown which factors control the composition of FHO-OM coprecipitates and how the structural properties translate into the cycling of the FHO and OM component involved. The objectives are thus to elucidate (i) the structural properties of FHO-OM coprecipitates at different initial Fe:C ratios, initial Al:Fe ratios, and organic matter types, and (ii) the subsequent stability of FHO-OM coprecipitates against ligand-induced dissolution. The structure of FHO-OM phases was characterized by Mössbauer spectroscopy, transmission electron microscopy, X-ray absorption spectroscopy, and selective extractions; the latter to determine the amount of organically complexed Al. The selective precipitation of certain OM components under the variable experimental conditions was shown by pyrolysis gas chromatography. Kinetic dissolution experiments with oxalate and ascorbate were conducted to determine the initial dissolution rates and the extent of dissolution. These parameters were related to the FHO structures in order to elucidate the factors controlling the stability of the mixed FHO-OM phases.



S02.05a -4

INVESTIGATIONS ON THE STABILITY OF SUPERPARAMAGNETIC MINERALS IN SOILS AND ROCKS

Preetz Holger^[1], Christian Rolf^[2], Jan Igel^[3]

^[1]Leibniz Institute for Applied Geophysics ~ Geoelectrics and Electromagnetics ~ Hannover ~ Germany ^[2]Leibniz Institute for Applied Geophysics ~ Petrophysics and Borehole Geophysics ~ Hannover ~ Germany ^[3]Leibniz Institute for Applied Geophysics ~ Geoelectrics and Electromagnetics ~ Hannover ~ Germany

Today, the presence of ultrafine grained, superparamagnetic (SP) minerals in soils as indicated by frequency dependent (FD) magnetic susceptibility is widely used as evidence for soil formation processes. However, SP minerals can also be of lithogenic origin. They occur in magmatic rocks or pyroclastic materials and they may be detritally enriched in soils. In many studies citrate/bicarbonate/dithionite(CBD)-treatment is used to separate lithogenic and pedogenic SP components of soils. We started a comparative study on the chemical stability of SP minerals from 3 rock (2 tuffstones, 1 rhyolite) and 4 soil samples from different climate zones and with different bedrocks. All samples feature noticeable FD susceptibility and were subjected to reductive atmospheres by means of oxygen-free water and by sodium sulphide providing reductive conditions similar to the field. Mutations in magneto mineralogy were controlled by regular measurements of FD susceptibility over a nine-month period. All but one sample remained unaffected suggesting that chemical stability of lithogenic and pedogenic SP minerals is comparable. One humous soil sample displayed a significant increase in SP minerals, which can be explained only by activity of anaerobic dissimilatory bacteria. The observation is ongoing. Additionally, CBD treatment is applied to the samples before and after reduction. Temperature dependent susceptibility measurements ($K_{\text{para}}(T)$) were performed at the beginning of our test series. These measurements will be repeated at the end of the study to clarify changes of the ferrimagnetic composition and grain size by reduction as well as the effects of CBD treatment.



S02.05a -5

MERCURY MOBILIZATION IN FERRALITIC SOILS UNDER REDUCTIVE CONDITIONS

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The biogeochemical cycle of Hg in ferralitic tropicals soil is considered still poorly understood. While, several studies demonstrated that in these soils and under anaerobic conditions, the mobility of heavy metals was correlated to dissolution of iron oxyhydroxides and the degradation of organic matter, there is a lack of information about the importance of these processes on mobility of mercury. Little is available too about the role of anaerobic bacteria on the observed solubilisation. In this context, samples of ferralitic soils originating from French Guyana and containing mercury were incubated in batch reactor in presence of growth medium under standard anaerobic conditions. During incubation, bacterial metabolism and metal solubilisation (FeII, FeT, HgT) were followed. Results obtained showed that at the beginning of incubation, a small amount of mercury was solubilised while any bacterial developpement was detected. This mercury was associated to exchangeable phase of soil. A significant solubilisation of mercury was then observed concomitantly to bacterial reduction of amorphous iron oxides. At the end a last part of mercury is solubilised concomitantly to bacterial solubilisation of crystallized iron oxides and organic matter degradation. Our study demonstrated that in anaerobic conditions like those encountered in hydromorphic ferralitic soils, autochthonous bacteria solubilize iron oxide and degrade organic matter liberating associated mercury and rendering it bio-available for further bacterial transformation such as methylation and accumulation along the food chaine.



S02.05a -6

PATTERNS OF ORGANIC ACID EXUDATION OF PIONEERING FUNGI FROM A GLACIER FOREFIELD

Brunner Ivano*^[1], Goren Asena^[2]

^[1]Swiss Federal Research Institute WSL ~ Forest Soils and Biogeochemistry ~ Birmensdorf ~ Switzerland ^[2]University of Guelph ~ Department of Plant Agriculture ~ N1G 2W1 Ontario ~ Canada

*Fungi, isolated from fine granitic sediments in front of the Damma glacier in the central Swiss Alps, have the capacity to exude organic acids and dissolve granite materials. In particular the zygomyceteous species *Mucor hiemalis* and *Umbelopsis isabellina* and the ascomyceteous species *Penicillium chrysogenum* showed a high capacity to exude citrate, malate and/or oxalate. In this study, we investigated the capacity of these fungal species to exude the organic acids in dependency on the available carbon source. As carbon source we used potentially naturally occurring carbon sources such as dried and powdered cell wall components, bee pollen, green algal cells, cyanobacteria thalli, and fungal mycelia. The patterns of the exuded organic acids will be presented and discussed, and put in relation to the capacity of the fungal species to weather granite materials.*



S02.05b - BIOLOGICAL WEATHERING AND CYCLING OF IRON, SILICON AND OTHER MAJOR AND TRACE ELEMENTS IN SOIL

Chair Persons:

Jacques Berthelin, Nancy - France

Catherine Keller, Aix-Marseille - France

Wednesday 04 July 2012 from 15:30 to 17:00. Room Biancospino

S02.05b -1

NUMERICAL MODELLING AND SIMULATION TO COUPLE MYCORRHIZAL WEATHERING AT SINGLE-HYPHA AND WHOLE-MYCELIUM SCALES

Jonathan Bridge, Sheffield - United Kingdom

S02.05b -2

THE INFLUENCE OF DIFFERENT MINERALS ON THE GROWTH OF ECTOMYCORRHIZAL FUNGI

Christoffer Berner, Lund - Sweden

S02.05b -3

AGRICULTURAL SILICA HARVEST: A NEW LOOP IN THE TERRESTRIAL SILICA CYCLE?

Floor Vandevenne, Antwerp - Belgium

S02.05b -4

LONG-TERM REMOVAL OF WHEAT STRAW DECREASES SOIL AMORPHOUS SILICA AT BROADBALK WINTER WHEAT EXPERIMENT, ROTHAMSTED

Jean-Dominique Meunier, Aix-en-Provence - France

S02.05b -5

DEVELOPING A NEW METHOD TO MEASURE BIOGENIC SILICA IN TERRESTRIAL ECOSYSTEMS

Lucia Barao, Antwerp - Belgium



S02.05b -1

NUMERICAL MODELLING AND SIMULATION TO COUPLE MYCORRHIZAL WEATHERING AT SINGLE-HYPHA AND WHOLE-MYCELIUM SCALES

Bridge Jonathan^{*[1]}, Bonneville Steeve^[2], Taylor Lyla^[3], Benning Liane^[4], Banwart Steven^[1]

^[1]The University of Sheffield ~ Kroto Research Institute ~ Sheffield ~ United Kingdom ^[2]Université Libre de Bruxelles ~ Departement de Science de la Terre et d'Environnement ~ Bruxelles ~ Belgium ^[3]The University of Sheffield ~ Department of Animal and Plant Sciences ~ Sheffield ~ United Kingdom ^[4]University of Leeds ~ School of Earth and Environmental Sciences ~ Leeds ~ United Kingdom

Soil mycorrhizal fungi act through biochemical interactions at nanometre scale to dissolve minerals and transport weathering products to plant symbionts through metre-scale mycelial networks. Previous research within our consortium project has shown convincingly the nanoscale weathering of minerals by hyphae in direct contact with minerals [1], and at the same time the transport and redistribution of mineral- and plant-derived nutrients (carbon, phosphorus) within the rhizosphere and the plant itself [2]. A key factor in this biologically-driven weathering system is the relationship between the energy supplied from the plant to the mycorrhiza, and the rate of weathering of minerals. Critically, what is the nature of the feedback between the plant root and the distal hyphae that controls allocation of photosynthate within the mycelial network in response to nutrient uptake? Here, we present the results of numerical modelling and simulation of hypha-mineral weathering and hyphal network growth which couples a mechanistic model of element release from minerals to potential fluxes of carbon and nutrient to the plant root from the whole mycelium. Our models indicate that the efficiency of mycorrhizal weathering is sensitive to both geochemical and biological parameters and suggest that local variations in weathering efficiency drive hyphal growth behaviour (e.g., exploratory vs. exploitative) and photosynthate demand. REFERENCES [1] Bonneville, S. et al. (2011) *Geochimica et Cosmochimica Acta* 75 6988–7005. [2] Leake et al. (2008) *Mineralogical Magazine* 72, 85–89.



S02.05b -2

THE INFLUENCE OF DIFFERENT MINERALS ON THE GROWTH OF ECTOMYCORRHIZAL FUNGI

Berner Christoffer^{*[1]}, Smits Mark M^[2], Wallander Håkan^[1]

^[1]Lund University ~ Microbial Ecology ~ Lund ~ Sweden ^[2]Hasselt University ~ Environmental Biology ~ Hasselt ~ Belgium

Ectomycorrhizal (EM) fungi increase nutrient uptake by trees in boreal forests. Nutrient deficiency leads to increased carbon allocation to the EM fungi to increase the uptake of nutrients, particularly those of low mobility. Growth and composition of EM communities might differ depending on amount of carbon allocated down to the ECM fungi. We have analysed the EM biomass and community structures at three locations with different nutrient statuses due to different bedrocks, in the Czech republic. The bedrocks were granite, low in Mg, serpentinite, low in P and K, and amphibolite with all nutrients at sufficient level. Sand filled mesh bags amended with apatite (P source), biotite, (K source), hornblende (Mg source), or unamended as controls, were planted in the organic horizon to measure the influence of these minerals on EM growth and on the composition of the EM communities in the sites with different bedrocks. The bags were harvested after 4 or 15 months. We analysed EM growth by measuring ergosterol content in the samples. Community structure were analysed by sequencing mycelia collected from the mesh bags. We found that EM growth was higher in the serpentinite site both after 4 and 15 months while the granite sites showed significantly lower EM growth. Apatite enhanced EM growth in serpentinite site while other amendments had no effect. Another experiment (over 5 years) showed that P deficiency enhanced carbon allocation to EM fungi colonizing apatite amended mesh bags, but the increased carbon allocation did not influence the composition of the EM community.



S02.05b -3

AGRICULTURAL SILICA HARVEST: A NEW LOOP IN THE TERRESTRIAL SILICA CYCLE?

Vandevenne Floor^[1], Lucia Barao^[1], Wim Clymans^[2], Patrick Meire^[1], Eric Struyf^[1]

^[1]University of Antwerp ~ Biology ~ Antwerp ~ Belgium ^[2]Catholic University of Leuven ~ Earth and Environmental Sciences ~ Leuven ~ Belgium

It has been shown that biological silica (Si) cycling controls a large part of the plant-available silica pool in soils, strongly interfering with Si export fluxes to rivers and oceans. In plants, Si is present as biogenic opaline plant structures (phytoliths) –highly soluble compared with mineral silicates-, which return quickly to topsoil after plant death and decomposition. Large biogenic silica (BSi) pools have already been found in forest, grassland and wetland soils. Despite the importance of vegetation for terrestrial Si budgets, only a few studies addressed the imprint of anthropogenic land use changes (i.e. deforestation) on Si pools and fluxes. We show that agriculture and harvest of high Si-accumulating crops (maize, wheat, barley,...) in a temperate European watershed (Scheldt river) constitutes a major flow of BSi out of terrestrial systems, as compared with BSi production in climax forest and grasslands. In addition, reactivity of biogenic silica and soil-plant phytolith pools are compared between different land use types (forest, pasture and croplands) and between soil horizons. Although the fate of the harvested BSi in croplands is still an enigma, we state that its majority ends up in several sinks, depleting soil phytolith pools even more, and suggest a preliminary life-cycle assessment scheme for BSi in an agricultural watershed. As Si-burial in agricultural sinks directly impacts atmospheric carbon dioxide concentrations and diatom production rates in the ocean, a thorough understanding and quantification of the agricultural silica loop is required.



S02.05b -4

LONG-TERM REMOVAL OF WHEAT STRAW DECREASES SOIL AMORPHOUS SILICA AT BROADBALK WINTER WHEAT EXPERIMENT, ROTHAMSTED

Guntzer Flore^[1], Keller Catherine^[1], Poulton Paul^[2], Mcgrath Steve^[2], Meunier Jean-Dominique^{*[1]}

^[1]Aix-Marseille University ~ CEREGE ~ Aix-en-Provence ~ France ^[2]Rothamsted Research ~ Soil Science ~ Harpenden ~ United Kingdom

Most cereals accumulate Si in their shoots. Soil bioavailability of Si may be a constraint on the beneficial role of silica in cereals but it is not yet well supported by field data. The aim of this study is to evaluate the long-term impact of wheat straw exports on the pool of soil phytoliths, which, it is suggested, represents the most labile and renewable pool of soil Si. We measured the amorphous Si (ASi) in soils from several experiments at Rothamsted Research (UK), which provided long-term soil data back to the middle of the 19th century, using two alternative extraction techniques: Na₂CO₃ (referred to as ASnc) or zinc bromide extraction (referred to as ASizb). All samples showed a similar range of ASnc and ASizb but low values (0.1- 3.4 mg g⁻¹ DW) compared to published data on natural ecosystems. In the Broadbalk experiment, a decrease over time in ASi in the topsoil samples is in good agreement with the hypothesis that cropping and exports of straw leads to depletion of soil phytoliths. A decrease in Si concentration in straw samples was observed between 1883 and 1944. From 1944 to the present, Si concentration increased irregularly in the straw, probably as the result of liming, which enhanced the dissolution of the remaining phytoliths through increasing pH. Our results therefore support the hypothesis that export of wheat straw leads to a decrease in bioavailable Si.



S02.05b -5

DEVELOPING A NEW METHOD TO MEASURE BIOGENIC SILICA IN TERRESTRIAL ECOSYSTEMS

Barao Lucia^{*[1]}, Vandevenne Floor^[1], Clymans Wim^[2], Struyf Eric^[1]

^[1]University of Antwerp ~ Ecosystem Management Research Group ~ Antwerp ~ Belgium ^[2]KULeuven ~ Department of Earth and Environmental Sciences ~ Leuven ~ Belgium

The silica cycle is an important biogeochemical cycle. In the oceans, silica is essential for diatom growth, which represents 50% of phytoplankton biomass in today's ocean. Permanent burial of diatom C yearly accounts for about 25% of all human CO₂ output. Silica sources for the ocean and the coastal zone coming from continental fluxes to rivers represent 80% of the total inflow. Besides primary and secondary minerals, silica is also present in soils in the biogenic form of phytoliths which have a solubility rate almost one order of magnitude higher than minerals, contributing more to availability of dissolved silica in a shorter time frame. Although the BSi has been intensively studied in marine sediments, only a few studies did the same for the BSi in terrestrial soils. In this work we collected samples from soils with different land uses and locations and analyzed them by carrying out a continuous extraction of silica and aluminium. The BSi content was determined with: 1) the Kamatani and Oku (2000) approach using aluminium correction ; 2) Koning et al. (2002) approach using mathematical models; 3) a new model that splits the silica curve in two parts; and 4) DeMasters (1981) approach. Results showed that the Kamatani and Oku approach is not suitable for soil samples, while the DeMasters technique mostly underestimates BSi content. The application of mathematical models to silica curves provides a new possibility to study the changing silica reactivity through the soil profile and link this to processes occurring in different horizons.



S03.01a - SOIL DEGRADATION

Chair Persons:

Marcello Pagliai, Firenze - Italy

Julia Krümmelbein, Brandenburg - Germany

Monday 02 July 2012 from 13:30 to 15:00. Room Acero

S03.01a -1

COMPACTION AND NATURAL RESILIENCE OF FOREST SOIL : TOWARDS BETTER UNDERSTANDING AND CHARACTERIZATION

Pascal Boivin, Jussy, Geneva – Switzerland - Invited

S03.01a -2

IMPACT OF MODERN FOREST VEHICLES ON SOIL PHYSICAL PROPERTIES AND THE POSSIBILITY FOR STRUCTURE REGENERATION

Rainer Horn, Kiel - Germany

S03.01a -3

RECOVERY OF FOREST SOIL STRUCTURE AND FINE ROOT PROPAGATION AFTER COMPACTION

Jürgen Schäffer, Freiburg - Germany

S03.01a -4

ASSESSING THE FOREST SOIL COMPACTION IN A LOAMY SOIL

Charlotte Rosière, Gembloux - Belgium

S03.01a -5

PERSISTENT EFFECTS OF SUBSOIL COMPACTION ON SOIL PORE STRUCTURE AND TRANSPORT PROCESSES

Thomas Keller, Zurich - Switzerland

S03.01a -6

EVOLUTION OF STRUCTURAL PROPERTIES OF AN ARABLE SOIL AFTER COMPACTION AND DIFFERENT REGENERATION PATHWAYS

Peter Weisskopf, Zürich - Switzerland



S03.01a -1

COMPACTION AND NATURAL RESILIENCE OF FOREST SOIL : TOWARDS BETTER UNDERSTANDING AND CHARACTERIZATION

Boivin Pascal^[2], Goutal Noémie^[3], Ranger Jacques^[3]

^[1]INRA ~ INRA ~ Nancy ~ France ^[2]University of applied sciences of western Switzerland - hepia ~ Agronomy - Soils and Substrates Group ~ Jussy-Geneva ~ Switzerland ^[3]INRA ~ Biogéochimie des Ecosystèmes Forestiers ~ Nancy ~ France

Soil compaction is a key issue in forest soils, and it is suspected of dramatic impact on earth environment. Estimating the compactness, the natural recovery rate, and understanding their factors are, therefore, essential. In the literature, sampling the soil for bulk density at standard water content is recommended, and several techniques such as penetrometer measurements are experimented. These techniques, however, often fail to make diagnosis. On another side, new result and new techniques on the relationships between soil bulk volume, soil constituents, and soil water content, are available, based on shrinkage analysis, constituent's analyses and covariance analyses. This was not performed on forest soils, however, and this was the aim of our study. On two acid forest soils sites monitored after soil compaction we show the limitations of diagnosis based on bulk density assessment and mechanical characterizations. The shrinkage analysis of undisturbed soil samples is used together with covariance analysis to overcome these limitations. We show how the soil constituents, namely soil organic carbon, clay content and free aluminium can be taken into account to understand either the compaction observed or the natural recovery rate. The compactness is mostly driven by SOC, and the observed hydro-structural behaviour of the compacted soils fully agree with previously reported laboratory experiments, thus enforcing new conclusions on the structural behaviour of compacted soils, and how it must be characterized. Taking into account the soil volume on the full water content range and SOC are the keys for improved diagnosis



S03.01a -2

IMPACT OF MODERN FOREST VEHICLES ON SOIL PHYSICAL PROPERTIES AND THE POSSIBILITY FOR STRUCTURE REGENERATION

Horn Rainer*^[1], Heiner Fleige^[1]

^[1]Christian Albrechts University zu Kiel ~ Soil Science ~ Kiel ~ Germany

Ecological as well as economical consequences of mechanized harvesting procedures are of great importance in forestry, not only because of an intense increase in machine mass during tree cutting and transportation, but also because of a drastic increase in the stress application due to more pronounced vibration energy created from the harvesting machines themselves. The actual soil stresses and displacements in soil profiles were analyzed to give an overview on the range of possible effects of harvesting/forwarding systems with respect to the changes in soil physical properties of the forest soils at two depths: 20 cm and 40 cm. The maximum vertical stresses for all experiments exceeded always 200 kPa and reached at the 20 cm depth for some vehicles and sequences of harvesting operations 500 kPa or more. To evaluate the impact of soil stresses on soil structure, the internal soil strength was determined by the precompression stress method. Top and subsoil compaction, an increase in precompression stress values in the various soil horizons, deep rut depth and vertical and horizontal soil displacement associated with shearing effects take place and affect the mechanical strength of forest soils. At comparable sites of former forest soil wheeling and harvesting also the processes of soil regeneration after severe compaction were analyzed. Even after more than 20 years we could not proof a significant structure regeneration which underlines the threat of a longterm irreversibility of soil degradation in case of non adjusted landuse and wheeling/harvesting strategies.



S03.01a -3

RECOVERY OF FOREST SOIL STRUCTURE AND FINE ROOT PROPAGATION AFTER COMPACTION

Schäffer Jürgen^[1], V. Wilpert Klaus^[1]

^[1]Forest Research Institute of Baden-Württemberg ~ Soil science and environment ~ Freiburg ~ Germany

In Central Europe, first indications of areal soil damages caused by soil compaction were reported at the beginning of the 1970' shortly after heavy specialized logging machines were introduced into forest practice. Unfortunately no investigation sites were set aside in the past in order to study the restructuring dynamics after compaction. Thus, well documented wheel track situations from practical harvesting operations differing significantly in the time spans of restructuring were used to derive the status of recovery of soil structure and root propagation. At 11 sites on sensitive loamy substrates in Baden-Wuerttemberg, fine root distribution, pore volume, and gas diffusion coefficients were used to characterize the status of recovery from former soil compaction. The time delays of machine impact reached from 6 to 37 years; apart from two sites dating back to the 1960', the machine weights including load exceeded 10 Mg. Even at the sites with the longest period of restructuring, recovery of pore volume and gas diffusion properties in wheel tracks was limited to the first 10 cm to 20 cm. As well as the soil physical parameters, fine root densities proved a regaining of root propagation in the top soil. The density levels for reference and wheel track strata converged. Below that depth, persistence of damage was still high. Summarizing the results from the 11 study sites it can be stated that on sensitive loamy substrates four decades of natural restructuring will not be sufficient for an overall restoration of soil functionality.



S03.01a -4

ASSESSING THE FOREST SOIL COMPACTION IN A LOAMY SOIL

Rosière Charlotte^{*[1]}, Marie-France Destain^[1], Robert Charlier^[2], Jean-Claude Verbrugge^[3]

^[1]Gembloux Agro-Bio Tech (Ulg) ~ Environmental sciences and technologies ~ Gembloux ~ Belgium ^[2]ULG ~ ArGenCo ~ Liège ~ Belgium ^[3]ULB ~ BaTir ~ Bruxelles ~ Belgium

Several studies measured the level of compaction in forest soils due to the use of heavy machinery. According to the soil texture and water content, machines mass and traffic intensity, an increase of bulk density in the soil profile may be induced (Ampoorter, 2007, 2010). The aim of this study is to assess the effects of several machines configurations on soil compaction of Rulles forest (Wallonia, Belgium) (beech forest). The soil is a gravelly loam with a good natural drainage. Three trails C1, C2, and C3, with a length of 70 meters long were selected. These trails corresponded respectively to the passage of a harvester Timberjack 810D, a skidder Timberjack 360C and an agricultural tractor with a trailer. In each trail, the number of skidding cycles varied: one pass, 5 and 15 passes. Following measurements were performed in topsoil (10 cm) and in subsoil (40 cm): water content and bulk density. Furthermore, in subsoil, pF and oedometric tests were performed. The results show that, for a moisture content of 35 %, machines passes don't lead to any significant bulk density increase in topsoil. This was not the case for the agricultural tractor which induces 30% bulk density increase in topsoil. On the other hand, in subsoil, machines passes are responsible of a significant increase of precompression stress. The effect of machines on pore continuity was assessed in topsoil by microtomography by X-ray and in subsoil by pF measurement.



S03.01a -5

PERSISTENT EFFECTS OF SUBSOIL COMPACTION ON SOIL PORE STRUCTURE AND TRANSPORT PROCESSES

Keller Thomas^[1], Berisso Feto^[2], Etana Ararso^[3], Lamandé Mathieu^[2], Larsbo Mats^[3], Forkman Johannes^[5], Arvidsson Johan^[3], De Jonge Lis W.^[2], Iversen Bo V.^[2], Jarvis Nicholas^[3], Simojoki Asko^[4], Schjønning Per^[2]

^[1]Agroscope ART ~ Natural Resources & Agriculture ~ Zurich ~ Switzerland ^[2]Aarhus University ~ Agroecology ~ Tjele ~ Denmark ^[3]Swedish University of Agricultural Sciences ~ Soil & Environment ~ Uppsala ~ Sweden ^[4]Helsinki University ~ Food and Environmental Sciences ~ Helsinki ~ Finland ^[5]Swedish University of Agricultural Sciences ~ Crop Production Ecology ~ Uppsala ~ Sweden

Soil compaction affects many physical, chemical and biological processes in soil, potentially leading to environmental and agronomic problems. However, effects of compaction on soil pore functioning are still poorly understood. The objective of the work was to investigate the persistency of subsoil compaction, and to quantify effects of subsoil compaction on soil pore structure and transport processes. We present data from investigations made in 2009, 14 years after compaction. We sampled intact soil cores at 0.3, 0.5, 0.7 and 0.9 m depth that were used to measure water retention characteristics, saturated hydraulic conductivity (K_{sat}), air permeability (k_a) at -6, -30 and -100 hPa water tension, and gas diffusivity (D_s/D_0) at -100 hPa. Gas transport properties were measured in vertical as well as horizontal direction, in order to assess anisotropy. Finally, we studied the flow pattern in the soil profile by means of infiltration experiments with Brilliant Blue dye. Analysis of the water retention characteristics revealed that structural pores were significantly reduced by compaction, with considerable effects on soil functions. We measured consistently lower values of K_{sat} , k_a and D_s/D_0 , respectively, in the compacted treatment at all depths. Compaction significantly modified anisotropy of k_a and D_s/D_0 . Consequently, compaction modified the flow pattern: we observed that solute transport was confined in the upper subsoil, leading to an accumulation of 'perched' water in the topsoil. Our results suggest that subsoil compaction is persistent for at least more than a decade, with negative consequences for important soil pore functions.



S03.01a -6

**EVOLUTION OF STRUCTURAL PROPERTIES OF AN ARABLE SOIL AFTER COMPACTION
AND DIFFERENT REGENERATION PATHWAYS**

Weisskopf Peter^[1], Keller Thomas^[1], Oberholzer Hans-Rudolf^[1], Rek Jan^[1]

^[1]Agroscope Reckenholz-Tänikon Research Station ART ~ Soil fertility and soil protection ~ Zürich ~ Switzerland

Knowledge on the evolution of soil structure is essential for assessing and improving the sustainability of soil management techniques in relation to soil quality. The evolution of soil structure results in changes of physical, biochemical and biological soil functions caused by modifications of pore space and soil strength. From an agricultural point of view the potential for structure formation and regeneration made possible by adequate agricultural management techniques is important for the improvement of soil quality and the alleviation of damages caused by mechanical impacts of agricultural machines. To obtain quantitative information on structural evolution in field situations, a model experiment was performed at field scale over five years on an arable soil (loamy cambisol). Agricultural management techniques directly (tillage intensity, compaction frequency) and indirectly (rooting: crop sequence, soil moisture status: irrigation) affecting soil structure formation were applied as experimental factors by using typical farm equipment. The rate of regeneration after soil structure deformation was followed in different treatments by measuring parameters characterizing porosity, permeability and strength of soil structure as well as the composition of soil air, either directly in field soil profiles or in soil samples. The results of this experiment show the importance of weather conditions (or climate, respectively) for the extent and the effects of soil deformations, highlight the relevance of interactions between compacted topsoil and non-affected subsoil layers for soil functions, and demonstrate the significance of factors for the regeneration of soil structure, which can only indirectly be influenced by agricultural management practices.



S03.01b - SOIL DEGRADATION

Chair Persons:

Julia Krümmelbein, Brandenburg - Germany

Annika Badorreck, Münchenberg - Germany

Monday 02 July 2012 from 15:30 to 17:00. Room Acero

S03.01b -1

SOIL RHEOLOGICAL PROPERTIES CHANGES UNDER ANTHROPOGENOUS LOADING

Dolgor Khaydapova, Moscow - Russian Federation - Invited

S03.01b -2

SOIL SUSCEPTIBILITY TO DEFORMATION: ASSESSMENT FROM WATER RETENTION CURVE CHARACTERISTICS AT LOW SUCTION

Levy Guy, Bet Dagan - Israel

S03.01b -3

CREEP MOVEMENT ON SLOPES - HOW STRUCTURE, HYDRAULICS AND MECHANICS INFLUENCE DEFORMATION PATTERNS

Hamoudy Ould Baba, Kiel - Germany

S03.01b -4

STRUCTURAL STABILITY OF MARSHLAND SOILS OF THE RIPARIAN ZONE OF THE ELBE ESTUARY AND RIVER

Wibke Markgraf, Kiel - Germany

S03.01b -5

SOIL VULNERABILITY ASSESSMENT IN MOUNTAIN AREAS: THE VAL D'AOSTA EXAMPLE

Michele D'amico, Torino - Italy



S03.01b -1

SOIL RHEOLOGICAL PROPERTIES CHANGES UNDER ANTHROPOGENOUS LOADING

Khaydapova Dolgor^[1], Milanovskiy Eugeny^[1], Shein Evgeny^[1], Pochatkova Tatyana^[1]

^[1]Moscow State University ~ Soil Science Faculty ~ Moscow ~ Russian Federation

The use of heavy agricultural machinery, climate changes and other factors cause mechanical deformation of the soil humus horizons which often aren't found out by traditional methods of soil physics. Rheological approaches allow to estimate inter-partial interactions, micromechanical behavior and, hence, to receive the information I of soil structure deformations and its consequences. The humus horizons of typical chernozem (Kursk region) of the arable field, an adjoining forest belt, chernozems under fallow during 40 years and under natural oak forest have been investigated. Rotational viscosimeter with the cylindrical measuring device was used to study rheological behavior of soil samples. The preliminary capillary humidified samples were used. Complete rheological curves (direct and return branches) have been received. Dependences of viscosity of soil on speed of shear in half-logarithmic scale have been constructed. The received dependences looked like power-low behavior. The investigated samples on viscosity value have arranged in a following decreasing order: oak forest – a virgin soil – a forest belt - fallow – an agricultural arable land. The strongest inter-partial interactions have remained in soil under oak wood and on a virgin soil. The carbon content in the investigated number of soils decreases in the same order, as well as viscosity. Possibly, the content and quality of organic matter of chernozem soils is the main factor of soil structure stability, but constant plowing and agricultural use have led to the accelerated mineralization of organic substances and accordingly to degradation of soil structure.



S03.01b -2

SOIL SUSCEPTIBILITY TO DEFORMATION: ASSESSMENT FROM WATER RETENTION CURVE CHARACTERISTICS AT LOW SUCTION

Guy Levy^[1], Mamedov Amrakh^[2]

^[1]Agricultural research Organization ~ Institute of Soil, Water and Environmental Sciences ~ Bet Dagan ~ Israel ^[2]USDA-ARS ~ Engineering and Wind Erosion Research Unit ~ Manhattan, Kansas ~ United States

Soil resistance to deformation (i.e., soil structure stability), describes the ability of the soil to retain its arrangement of solid and pore space (i.e., aggregates and pores) when exposed to external forces (e.g., tillage, cropping, compaction and irrigation). Aggregate stability tests are commonly used to quantitatively express soil susceptibility to deformation. We studied aggregate stability with the High-Energy-Moisture-Characteristics (HEMC) method, where energy of hydration and entrapped air are the main forces responsible for breaking down of aggregates, and aggregate/structure stability is then inferred from changes in the water retention curves (i.e., changes in pore size distributions) at low suction (0-50 mm). The water retention curves were characterized by the modified van Genuchten (1980) model that yielded, in addition to the model parameters (e.g., α and n that represent the location and the steepness of the S-shaped water retention curve, respectively), two soil structure indices, (i) the volume of drainable pores (VDP) and (ii) the modal suction (MS) which corresponds to the most frequent pore size. These parameters and indices were then used to test the impact of agricultural management practices on soil susceptibility to deformation. Results from four case studies on the impact of (i) tillage history, (ii) crop rotation, (iii) irrigation water quality, and (iv) polymer application clearly indicate that the parameters and indices obtained from the HEMC method can identify and characterize, in quantitative terms, the changes in the degree of soil deformation that may result from employing different types of management practices.



S03.01b -3

**CREEP MOVEMENT ON SLOPES - HOW STRUCTURE, HYDRAULICS AND MECHANICS
INFLUENCE DEFORMATION PATTERNS**

Ould Baba Hamoudy^{*[1]}, Peth Stephan^[1]

^[1]Institute for Plant Nutrition and Soil Science ~ Soil Science ~ Kiel ~ Germany

Soil deformation by shear forces is one of the key factors affecting the development of ecosystems by changing soil structure and pore systems. Natural shear forces due to gravity along slopes are controlled by the inclination of the terrain, material composition and mechanical properties, stratification and hydraulic situation. The objective of this study was to investigate creep movement in an artificial water catchment (Chicken Creek) and to examine its stability in relation to a rising water level. We are also interested in understanding the effect of creep movement on soil development in re-cultivated post-mining landscapes such as the lignite mining district of the Lausitz (Brandenburg, Germany). In order to more systematically understand the interaction between the above mentioned factors a laboratory experiment (soil box) with the dimensions $l \times w \times h = 3 \times 1 \times 1.2$ m was built to simulate the influence of different combinations of hydraulic and mechanical stresses on creep movements. High resolution digital imaging and Particle Image Velocimetry (PIV) were used to measure the small scale deformation patterns. First results showed a vertical consolidation at the beginning of the experiment followed by shear movement parallel to the main slope after the soil was saturated from the bottom. Deformation patterns were very heterogeneous and clearly influenced by the initial soil structure/stratification. Time series analysis provided details on deformation velocities, which decreased over time.



S03.01b -4

STRUCTURAL STABILITY OF MARSHLAND SOILS OF THE RIPARIAN ZONE OF THE ELBE ESTUARY AND RIVER

Markgraf Wibke^[1], Peth Stephan^[1], Neugebauer Thomas^[1], Von Rymon-Lipinski Franziska^[1], Fuchs Elmar^[2], Horn Rainer^[1]

^[1]Christian-Albrechts-University zu Kiel ~ Soil Science ~ Kiel ~ Germany ^[2]Bundesamt für Gewässerkunde ~ BfG ~ Koblenz ~ Germany

Proceeding deepening and regulation of the waterway are leading to an alteration of the riparian zone of the Elbe estuary and inland. Accumulation and erosion areas are shifted. Due to a naturally given salinity gradient, 3.5‰ in the North Sea to ca. 1.5‰ in the Elbe estuary and <1‰ in the Elbe river, respectively, soil (micro)mechanical stability and is mainly influenced by texture, water content and matric potential, ionic strength (Na⁺, Ca²⁺, Mg²⁺, Cl⁻, CO₃²⁻, SO₄²⁻), resulting osmotic pressure, and organic matter. (1) Zeta potentials (ζ , mV) were derived from particle charge density (PCD) measurements; due to this, particle strength (attractive vs. repulsive forces) on the colloidal scale was determined. (2) Rheometry was applied to achieve micromechanical parameters (particle-to-particle-scale), i.e. storage and loss moduli G' and G'' (Pa), loss factor $\tan \delta$ (G''/G') integral z (dimensionless parameter of quasi-elasticity) and information about the shear behaviour. (3) Dynamic loading tests were performed leading to data of pre-compression stress and mechanical strength on the meso scale (200cm³ structured soil cores). By applying compressibility factor (C_n), data of rheometry (micro scale) and soil meso scale mechanics were linked. Collected data deriving from this approach may deliver important information to classify and estimate the mechanical stability of the littoral zone of the Elbe estuary and river on several scales.



S03.01b -5

SOIL VULNERABILITY ASSESSMENT IN MOUNTAIN AREAS: THE VAL D'AOSTA EXAMPLE

D'amico Michele^{*[1]}, Stanchi Silvia^[1], Ratto Sara^[2], Navillod Evelyne^[2], Filippa Gianluca^[1], Freppaz Michele^[1], Zanini Ermanno^[1]

^[1]Università di Torino ~ DIVAPRA ~ Torino ~ Italy ^[2]Regione Autonoma Valle d'Aosta ~ Centro Funzionale Regionale ~ Aosta ~ Italy

Mountain ecosystems are highly vulnerable to flash flood phenomena, which can result in sudden soil water saturation and surface erosion. Saturated soils are vulnerable to solifluction and liquefaction, depending on soil plastic properties. Surface erosion and mass movements create serious hazards for the population and the infrastructures: the recognition and mapping of areas characterized by different vulnerability to erosion processes are of primary importance in order to properly manage the land use and the hydro-geological hazards. The study area is the whole Val d'Aosta region, characterized by a wide range of geological substrates, vegetation types, altitude variations and pedoclimates (from perudic in south-east and at high altitude to xeric-ustic in the intra-alpine central valley). All genetic horizons from 150 soil profiles have been described and analyzed (standard chemical analysis and Atterberg limits), in order to understand how pedogenic processes influence soil plastic properties; the results were also statistically correlated with parent material, plant cover, and pedoclimate. Liquid (LL) and plastic (PL) limits are positively correlated with humified organic matter and with pedogenic iron oxides, thus a decreasing depth trend is visible for most kinds of soils (high stability in A and Bs and low in C horizons). Both properties depend on soil pedogenic development degree, which in turn is related with pedo-climate and anthropic disturbances. The parent material is another important factor influencing soil stability: at similar development degree, carbonate and mica-rich soils show much lower liquid (LL) and plastic (PL) limits and much larger depth trends than other soils.



S03.01c - SOIL DEGRADATION

Chair Persons:

Rainer Horn, Kiel - Germany

Marcello Pagliai, Firenze - Italy

Tuesday 03 July 2012 from 08:30 to 10:00. Room Acero

S03.01c -1

ASSESSING SOIL COMPACTION RISK USING A BAYESIAN BELIEF NETWORK

Mads Trolborg, Aberdeen - United Kingdom - Invited

S03.01c -2

MODEL-BASED ASSESSMENT OF EROSION RISKS ON MAN-MADE SLOPES IN RECULTIVATION AREAS

Franziska Kunth, Freiberg - Germany

S03.01c -3

SLUMPING OF SANDY SOILS UNDER SIMULATED RAINFALL: HOW DOES WATER AFFECT THIS SELF-COMPACTED SOIL DEGRADATION

Hongtao Hao, Rennes - France

S03.01c -4

INVESTIGATING THE OCCURRENCE AND CONSEQUENCES OF SOIL WATER REPELLENCY IN NEW ZEALAND

Karin Müller, Hamilton - New Zealand

S03.01c -5

ASSESSMENT OF TOPSOIL STRUCTURE DEGRADATION IN A COMPOST-AMENDED SILTY CLAY LOAM SOIL UNDER SIMULATED RAINFALL

Sergio Pellegrini, Firenze - Italy

S03.01c -6

EVALUATION OF SOIL EROSION TRENDS TO ASSESS THE SUSTAINABILITY ASSOCIATED TO CROP MANAGEMENT PRACTICES IN SPAIN

Rosario Garcia Moreno, Madrid - Spain



S03.01c -1

ASSESSING SOIL COMPACTION RISK USING A BAYESIAN BELIEF NETWORK

Troldborg Mads^[2], Hough Rupert^[2], Towers Willie^[3], Aalders Inge^[2], Lilly Allan^[3], Hallett Paul^[4], Bengough Glyn^[4], Mckenzie Blair^[4], Balls Bruce^[5]

^[1]The James Hutton Institute ~ Soils ~ Aberdeen ~ United Kingdom ^[2]The James Hutton Institute ~ ICS ~ Aberdeen ~ United Kingdom ^[3]The James Hutton Institute ~ Environment ~ Aberdeen ~ United Kingdom ^[4]The James Hutton Institute ~ Environment ~ Dundee ~ United Kingdom ^[5]Scottish Agricultural College ~ Crop & Soil ~ Edinburgh ~ United Kingdom

Soil compaction is considered a serious threat, especially in highly managed agricultural systems. The adverse effects associated with soil compaction are many and include decreases in crop yield and increasing management costs. There is growing evidence that compaction, particularly of subsoils where amelioration is difficult, has been exacerbated by trends towards using larger and heavier machinery. Methodologies for assessing soil compaction risk are needed to reduce this threat and protect soil quality for future generations. An assessment of the risks, however, is hampered by the complex nature of soil compaction, which results from the sometimes poorly understood interaction of various soil physical properties, climatic factors and land management practices. We present here a Bayesian Belief Network (BBN) for assessing soil compaction risk. BBNs are graphical probabilistic models that are effective for integrating quantitative and qualitative information, and thus can strengthen decisions when empirical data are lacking. The developed BBN combines analytical and morphological data from standard soil surveys with qualitative expert knowledge to estimate the soil compaction risk. The BBN structure follows a standard risk assessment approach, where the risk is quantified by combining assessments of vulnerability and exposure. The soil's vulnerability to compaction is determined from inherent soil and site characteristics and from climatic factors influencing the soil water content, while the exposure is estimated from an evaluation of the stresses inflicted by land management. The BBN is applied to quantify and map the risk of compaction for Scotland using data from the National Soils Inventory of Scotland.



S03.01c -2

MODEL-BASED ASSESSMENT OF EROSION RISKS ON MAN-MADE SLOPES IN RECULTIVATION AREAS

Kunth Franziska^{*[1]}, Schmidt Jürgen^[1]

^[1]TU Bergakademie Freiberg ~ Soil and water conservation unit ~ Freiberg ~ Germany

Regressive open-cast mining and increasing reclamation of closed-down mining areas pose the challenge of a long-term and safe structuring of reclamation areas. Soil erosion by water leads to heavy losses, especially on fragile non-vegetated soils of these areas. Beyond that, erosion-induced discharge of detached dump particles in close-by abandoned open pits leads to acidification of surface waters. Sulfuric acid-formation due to weathering of pyrite-containing lignite burden dumps causes acidification of groundwater, seepage water and surface waters. The weathering products are stored in sediment pores. Detached by precipitation and transported by surface runoff, they are transported into worked-out open cuts. In addition to ground water influence, erosion processes are therefore involved in acidification of surface waters. To date, geotechnical foundations are used for reclamation of former opencast mining areas; for near-surface slope protection an exclusively experience-based guideline exists. Hitherto, a science-based approach to conceptions of near-surface slope protection does not exist. The aim of this study is the development of a reproducible methodology to determine erosion risks on slopes in reclamation areas. Moreover, a standardised technique is developed to plan, dimension and test erosion protection measures. The analyses of the study are based on the event-based physical erosion model EROSION 3D. The widely used model is able to predict runoff as well as detachment, transport and deposition of sediments. Its use and validation ranges from erosion prediction from agricultural land to sediment input into water bodies. In this study special characteristics of coal-containing dump soils (e.g. hydrophobicity) have to be considered.



S03.01c -3

SLUMPING OF SANDY SOILS UNDER SIMULATED RAINFALL: HOW DOES WATER AFFECT THIS SELF-COMPACTED SOIL DEGRADATION

Hao Hongtao^[1], Hartmann Christian^[2], Richard Guy^[3], Bruand Ary^[5]

^[1]INRA / Agrocampus Ouest ~ UMR SAS ~ Rennes ~ France ^[2]Institut de Recherche pour le Développement (IRD) ~ UMR 211 - Bioemco ~ Paris ~ France ^[3]Institut National de la Recherche Agronomique (INRA) ~ UR Science du Sol ~ Orléans ~ France ^[4]Université d'Orléans, CNRS/INSU, Université François Rabelais de Tours ~ Institut des Sciences de la Terre d'Orléans (ISTO) ~ Orléans ~ France ^[5]Université d'Orléans, CNRS/INSU ~ Institut des Sciences de la Terre d'Orléans (ISTO) ~ Orléans ~ France

The sandy soils can serve as a potential reserve for cultivation. However, they are prone to structural degradation which will limit their already low production potential. One special degradation is slumping, i.e. increase of bulk density (compaction) caused by rainfall or irrigation. A few field experiments have described slumping behavior, but the processes and factors are less clear. Our objective is to identify the processes and factors that affect slumping under simulated conditions. In laboratory, cultivated soil model were built in cylinders (20 cm in height and diameter). Two materials were used: 1) the original soil from one previous field experiment site, and 2) the sand fraction extracted from this soil. These model soils were submitted to simulated rainfalls with different intensities (20 to 120 mm h⁻¹), combined with different suctions (20 to 90 hPa) at the bottom of the cylinder. The slumping for original soil happens when 1) the water potential reached a threshold value near 0 hPa (before full saturation). Here the soil cohesion decreased and a fragile equilibrium conditions were reached according to granular material theory; 2) the potential value was kept long enough and the cohesion continue decrease until equilibrium failed. Surprisingly, no slumping was observed for extracted sand whatever the rainfall intensities and suctions. This demonstrates the particles of clay and silt could highly affect soil stability, even their content was less than 10 percent. To identify techniques that can prevent slumping is still an open question.



S03.01c -4

INVESTIGATING THE OCCURRENCE AND CONSEQUENCES OF SOIL WATER REPELLENCY IN NEW ZEALAND

Müller Karin^{*[1]}, Paramsothy Jeyakumar^[2], Van Den Dijssel Carlo^[2], Mason Karen^[2], Deurer Markus^[2], Clothier Brent^[2], Slay Mike^[3], Carter John^[2]

^[1]Plant & Food Research ~ Systems Modelling ~ Hamilton ~ New Zealand ^[2]Plant & Food Research ~ Systems Modelling ~ Palmerston North ~ New Zealand ^[3]AgTechnology and Advisory Service ~ Homlea ~ Hastings ~ New Zealand

There is increasing global concern about soil water repellency (SWR) as a soil degradation process. SWR is a transient property expressed in patchy wetting up behaviour of soils once they dry out below a site- and soil-specific critical water content. It might pose a threat to soil ecosystem services in particular to the regulating services in relation to water and carbon, and food provisioning. The understanding of the economic, ecological and environmental consequences of SWR is very limited. Moreover, we are unable to predict when SWR will occur, or disappear. To improve the knowledge on the extent of SWR in New Zealand, we conducted a survey on its occurrence under pastoral land use. Our survey in the North Island revealed that the phenomenon of SWR is prevalent throughout all regions independent of climate but it is influenced by soil order. Further field and laboratory experiments were conducted to assess how SWR impacts on the soil's buffering for water and the related filtering function of soils, and to assess if SWR compromises productivity. Results show that SWR reduced infiltration rates by up to a factor of 20, induced runoff, and increased the risk of contaminant loss. Pasture growth was reduced between 5 and 20%. Our research demonstrated that all the investigated ecosystem services of soils were affected by SWR. Research is needed to better understand the causes of SWR so that efficient and affordable mitigation strategies can be developed.



S03.01c -5

ASSESSMENT OF TOPSOIL STRUCTURE DEGRADATION IN A COMPOST-AMENDED SILTY CLAY LOAM SOIL UNDER SIMULATED RAINFALL

Pellegrini Sergio^[1], Andrenelli Maria Costanza^[1], Simoncini Stefania^[1], Vignozzi Nadia^[1]

^[1]CRA ~ CRA-ABP Research Centre for Agrobiological and Pedology ~ Firenze ~ Italy

A mesocosm experiment was set up to assess the effect of different rates of organic amendment addition on topsoil structural properties of a silty clay loam soil prone to crusting. Compost obtained from the organic fraction of municipal solid waste was added for two consecutive years to an Udifluventic ustochrept soil from Emilia-Romagna region (Northern Italy) at rates of 0 (C0), 10 (C10) and 40 (C40) Mg ha⁻¹ y⁻¹. Afterwards, the three soils were subjected to rainfall simulations (47.5 mm in 90 min) to evaluate the effect on soil crusting by quantifying runoff volume, soil loss, soil random roughness (RR), and macroporosity of the surface layer. Soil total organic carbon (TOC) content and loss of dissolved organic matter (DOM) through runoff were also assessed. C10 induced a 34.6% reduction in runoff volume respect to control (C0), while no runoff was observed in C40. A similar decrease (32.9%) was also detected as regards to soil loss. RR values increased from 0.221 to 0.242 and 0.495 cm in C0, C10 and C40, respectively, as a consequence of the lower amount of splashed soil. Moreover, compost addition caused a significant increase of TOC and a 40% decrease of DOM. Overall, even the lower compost addition rate (C10) significantly improved the soil surface response to the applied rainfall energy. These results, and the evidence of an increasing occurrence of heavy rainfall events associated with climate change, stress the importance of contrasting the depletion of organic matter pool in agricultural soils.



S03.01c -6

EVALUATION OF SOIL EROSION TRENDS TO ASSESS THE SUSTAINABILITY ASSOCIATED TO CROP MANAGEMENT PRACTICES IN SPAIN

Garcia Moreno Rosario^[1], Saa Requejo Antonio^[1], Diaz Alvarez Maria Cruz^[1]

^[1]CEIGRAM - UNIVERSIDAD POLITECNICA DE MADRID ~ EDAFOLOGIA ~ Madrid ~ Spain

Erosion is highly associated to agricultural activities. The increase in crop productivity during the last decades has developed new conservation techniques in order to assure the sustainability of soil. These practices are of great importance mainly in semiarid countries, as Spain, where erosion is one of the biggest environmental issue, especially that produced by water. In order to study the consequences of the increasing productivity in the erosion of soils, the present study evaluated the soil losses related to productivity of most important crops grown in Spain during the last twenty years. The selected indicators estimated the losses in soils as a function of fruit productivity, tons per year per kg, and economical income of produced item. The selected crops were the most significant for all the regions of the Spanish territory. The results showed an improving trend in conservation practices. The studied showed that conservational practices have decreased the losses of soils in an average of 300 t/ha-yr and have increased the production of the studied crops from 1987 to 2007 for the 52 provinces in Spain.



S03.02a - SOIL EROSION AND DEGRADATION ON AGRICULTURE LAND

Chair Persons:

Artemi Cerdà, Valencia - Spain

Luca Salvati, Roma - Italy

Tuesday 03 July 2012 from 10:30 to 12:00. Room Leccio

S03.02a -1

DUST EMISSIONS FROM ARABLE LAND: RELEASING PROCESSES, SOIL DEGRADING EFFECTS AND CONTROLLING FACTORS

Roger Funk, Müncheberg - Germany

S03.02a -2

"FALLOW BAND SYSTEM" FOR WIND EROSION CONTROL AND IMPROVEMENT OF SOIL FERTILITY IN THE SAHEL, WEST AFRICA

Kenta Ikazaki, Tokyo - Japan

S03.02a -3

SOIL EROSION RATES BY WIND-DRIVEN RAIN ON SOILS WITH DIFFERENT SOIL CONDITIONS AND SLOPE ANGLE

Wolfgang Fister, Basel - Switzerland

S03.02a -4

TEMPORAL EVOLUTION OF SOIL ERODIBILITY: ASSESSMENT OF EXPLANATORY FACTORS, AND CONSEQUENCES ON EROSION MODELLING. AN EXAMPLE FROM THE BEAUCE AREA, FRANCE

Baptiste Algayer, Orléans - France

S03.02a -5

RUNOFF AND SOIL EROSION SOURCES AND PROCESSES IN A SMALL MOUNTAIN AGROFORESTRY CATCHMENT, CENTRAL PORTUGAL

João Pedro Nunes, Aveiro - Portugal

S03.02a -6

EFFECT OF SOIL MANAGEMENT ON SOIL EROSION AND PHOSPHORUS LOSSES

Attila Nemes, College Park - United States



S03.02a -1

DUST EMISSIONS FROM ARABLE LAND: RELEASING PROCESSES, SOIL DEGRADING EFFECTS AND CONTROLLING FACTORS

Funk Roger*^[1]

^[1]Leibniz-Centre for Agricultural Landscape Research ~ Institute of Soil Landscape Research ~ Müncheberg ~ Germany

Dust emissions from agriculturally used areas cause gradual soil degradation and contribute to air pollution. Soil dust is released by wind erosion, tillage operations or traffic on the fields and its emission is affected by soil properties as texture, organic matter or soil moisture. The aims of our investigations were to quantify the carbon losses by wind erosion, to calculate the emitted dust during tillage operations and to compare the dust composition in relation to the releasing process. The diverse influencing factors were investigated in field and wind tunnel experiments. Effects of soil moisture, temperature and humidity on total dust emissions were investigated after drying the soil in the laboratory and at the field in the diurnal course. The results show the preferred removal of organic matter by wind erosion. Dust trapped in 6 m height showed an enrichment ratio of about 7 for organic matter. A heavy wind erosion event can remove about 500 kg humus per ha. The particle size composition of emitted dust is significantly influenced by the releasing process. Increasing mechanical impact causes more PM_{1.0} emissions, with traffic > wind erosion > tillage. Soil moisture affects the dust emission of sandy soils much more than of fine textured soils. There is a distinct diurnal course of the dust emission, caused by temperature (soil and air) and humidity with a maximum at the early afternoon.



S03.02a -2

"FALLOW BAND SYSTEM" FOR WIND EROSION CONTROL AND IMPROVEMENT OF SOIL FERTILITY IN THE SAHEL, WEST AFRICA

Ikazaki Kenta^{*[1]}, Shinjo Hitoshi^[2], Tanaka Ueru^[5], Tobita Satoshi^[4], Funakawa Shinya^[2], Kosaki Takashi^[1]

^[1]Tokyo Metropolitan University ~ Graduate School of Urban Environmental Sciences ~ Tokyo ~ Japan ^[2]Kyoto University ~ Graduate School of Agriculture ~ Kyoto ~ Japan ^[3]Research Institute for Humanity and Nature ~ Pre-Research ~ Kyoto ~ Japan ^[4]Japan International Research Center for Agricultural Sciences ~ Crop, Livestock and Environment Division ~ Tsukuba ~ Japan ^[5]Research Institute for Humanity and Nature ~ Ecosophy division ~ Kyoto ~ Japan

Wind erosion is a major contributor to desertification in the Sahel. So far three effective countermeasures for wind erosion (i.e. ridging, mulching with post-harvest crop residue, and windbreaks) have been proposed. However, they are not practical for Sahelian farmers who are economically challenged and have limited manpower. We therefore designed a new land management practice, "Fallow Band System," which can be used for both controlling wind erosion and improving soil fertility and crop production. This method does not impose additional expense and labor requirements on Sahelian farmers and thus, will be practical for them. The objective of this study was to evaluate the effects of the "Fallow Band System" on wind-erosion control and soil-fertility improvement. We conducted field experiments at the International Crops Research Institute for the Semi-Arid Tropics West and Central Africa and showed that (i) a fallow band can capture 74% of wind-blown soil particles and 58% of wind-blown coarse organic matter, which suggests that it can effectively control wind erosion, (ii) the amount of soil nutrients available for crops in a former fallow band was increased by the decomposition of trapped soil materials, and (iii) the amount of soil water available for crops in a former fallow band was increased by the trapped wind-blown soil materials through improvement of rainwater infiltration into surface soil. From these results, we concluded that the "Fallow Band System" can be useful for preventing desertification and improving soil fertility in the Sahel, West Africa.



S03.02a -3

SOIL EROSION RATES BY WIND-DRIVEN RAIN ON SOILS WITH DIFFERENT SOIL CONDITIONS AND SLOPE ANGLE

Fister Wolfgang^[1], Thomas Iserloh^[2], Miriam Marzen^[2], Manuel Seeger^[3], Nikolaus J. Kuhn^[1], Goswin Heckrath^[4], Reinhard-G. Schmidt^[2], Johannes B. Ries^[2]

^[1]Physical Geography and Environmental Change ~ University of Basel ~ Basel ~ Switzerland ^[2]Physische Geographie ~ Trier University ~ Trier ~ Germany ^[3]Land Degradation and Development ~ Wageningen University ~ Wageningen ~ Netherlands ^[4]Department of Agroecology ~ Aarhus University ~ Aarhus ~ Denmark

Soil erosion by wind and water is able to cause severe soil loss from agricultural fields depending on the erosivity of wind and rainfall as well as the soil's erodibility and the applied land management. Unfortunately, in most experimental field studies the combined effect of both erosional processes is not taken into account. The objectives of this study were therefore, to apply a newly developed portable wind and rainfall simulator (PWRS) on different agricultural soils and to explicitly investigate the importance of wind-driven rain for soil erosion. The PWRS was used on three test sites in Spain, The Netherlands, and Denmark. The test sites differed from crusted silty loam to fine loose sand and leeward slopes from $<2^\circ$ up to 10° . All soils were bare and consolidated. Simulated wind velocity and rainfall intensity was constant through all measurements to enable observation of direct influence of soil characteristics and slope angle. The results show a wide range of soil detachment ranging from zero up to 150 g m^{-2} in 30 minutes. On crusted silty loam soils with moderate slope angle highest erosion rates were measured for rainfall simulations on dry soil conditions. On flat surfaces with loose sandy texture highest erosion rates were reached under wind-driven conditions, exceeding rates under windless conditions up to 10 times. In conclusion, the expected increase of soil erosion on agricultural fields seems very likely is not as clear as expected and seems to be very dependent on soil conditions and slope angle of the surfaces investigated.



S03.02a -4

TEMPORAL EVOLUTION OF SOIL ERODIBILITY: ASSESSMENT OF EXPLANATORY FACTORS, AND CONSEQUENCES ON EROSION MODELLING. AN EXAMPLE FROM THE BEAUCE AREA, FRANCE

Algayer Baptiste*^[1], Darboux Frédéric^[1]

^[1]Institut National de Recherche Agronomique (INRA), UR 0272 Science du sol ~ UR 0272 Science du sol ~ Orléans ~ France

Soil erodibility is a key parameter in soil erosion models. Usually, water erosion models take erodibility as a constant for a given soil. However, many studies showed that erodibility changes during the year in relationship with climate. If the seasonal trends are recognized, the underlying factors and processes remain unclear. To assess the climatic parameters and soil properties causing these variations, a six-month long field monitoring was conducted in the Beauce area (south of the Paris Basin, France). Samples from two soils (a silty clay loam and a silt loam) and from two topographic positions were collected at two time scales: monthly, and a few days apart during the week following significant rain events. Aggregate stability was used as a proxy of soil erodibility. Other measurements were humidity and temperature of soil and air, organic matter content, soil texture, water content, microbial biomass, hydrophobicity, and soil crusting. Aggregate stability showed large variability at both time scales. After significant rain events, aggregate stability showed different trends depending on soil type, rain amount and topographic positions. These differences in aggregate stability imply different erodibilities. The results clearly contradict the common practice of assigning a temporally and spatially-constant erodibility to a given soil. Soil texture, organic matter and microbial biomass could not precisely explain erodibility changes. However, the post-rain desiccation was significantly related to the erodibility increase at the short time step. This result emphasizes the influence of the wetting-drying cycles in soil erodibility variation.



S03.02a -5

RUNOFF AND SOIL EROSION SOURCES AND PROCESSES IN A SMALL MOUNTAIN AGROFORESTRY CATCHMENT, CENTRAL PORTUGAL

Bernard-Jannin Léonard^[1], Rodríguez-Blanco María Luz^[2], Santos Juliana Marisa^[1], Rial-Rivas María Ermitas^[1], Batista Daniela Pereira^[1], Keizer Jan Jacob^[1], Coelho Celeste De Oliveira Alves^[1], Nunes João Pedro^{*[1]}

^[1]University of Aveiro ~ CESAM & Dept. Environment and Planning ~ Aveiro ~ Portugal ^[2]Universidad de A Coruña ~ Facultad de Ciencias ~ A Coruña ~ Spain

Soil erosion is a critical driver for desertification in Mediterranean regions, and this problem could be accelerated due to changes in rainfall intensity and vegetation cover caused by climate change. The study of these impacts can be done through the use of eco-hydrological and erosion models, but there is presently a lack of data on erosion rates and processes which limits the applicability of models to these regions. Project ERLAND seeks to address these issues through the intensive monitoring of representative Portuguese agroforestry watersheds. The Macieira de Alcoba watershed (north-central Portugal; 95 ha) is part of this monitoring network. It is located in the Caramulo mountain range, has a wet Mediterranean climate, and is covered mostly by commercial forests (c. 60%) and agricultural fields (c. 40%). Within this catchment, runoff and sediment discharge data are recorded in a representative field and at the catchment scale since the last trimester of 2010. The presentation will focus on the results for the hydrological years 2010/11 and 2011/12 at the field and catchment scales. In particular, an effort has been made to identify runoff and erosion sources and processes in this catchment using (i) runoff and erosion event analysis at plot and catchment scales; (ii) hydrograph separation using electrical conductivity, and (iii) hydrological and sediment connectivity mapping based on topography and land-use. Current results underline the high complexity of runoff and soil erosion processes, mainly due to the complex landcover pattern and the presence of irrigation channel network and terraces within the catchment.



S03.02a -6

EFFECT OF SOIL MANAGEMENT ON SOIL EROSION AND PHOSPHORUS LOSSES

Bechmann Marianne^[1], Kværnø Sigrun^[1], Nemes Attila^{*[2]}

^[1]Bioforsk ~ Soil and Environment ~ Aas ~ Norway ^[2]University of Maryland ~ Plant Science and Landscape Architecture ~ College Park ~ United States

In cereal cropping systems, soil management is a major factor contributing to increased risk of soil erosion, transport of soil particles and losses of particulate phosphorus by water. We present results based on several studies on the effect of soil management on soil and phosphorus losses. Examined soil tillage methods include direct drilling (no-till), shallow cultivation and ploughing. Preliminary results show that, in general, deeper and more intense soil management results in greater soil erosion at the plot scale. The effect of soil tillage on losses of total phosphorus generally follows the pattern of soil losses by erosion, but the relationship between soil tillage and losses of phosphorus are much more complex. Besides using descriptive statistical measures, we used a data mining tool - classification and regression tree analysis (CART) - to explore what geological, climatic and management factors were most influential in determining the success of tillage experiments in terms of reducing soil erosion and associated particulate phosphorus losses.



S03.02b - SOIL EROSION AND DEGRADATION ON AGRICULTURE LAND

Chair Persons:

Vincenzo Bagarello, Palermo - Italy

João Pedro Nunes, Aveiro - Portugal

Tuesday 03 July 2012 from 13:30 to 15:00. Room Leccio

S03.02b -1

EXTREME WATER EROSION EVENTS IN LOW RELIEF LANDSCAPES – THE ROLE OF STRUCTURES CAUSED BY HISTORICAL LAND USE

Detlef Deumlich, Muencheberg - Germany

S03.02b -2

QUANTIFYING AND MODELLING THE IMPACT OF LAND CONSOLIDATION AND ASSOCIATED FIELD BORDERS ON SOIL REDISTRIBUTION IN AGRICULTURAL LANDSCAPES (1954 – 2009)

Caroline Chartin, Tours - France

S03.02b -3

EVALUATION OF SEDIMENT TRAPPING EFFICIENCIES OF VEGETATIVE EROSION CONTROL STRUCTURES

Koen Verbist, Ghent - Belgium

S03.02b -4

MODELLING THE INFLUENCE OF BIOLOGICAL CRUST ON SOIL EROSION AT THE PLOT SCALE

Olivier Cerdan, Orléans - France

S03.02b -5

RELATIONSHIPS AMONG RUNOFF, LOSSES OF SOIL AND NUTRIENT WITH RAINFALL CHARACTERISTICS AND SOIL MANAGEMENT PRACTICES IN A HILLY VINEYARD (PIEDMONT, NW ITALY)

Francesca Opsi, Turin - Italy

S03.02b -6

A COMPARISON OF SPLASH EROSION BEHAVIOURS BETWEEN WETTABLE AND WATER REPELLENT SOILS

Sujung Ahn, Swansea - United Kingdom



S03.02b -1

EXTREME WATER EROSION EVENTS IN LOW RELIEF LANDSCAPES – THE ROLE OF STRUCTURES CAUSED BY HISTORICAL LAND USE

Deumlich Detlef^[1], Michael Sommer^[1], Sylvia Koszinski^[1], Wilfried Hierold^[1]

^[1]Leibniz-Center for Agricultural Landscape Research (ZALF ~ Institute for Soil Landscape Research ~ Muencheberg ~ Germany

In 2007 high frequency storm events set a new record in Brandenburg, E-Germany. Disastrous erosion damages occurred with unknown extent so far, especially in regions with low relief energy. We analysed the causes of these phenomena by dynamic EROSION-3D model coupled with very high resolution digital elevation model (DEM 1) and identified a combined effect of frequent strong rain events, high soil water contents, low soil resistance (weak silty sand), and insufficient soil coverage by the growing crop (corn). Beside these classical drivers we clearly detected structure-related process intensities by using DEM 1: erosion hot spots were observed at sites, where historical agricultural land use left behind a barely visible waved surface structure (“Wölbäcker”) in direction of slope. Only by the combined use of DEM1 with EROSION-3D a very good agreement between observed and modelled kinds of water erosion (gully, rill and sheet erosion) could be achieved. Any other approach failed to simulate observed severe erosion damages.



S03.02b -2

QUANTIFYING AND MODELLING THE IMPACT OF LAND CONSOLIDATION AND ASSOCIATED FIELD BORDERS ON SOIL REDISTRIBUTION IN AGRICULTURAL LANDSCAPES (1954 – 2009)

Chartin Caroline^{*[1]}, Evrard Olivier^[2], Salvador-Blanes Sébastien^[1], Hinschberger Florent^[1], Macaire Jean-Jacques^[1], Van Oost Kristof^[3]

^[1]Université François-Rabelais de Tours ~ UMR 6113 ISTO ~ Tours ~ France ^[2]CEA-CNRS-Université Versailles St Quentin ~ UMR 8212 LSCE ~ Gif-sur-Yvette ~ France ^[3]Université Catholique de Louvain ~ TECLIM ~ Louvain-la-Neuve ~ Belgium

Field borders induce landscape fragmentation and have an important role on the spatial variability of soil erosion and deposition processes. Vegetated borders affect the hydrological and sedimentological connectivity across hillslopes, and all types of field borders act as lines of zero-flux against tillage translocation. This leads to the development of linear anthropogenic landforms (e.g., ridges-and-furrows, headlands, and lynchets) which will keep evolving after field border removal. This is particularly the case in western Europe where agricultural policy and mechanisation led to the massive removal of field borders through numerous land consolidation schemes (1960 – 1990). The aim of this study is to assess the effect of field borders and their removal on soil redistribution in a cultivated hillslope of the SW Parisian Basin. Recent patterns of soil redistribution are derived from 137Cs inventories and analysed with respect to the different topographical settings, especially linear anthropogenic landforms. Then, erosion and deposition rates are calculated using a conversion model that integrates the dominant processes of soil redistribution over the last fifty years. Results show that areas submitted to intensive erosion or deposition are mainly concentrated on linear landforms induced by field borders. The use of the conversion model highlights that soil redistribution is strongly dominated by tillage-induced processes. Land consolidation enhanced soil redistribution through the conversion of depositional areas into sediment delivering areas. Erosion and deposition processes induced by field borders and their removal appear to be very important when compared to mean soil redistribution in the entire study area.



S03.02b -3

EVALUATION OF SEDIMENT TRAPPING EFFICIENCIES OF VEGETATIVE EROSION CONTROL STRUCTURES

Verbist Koen^{*[1]}, Vermang Jan^[1], Vanderlinden Bruno^[1], Cornelis Wim^[1], Gabriels Donald^[1]

^[1]Ghent University ~ Soil Management ~ Ghent ~ Belgium

Erosion on agricultural fields in the hilly regions of Flanders has been recognized as an important economical and ecological problem that requires effective control measures. Since 2004 this has led to the implementation of a myriad of field scale solutions, such as erosion control structures or dams made out of vegetative materials. In this study, dams made out of coir (coconut) and wood chips were evaluated on three different levels of complexity. Under laboratory conditions, one meter long dams were submitted to two different discharges and three sediment concentrations under two different slopes, to assess the sediment delivery ratios under variable conditions. At the field scale, discharge and sediment concentrations were monitored under natural rainfall conditions on six 3 m wide plots, of which three were equipped with coir dams, while the other three served as control plots. The same plots were also used for rainfall simulations, which allowed to control sediment delivery boundary conditions more precisely. Results show a clear advantage of these dams to reduce discharge by minimum 49% under both field and lab conditions. Sediment delivery ratios were very small under laboratory and field rainfall simulations (4-9% and 2% respectively), while larger SDRs were observed under natural conditions (43%), probably due to the small sediment concentrations (1-5 g l⁻¹) observed and as such a larger influence of boundary effects. Also a clear enrichment of larger sand particles (+167%) could be observed behind the dams, showing a significant selective filtering effect.



S03.02b -4

MODELLING THE INFLUENCE OF BIOLOGICAL CRUST ON SOIL EROSION AT THE PLOT SCALE

Cerdan Olivier^[1], Oumarou Malam Issa^[2], Christian Valentin^[3], Jean-Louis Rajot^[4], Jean-François Desprats^[5]

^[1]BRGM ~ RIS ~ Orléans ~ France ^[2]IRD ~ BIOEMCO ~ Niamey ~ Niger ^[3]IRD ~ BIOEMCO ~ Bondy ~ France ^[4]IRD ~ BIOEMCO ~ Créteil ~ France ^[5]BRGM ~ RIS ~ Montpellier ~ France

Biological soil crusts occur extensively in semi-arid regions; in western Niger, they are associated with various types of physical soil crusts in fallows and in the “tiger bush ecosystem” (landscape with a typical banded pattern consisting of densely vegetated bands of small trees and shrubs alternating with bare soil bands). The objectives of this study is: (i) to highlight the relative contribution of biological soil crusts in runoff and erosion on crusted soil in respect with other soil factors, and (ii) to elaborate and calibrate a dynamic erosion model coupling the Shallow Water equations with the Hairsine-Rose model for different sediment size classes. The study is based on runoff measurements performed in situ on ten 1-m² plots under simulated rainfalls. Biological soil crusts capped pre-existing physical soil crusts with a percentage cover between 39 and 80% on structural crusts compared to 4 and 29% on erosion crusts. Calibration is firstly performed on the saturated infiltration capacity of the different crust types using a minimising algorithm where the distance is based on the Nash–Sutcliffe coefficient. The result is that whatever the suction values we find a power relation between the infiltration of BSC and the infiltration of BSC overlying physical soil crusts. The erosion model is also calibrated to take the different types of crust into account. These results will contribute to evaluate the potential role of biological soil crusts in soil and water redistribution modelling in arid environment of western Niger.



S03.02b -5

RELATIONSHIPS AMONG RUNOFF, LOSSES OF SOIL AND NUTRIENT WITH RAINFALL CHARACTERISTICS AND SOIL MANAGEMENT PRACTICES IN A HILLY VINEYARD (PIEDMONT, NW ITALY)

Opsi Francesca^[1], Biddoccu Marcella^[1], Cavallo Eugenio^[1]

^[1]Italian National Research Council (CNR) ~ Institute for Agricultural and Earthmoving Machines (IMAMOTER) ~ Turin ~ Italy

Runoff and soil losses caused by natural rainfall events were monitored through a 10-years period of observation in three vineyard experimental plots, located in Alto Monferrato, a vine-growing area of Piedmont, NW Italy. The plots are characterized by slope of about 15% and clay soil. Different soil managing practices were adopted in inter-rows of each plot: controlled grass cover (GC), conventional tillage (CT) and reduced tillage (RT). The rainfall characteristics, runoff discharge, concentration in the water of soil and nutrients were measured. More than 150 rainfall events produced runoff, 63 resulted to be erosive and 55 events recorded losses of nutrients. The data set was elaborated to investigate relationships among runoff, soil and nutrient losses, with rainfall amount, intensity and kinetic energy. The amounts of water, soil and nutrients that run away from the vineyard resulted to be differently related to the season, rainfall characteristics, soil surface conditions. Each year, few rainfall events were responsible of most of the annual soil erosion. The collected data showed that the soil management practices have strongly affected runoff and soil losses. Particularly, considering the soil losses and the vine production, the reduced tillage has proved to be the worst practice for managing the inter-rows. Conversely, the grass cover has a relevant role in reducing water (up to 36%) and soil losses (up to 88%), mainly during summer events characterized by high rainfall intensities. The protective effect of grass cover was also noted in the reduction of nitrogen losses, about 60%.



S03.02b -6

A COMPARISON OF SPLASH EROSION BEHAVIOURS BETWEEN WETTABLE AND WATER REPELLENT SOILS

Ahn Sujung^[1], Hamlett Christopher^[2], Doerr Stefan^[1], Bryant Robert^[3], Douglas Peter^[3], Mchale Glen^[2], Newton Michael^[2], Shirtcliffe Neil^[6]

^[1]Swansea University ~ Department of Geography ~ Swansea ~ United Kingdom ^[2]Nottingham Trent University ~ School of Science and Technology ~ Nottingham ~ United Kingdom ^[3]Swansea University ~ College of Engineering ~ Swansea ~ United Kingdom ^[4] ~ ~ ~ Germany ^[5]Swansea University ~ Department of Chemistry ~ Swansea ~ United Kingdom ^[6]Rhine-Waal University of Applied Sciences ~ Germany

Soil water repellency may enhance detachability of bare soil by reducing capillary forces between particles. Splash behaviour by multiple water drop impacts has been reported to be different between wettable and water repellent soils. Here we examine the impact of single drops in detail to isolate the effect of soil wettability on the behaviour from other factors related to multiple drop impacts. The populations and travel distances of particles detached by individual water drops impacting from 40 cm height were compared between wettable and chemically hydrophobized glass beads (350-400µm) used as model soil material. The individual trajectory of each ejected particle was traced on high-speed video frames (976 frames/sec). A single drop impact generated particle dispersions (splash saltation) rather than ejections entrained by a water droplet (splashing). Twice as many particles travelled further than 1cm from hydrophobic beads (HB) than from hydrophilic beads (HL), resulting in a significantly greater median travel distance for HB than HL (HB: 1.28cm, HL: 1.16cm, $p=0.007$, $dF=7$). The significantly greater average initial velocities of HB particles ($p=1.45E-09$, $dF=737$) led to higher trajectories and greater travel distances despite the significantly lower average ejecting angles ($p=3.6E-09$, $dF=749$) than for HL. This result suggests that hydrophobic soil particles are more vulnerable to splash erosion than wettable ones from the onset of rainfall even before a water film is generated by accumulated rain drops, which reportedly affects the vulnerability of soil to splash. The further displacement of hydrophobic particles seems to be mainly driven by higher particle velocities.



S03.02c - SOIL EROSION AND DEGRADATION ON AGRICULTURE LAND

Chair Persons:

Eric L.H. Cammeraat, Amsterdam - Netherlands

Vito Ferro, Palermo - Italy

Tuesday 03 July 2012 from 15:30 to 17:45. Room Leccio

S03.02c -1

GLOBAL AND EUROPEAN POLICIES FOR PROTECTING OUR AGRICULTURAL LAND FROM EROSION AND DEGRADATION

Luca Montanarella, Ispra - Italy

S03.02c -2

DOES AGRICULTURAL INTENSIFICATION CAUSE TERRACE DEGRADATION?

Sarah Schönbrodt, Tübingen - Germany

S03.02c -3

DESERTIFICATION, THE ROLE OF INTENSIVE AGRICULTURE

Gil Eshel, Emek Hefer - Israel

S03.02c -4

EFFECTS OF ORGANIC FARMING ON SOIL STRUCTURE AND CROP YIELD UNDER PEA (PISUM SATIVUM)

Maria Isabel Garcia Meca, Vienna - Austria

S03.02c -5

CONTROL OF SOIL EROSION BY MEANS OF SOD SEEDING IN A MEDITERRANEAN ENVIRONMENT

Giovanni Scalici, Catania - Italy

S03.02c -6

SOIL EROSION FROM AGRICULTURAL LAND IN THE POLEG CATCHMENT: SOURCES, RATES, MEASUREMENTS AND FUTURE SOLUTIONS

Roey Egozi, Emek Hefer - Israel



S03.02c -7

*CONNECTING THE CYCLES: IMPACT OF SEDIMENT, CARBON AND NUTRIENT EROSION
ON GHG EMISSIONS*

Nikolaus J. Kuhn, Basel - Switzerland



S03.02c -1

GLOBAL AND EUROPEAN POLICIES FOR PROTECTING OUR AGRICULTURAL LAND FROM EROSION AND DEGRADATION

Montanarella Luca*^[1]

^[1]European Commission ~ Joint Research Centre ~ Ispra ~ Italy

Global soil resources are limited and are under increased pressure by competing land uses. Protecting sufficient agricultural land for feeding the growing global population becomes therefore of primary importance in the immediate future. Governments and international organizations are therefore paying increased attention to this limited natural resource. Only in few countries effective soil protection policies are in place. Therefore there is increased interest in developing transnational soil protection strategies and policies, like the European Soil Thematic Strategy by the EU and the Global Soil Partnership by FAO. The status of these two European and Global policies will be reviewed, including the most recent policy developments.



S03.02c -2

DOES AGRICULTURAL INTENSIFICATION CAUSE TERRACE DEGRADATION?

Schönbrodt Sarah^[1], Karsten Schmidt^[1], Thorsten Behrens^[1], Thomas Scholten^[1]

^[1]University of Tübingen ~ Department of Geosciences, Chair of Physical Geography and Soil Science ~ Tübingen ~ Germany

The effect of bench terraces on the reduction of soil erosion is globally without controversy. However, agricultural intensification and ecosystem changes that currently take place in the Three Georges Region (China) are assumed to reduce the capability of bench terraces to protect the soil against erosion. This terrace degradation is further assumed to enforce the process of soil erosion. Our study aims at the assessment and classification of the different terrace conditions and on the factors triggering terrace degradation by incorporating field mapping and data mining approaches. A total of approximately 1000 bench terraces in the Xiangxi catchment (3,200 km²) was classified according to their condition. The results are: well (14 %) and fairly maintained (39 %), partially (22 %) and completely collapsed (11 %). A sequence of terrace condition is obvious. Overall accuracies of 92 % provide extremely precise information on environmental and anthropogenic indicators affecting terraces in their capability to protect the soil against soil erosion. Mainly anthropogenic-induced effects (e.g., distance to roads, markets, and stream lines) cause the terrace degradation. Also the geomorphic settings (e.g., curvature) affect the terrace condition. However, this effect strongly diminishes against the background of the high land-use dynamics. Our study shows the utmost urgency of understanding the mostly anthropogenic-induced mechanisms of terrace degradation and the process of soil erosion. In a further step, the conceptual TerraCE model was developed in order to transfer the findings onto a larger scale. This enables the consideration of the terrace degradation in soil erosion modeling.



S03.02c -3

DESERTIFICATION, THE ROLE OF INTENSIVE AGRICULTURE

Eshel Gil^[1], Egozi Roey^[1]

^[1] Ministry of Agriculture and Rural Development, Israel ~ The Soil Erosion Research Station, ~ Emek Hefer ~ Israel

Conventional intensive agriculture is characterized by high productivity, high water use efficiency, longer growing season period, less need for manpower and bare soil. The bare soil concept emerged from the need of crop sanitation and to minimize weeds competition. As a result, it is common to find that large portion of the agricultural area that under conventional management is left bare during the raining season. The coupling of these two characteristic intensify the rain-drop impact that commonly is considered as small scale process. Studies all over the world show that the infiltration rate of bare soil can be decreased by an order of magnitude, or even more, as the sealing layer (commonly named crust) has been developing. When this process is looked as a distributed process over a large agricultural area (watershed, regions) it may lead to large impact on rainfall-runoff relation. This is similar to hydrological regime typically of desert environment where small amount of rainfall with limited infiltration rate produces runoff and flashfloods. Thus agriculture areas in semi-arid and humid environments may behave like a desert land.



S03.02c -4

EFFECTS OF ORGANIC FARMING ON SOIL STRUCTURE AND CROP YIELD UNDER PEA (PISUM SATIVUM)

Garcia Meca Maria Isabel^[1], Klik Andreas^[1]

^[1]University of Natural Resources and Life Sciences Vienna ~ Institute of Hydraulic and Rural Water Management, Department of Water, Atmosphere and Environment ~ Vienna ~ Austria

Agricultural practises, especially under dry conditions, should be managed to protect soil quality and adapt soils to prevent possible negative effects of climate change. The objective of this study was to determine the effect of organic fertilizers on selected soil physical parameters and crop yield. Field experiments were carried out in the Pannonian Basin, northeast of Vienna, Austria. Soil is a chernozem, with 21,9 % sand, 33 % clay, 45,1 % silt and less than 2 % organic carbon. Four farming systems were tested: green manure (G), bio waste compost (C), farmyard manure (F) and biogas slurry (S). Undisturbed samples were taken to measure bulk density, saturated hydraulic conductivity and porosity in two soil depths: 10-15 cm and 25-30 cm. Aggregate stability was determined for surface samples (0-5 cm). Results show significant differences between the treatments. Saturated hydraulic conductivity in the upper soil layer was around 2 times higher in G than all other tested systems. Corresponding to it, lower bulk density is found under G treatment. There were no significant differences of total porosity between the four treatments. Aggregate stability increases in following order: G < F < S < C. Crop yield are higher in S. Combination of green manure with bio waste compost could be an adequate sustainable management to improve soil properties without yield losses under tested conditions.



S03.02c -5

CONTROL OF SOIL EROSION BY MEANS OF SOD SEEDING IN A MEDITERRANEAN ENVIRONMENT

Cosentino Salvatore Luciano^[1], Scalici Giovanni^{*[1]}, Ambra Riccardo^[1], Guarnaccia Paolo^[1]

^[1]Università degli Studi di Catania ~ DISPA ~ Catania ~ Italy

The research has been carried out over the years 2004-2010 in an area of the internal hill of Sicily region (Enna, c.da Geracello, 550 m a. s. l. 37° 23' N. Lat, 14° 21' E. Long), mainly devoted to durum wheat cultivation, using the experimental plots, established since 1996 on a slope of 26-28%, equipped to determine surface runoff and soil losses. The establishment consists of twelve plots, having 40 m length and 8 m width. In order to study the effect of sod seeding techniques in controlling soil erosion in slopes subjected to water erosion, two plots were not tilled since summer 2004 and plant residues were left on soil surface. In these two plots, annual crops were cultivated. The two plots were compared to several perennial crops and annual crop rotations conventionally sown. The results pointed out that the cropping systems with perennial crops allowed to keep low the soil loss, while annual crop rotation determined a high amount of soil loss. Sod seeding showed promising results also for annual crop rotations.



S03.02c -6

SOIL EROSION FROM AGRICULTURAL LAND IN THE POLEG CATCHMENT: SOURCES, RATES, MEASUREMENTS AND FUTURE SOLUTIONS

Egozi Roey^[1], Eshel Gil^[1]

^[1]Ministry of Agriculture and Rural Development ~ The Soil Erosion Research Station ~ Emek Hefer ~ Israel

Located at the central costal area of Israel the Poley Catchment is a typical Mediterranean watershed with mean annual rainfall of 550 mm, winter flashfloods and severe soil erosion problems. The soils in the catchment are brown loamy sand to sandy loam soils with potential infiltration rate of 60-80 mm/hr. Of its 135 km², 65% is agricultural land, mainly orchards and row crops (mostly potatoes and carrots). The fields are managed by conventional tillage practices and over the last decade the row crops portion has been increased by 5% and young orchards replaced old ones. As a result of the soil type and the crumbled and bare soil, significant soil losses have been observed. The annual soil loss rate is estimated at 0.007 m. Sediments are delivered to the channel network, in which the fine material (clay and silt size fractions) is transported in suspension and large amounts of well sorted sand (D₅₀ = 0.210 mm) are transported as bedload. As a result river bed is aggrading due to sand bed deposits ranging between 0.2 and >1 m high. However, the cohesive banks of the river remain stable and therefore the incised channels have been mutant into sand bed conduits. This leads to reduction in channel capacity and increasing flood hazards. To solve the problems soil conservations practices must be applied at the catchment scale.



S03.02c -7

**CONNECTING THE CYCLES: IMPACT OF SEDIMENT, CARBON AND NUTRIENT EROSION
ON GHG EMISSIONS**

Kuhn Nikolaus J.*^[1]

^[1]University of Basel ~ Environmental Sciences ~ Basel ~ Switzerland

The lateral movement of soil through terrestrial ecosystems has been recognized as a significant flux of C within the global C cycle. Soil erosion removes approximately 0.5 Gt of C per year from agricultural land. Much of this C is deposited in the landscape, effectively burying the organic matter and taking it, at least for an unspecified time, out of the C exchange between soil and atmosphere. However, the burial does not consider the full coupling between the biogeochemical cycles. For example, apart from C, nitrogen is eroded and has to be replaced, at least in part, by artificial fertilizers, to maintain soil fertility and dynamic replacement of C. At this point Carbon and nitrogen cycles meet, because the production of fertilizer generates greenhouse gases. The production of one ton of fertilizer generates on the order of 850 kg of carbon dioxide. Applying this number to the 0.5 GT C erosion estimate, the amount of nitrogen lost owing to erosion each year yields carbon dioxide emissions of 0.02–0.04 Pg per year. These emissions correspond to 15–30% of the organic carbon buried owing to soil erosion. In this presentation, the full complexity of biogeochemical cycling on agricultural land is explored and connections between cycles which require consideration for a full GHG emission balance of soil erosion on agricultural land are identified.



S03.03 - FOREST FIRE EFFECTS ON SOIL SUSTAINABILITY

Chair Persons:

Giacomo Certini, Firenze - Italy

Jorge Mataix-Solera, Alicante - Spain

Wednesday 04 July 2012 from 08:30 to 10:00. Room Mirto

S03.03 -1

*FACTORS CONTROLLING THE QUALITY AND QUANTITY OF SOIL ORGANIC MATTER
AFTER WILDFIRE*

Cornelia Rumpel, Thiverval-Grignon - France

S03.03 -2

*CHEMICAL AND MICROBIOLOGICAL PROPERTIES OF SOILS FOLLOWING PRESCRIBED
FIRE IN THE ROCKY MOUNTAINS*

Cindy Prescott, Vancouver - Canada

S03.03 -3

TRACING WILDFIRE INTENSITY IN SOILS VIA MOLECULAR PROXIES

Guido Wiesenberger, Bayreuth - Germany

S03.03 -4

*MODELING SOIL WATER REPELLENCY IN BURNT HILLSLOPES AND ITS CONSEQUENCES
FOR RUNOFF AND SOIL EROSION*

Joao Pedro Nunes, Aveiro - Portugal

S03.03 -5

*ASSESSING THE SIGNIFICANCE OF POST-WILDFIRE SOIL EROSION IN MEDITERRANEAN
EUROPE*

Richard Shakesby, Swansea - United Kingdom

S03.03 -6

*SOIL AS A CARBON STORE: STOCKS AND RECALCITRANCE IN FIRE-AFFECTED
AUSTRALIAN FOREST SOILS*

Stefan Doerr, Swansea - United Kingdom



S03.03 -1

**FACTORS CONTROLLING THE QUALITY AND QUANTITY OF SOIL ORGANIC MATTER
AFTER WILDFIRE**

Rumpel Cornelia*^[1]

^[1]CNRS ~ BIOEMCO ~ Thiverval-Grignon ~ France

One of the main fire effects on soils is the alteration of quality and quantity of organic matter input. In general, more than 90% of carbon from the aboveground biomass is lost immediately after fire in form of CO₂. Fire effect on litter layer is dependent on fire intensity. Alterations of organic matter in mineral soil are mainly related to altered input. In addition to reductions of fresh litter input immediately after fire, charcoal, a stable organic matter type, formed through the condensation of labile plant litter compounds and the formation of stable aromatic molecules is usually added to soil. It consists of a continuum of slightly burned plant residues to completely graphitized material. The nature and reactivity of this fire derived organic matter component may depend on precursor material as well as particle size. Coarse charcoal particles are in general characterized by a more stable structure and higher resistance to chemical attack compared to fine ones. The relative addition of coarse and fine particles as will depend on fire characteristics. The OM added to soil after fire is susceptible to be lost from soil either by microbial decomposition or horizontal and vertical transport in solid or dissolved form. I will present examples from different regions and show how fire alters the quantity and quality of soil organic matter and analyze if this has a long-lasting effect on the biological functioning of soil.



S03.03 -2

CHEMICAL AND MICROBIOLOGICAL PROPERTIES OF SOILS FOLLOWING PRESCRIBED FIRE IN THE ROCKY MOUNTAINS

Prescott Cindy*^[1], Grayston Sue^[1], Switzer Joshua^[1], Hope Graeme^[1]

^[1]University of British Columbia ~ Forest Sciences ~ Vancouver ~ Canada

Thinning followed by prescribed fire is being used to restore forest ecosystems in the Rocky Mountains of North America. We investigated the relationships between fuel loadings (pile size), fire temperature and duration, and changes in selected chemical and biological properties of the underlying soil. Forest floor depth declined from 4.6 to 2.5 cm and consumption was negatively correlated with pre-fire moisture content. Increases in pH and availability of PO₄, Ca and Mg (assessed with plant root simulator probes) were observed in burned plots and were sustained for the first year following fire. Abundances of bacteria (total, gram negative and gram positive, assessed through phospholipid fatty acid analysis) declined in burned plots. Fungal abundance declined in the forest floor of burned plots, but not in the mineral soil. Microbial abundances had not recovered to pre-fire levels one year after fire. In the forest floors, microbial abundances were most strongly correlated with N concentrations prior to fire, and with pH following fire. In mineral soil, microbial abundance was positively correlated with C and N concentrations prior to fire and with N concentrations one year after fire. Litter depth and moisture content were more important determinants of fire effects on soil than was pile size.



S03.03 -3

TRACING WILDFIRE INTENSITY IN SOILS VIA MOLECULAR PROXIES

Wiesenberg Guido*^[1]

^[1]University of Bayreuth ~ Agroecosystem Research Department ~ Bayreuth ~ Germany

Effects of fire intensity on the chemical composition of charcoal and ash remains have been described recently, which may also alter the chemical composition of soil organic matter (SOM). Such changes have been documented in laboratory experiments e.g. on alkanes, PAHs, BPCA and other molecular markers. This study aims at the investigation of the transferability of such laboratory results to recent grassland, cropland and forest fires, where charred plant residues were sampled from the soil surface and compared to plant biomass and topsoil layers. Chemical composition of wildfire residues corresponded well to laboratory results from low to intermediate fire intensity (<400°C). Compared to living plant biomass a reduction in the amount of extractable lipids and an enrichment in short chain even numbered alkanes was observed, whereas the biogenic signal of long chain alkanes (predominance of odd numbered homologues) was still present. Forest fire residues revealed a stronger enrichment of short chain alkanes compared to grassland and cropland fires, thus suggesting higher burning temperatures. Commonly, topsoil samples (0-2 cm) were characterized by an enrichment of burning residues compared to deeper soil (2-5 cm), except for the investigated oak forest, where a fire occurred ~3 years before sampling. Most likely, the soil was bioturbated, leading to enrichment of burning residues even in slightly deeper soil layers. Temperature influence and composition of burning residues deriving from laboratory experiments were confirmed by samples from natural wildfires. These allow for an assessment of the burning history via SOM, as burning residues might accumulate over time.



S03.03 -4

MODELING SOIL WATER REPELLENCY IN BURNT HILLSLOPES AND ITS CONSEQUENCES FOR RUNOFF AND SOIL EROSION

Nunes Joao Pedro^[1], Malvar Maruxa^[1], Keizer Jan Jacob^[1]

^[1]University of Aveiro ~ CESAM & Dept. Environment and Planning ~ Aveiro ~ Portugal

Forest fires can enhance soil water repellency and its impacts on soil hydrology and surface runoff generation, with consequences for soil loss. This creates a challenge for hydrological and erosion modeling in burnt forests, since current models do not usually take repellency into account. This presentation focuses on the development and evaluation of an empirical model to predict the seasonal patterns of repellency, and its incorporation in a simple “bucket” model for soil hydrology, runoff generation and soil erosion. The model was developed and tested using data from six eucalypt hillslopes in central Portugal which burned in 2005 and 2006. Data included weekly runoff and sediment collection, and bi-weekly transects detailing soil moisture and water repellency in different parts of the slopes. The sites showed low repellency during the wet winter season and high repellency during the dry summer season, and this seasonal pattern was strongly related with soil moisture fluctuations. Runoff occurred mostly in periods with both high rainfall and repellency, at the transition between the dry and wet seasons; erosion followed runoff episodes. Model development was based on the combined simulation of soil moisture and repellency driven by rainfall and potential evapotranspiration, with repellency limiting the soil water holding capacity. This was applied to a water balance model based on the Thornthwaite-Mather method, using the Morgan-Morgan-Finney approach to estimate runoff and erosion. Results indicate that a simple approach to simulate repellency is feasible and can be included in hydrological and erosion models, improving their performance for burnt hillslopes.



S03.03 -5

ASSESSING THE SIGNIFICANCE OF POST-WILDFIRE SOIL EROSION IN MEDITERRANEAN EUROPE

Shakesby Richard*^[1]

^[1]Swansea University ~ Geography ~ Swansea ~ United Kingdom

Wildfires in Mediterranean Europe are said not only to destroy vegetation and litter, damage property and cause death, but also to cause serious soil loss. This presentation challenges this last view and addresses gaps in understanding. Belief in the seriousness of post-wildfire erosion has led to the view that wildfire is the main agent of Mediterranean soil degradation, apparently supported by much higher post-wildfire erosion rates than those on unburnt terrain. These comparisons, however, mostly exaggerate the former, since erosion rates on the latter are usually extremely low. More meaningful comparisons are needed, but are rare. Soil loss tolerance would theoretically provide a useful comparison, but has been developed mostly for agricultural soils and few estimates relate to Mediterranean-type conditions. An alternative is soil renewal rate, but its determination is difficult as reflected in the few published assessments, and some basic controls are poorly understood. Arguably, comparison with erosion by other disturbance agents (cultivation practices) is the best option. It indicates that Mediterranean post-wildfire soil loss is mostly unremarkable. It is possible, however, that post-wildfire erosion may be (a) directly important in reducing soil quality through preferential loss of organic matter and nutrients, and (b) indirectly important in leading to disturbance by post-fire land management practices that cause significant erosion.



S03.03 -6

SOIL AS A CARBON STORE: STOCKS AND RECALCITRANCE IN FIRE-AFFECTED AUSTRALIAN FOREST SOILS

Doerr Stefan^{*[1]}, Santin Cristina^[1], Shakesby Richard^[1], Sheridan Gary^[2], Lane Patrick^[2], Hugh Smith^[3]

^[1]Swansea University ~ Geography Department ~ Swansea ~ United Kingdom ^[2]Department of Forest and Ecosystem Science ~ The University of Melbourne ~ Melbourne ~ Australia ^[3]University of Plymouth ~ School of Geography ~ Plymouth ~ United Kingdom

The role of vegetation fires in the global carbon (C) cycle remains unclear. On the one hand, fires emit substantial amounts of C to the atmosphere. On the other, they also transform some of the relatively labile organic C (OC) stored in biomass to more stable pyrogenic OC, which may provide a long-term C sink when accumulating in soils. Here, we present an analysis of OC stocks in Australian forest soils in relation to recent fire history; with a special focus on OC recalcitrance and the relative significance of the pyrogenic OC component in this C reservoir. After the extremely severe '2009 Black Saturday' wildfires near Melbourne, soils were sampled (0-5 cm) at three burnt sites and a long-unburned site in mixed eucalyptus forest, and also at burnt and long-unburned temperate rainforest sites. All were previously affected by wildfire in 1939, with two of the burnt sites also having undergone a fuel reduction burn at different times in the 1980s. OC contents were determined and the OC recalcitrance tested by oxidative degradation (Ascoug et al. 2011, Cosmochim. Acta 75:2361). Three different pools of OC were defined and quantified: labile, moderately resistant and recalcitrant (OC remaining after 24, 100 and 400h oxidation respectively; Masiello et al. 2002, Cosmochim. Acta 66:1025). The results are discussed in the context of fire as a potentially important driver enhancing the stability, and therefore sustainability, of carbon in soil. Funding: NERC grant NE/F00131X/1 and Alfonso Martin Escudero Foundation. We thank C. Sherwin for fire history information.



W03.01 - SOIL DEGRADATION IN THE MEDITERRANEAN: A NEVER ENDING STORY THAT STILL NEEDS SOLUTIONS

Chair Persons:

Pandi Zdruli, Bari - Italy

Nicola Lamaddalena, Bari - Italy

Antonio Coppola, Potenza - Italy

Wednesday 04 July 2012 from 10:30 to 12:00. Room Mirto

W03.01 -1

A SOIL EROSION MAP FOR THE MEDITERRANEAN BASIN, CURRENT AND FUTURE TRENDS

Yves Le Bissonnais, Montpellier - France

W03.01 -2

ENVIRONMENTALLY SENSITIVE AREAS TO DESERTIFICATION IN GREECE

Mina Karamesouti, Athens - Greece

W03.01 -3

KNOWLEDGE OF SOIL WATER BALANCE OF MEDITERRANEAN KARST OF BOSNIA AND HERZEGOVINA IN THE FUNCTION OF WATER CONSERVATION AND PROTECTION FROM EROSION

Hamid Custovic, Sarajevo - Bosnia and Herzegovina

W03.01 -4

DEGRADATION OF ARABLE LANDS BY URBAN SPRAWL IN LEBANON

Darwish Talal, Beirut - Lebanon

W03.01 -5

EFFECTS OF THE RESTORATION ACTIONS TO COMBAT DESERTIFICATION ON SOILS. THE PRACTICE PROJECT STUDY SITE IN PULA (SARDINIA, ITALY)

Claudio Zucca, Sassari - Italy

W03.01 -6

INDICATORS OF SOIL AND SEDIMENT LOSS ON A SMALL, DENSELY POPULATED ISLAND: A CASE STUDY OF MALTA

Avertano Role, Msida - Malta



W03.01 -1

A SOIL EROSION MAP FOR THE MEDITERRANEAN BASIN, CURRENT AND FUTURE TRENDS

Olivier Cerdan^[1], Jean-François Desprats^[2], Julien Fouché^[2], Le Bissonnais Yves^[3], Bruno Cheviron^[3], Vincent Simonneau^[4], Damien Raclot^[3], Florent Mouillot^[5]

^[1]BRGM ~ RIS ~ Orléans ~ France ^[2]BRGM ~ RIS ~ Montpellier ~ France ^[3]INRA ~ LISAH ~ Montpellier ~ France ^[4]IRD ~ CESBIO ~ Toulouse ~ France ^[5]IRD ~ CEFE ~ Montpellier ~ France

Many studies developed soil erosion risk modeling methodologies at various scales from regional to Continental scale. The MESOEROS project is the first which aims to understand the soil loss risk on the whole Mediterranean basin for the current climate context and also for the predicting climate changes expected for the 21st century. Two models are used: MESALES (expert rules model) and PESERA (physical based model). Model inputs come from homogenized regional datasets that cover the whole study area. After being calibrated with watersheds data and the PESERA modeling on Europe, the two modeling results are analyzed as well as the model sensitivity to the different input parameters. The modeling validation allow understanding the integration of climate change on modeling results. MESALES and PESERA point out an evolution of the soil erosion risk between the 20th and the 21st centuries around the Mediterranean basin. The two models assess a global augmentation of the soil loss risk at the Mediterranean scale. They both show an increase – in intensity and surface - of the soil erosion risk on areas already sensitive during the 20th century.



W03.01 -2

ENVIRONMENTALLY SENSITIVE AREAS TO DESERTIFICATION IN GREECE

Karamesouti Mina^[1], Yassoglou Nikolaos^[1], Kosmas Konstantinos^[1], Kairis Orestis^[1]

^[1]Agricultural University of Athens ~ Soil Science and Agricultural Chemistry ~ Athens ~ Greece

There has been a serious concern about desertification during the last decades, which seems to be a threat for agricultural areas, forests and pastures. Based on existing methodology (MEDALUS research project) the Environmental Sensitive Areas (E.S.A.) of Greece, have been identified. Data for the calculation of indices related to desertification derived from CORINE 2000 land uses, the Soil Associations Map of Greece and series of meteorological data from 97 stations of the Hellenic National Meteorological Service, for the period of 1940 -1970. Geographical Information Systems were used in order to handle and interpret primary data. Theissen polygons created by the 97 meteorological stations were used for the division of Greece in corresponding areas. Each area was classified in zones with a difference of 200m in elevation, to which primary meteorological data were adjusted. Through simple processes in the geodatabase and with the use of the Field calculator tool of ArcGIS 10, meteorological data were translated into E.S.A. climate indices, from which Climate Quality Index (C.Q.I.) was calculated. With the same processes, Soil Quality Index (S.Q.I.) was calculated based on Soil Associations Map of Greece and Vegetation Quality Index (V.Q.I.) and Management Quality Index (M.Q.I.) were calculated based on CORINE 2000. These three levels of information were joined in order to give as a result the E.S.A. Index through geo-processing procedures. The study showed that almost 50% of Greek land was characterized as fragile to desertification, whereas only 6% of Greek land seems to be non-affected by the phenomenon.



W03.01 -3

KNOWLEDGE OF SOIL WATER BALANCE OF MEDITERRANEAN KARST OF BOSNIA AND HERZEGOVINA IN THE FUNCTION OF WATER CONSERVATION AND PROTECTION FROM EROSION

Custovic Hamid^[1], Misilo Marija^[2], Markovic Mihajlo^[3]

^[1]Faculty of Agriculture and Food Science Sarajevo ~ Soil Science ~ Sarajevo ~ Bosnia and Herzegovina ^[2]Faculty of Science ~ Department of Geography ~ Sarajevo ~ Bosnia and Herzegovina ^[3]Agricultural Institute ~ Soil Science ~ Banja Luka ~ Bosnia and Herzegovina

This study was conducted at the site in Popovo polje, which is one of the typical Dinaric karst poljes, located within the Mediterranean part of Bosnia and Herzegovina (temperature around 14°C and precipitation about 1950 mm). The aim of this work is to shed more light to the relationship between retention, percolation and water runoff and to determine the water balance of soil and its relation to soil erosion in karst conditions. For the purpose of accomplishing this objective the method of lysimeters was applied. The total of six lysimeters with different soil depths (1.3 m, 1 m, 0.5 m, 0.3 m and simulation of karst) was posted. The lisimeters were used in order to study the relationship of precipitation, ET and drainage runoff in the function of soil depth and no-irrigation conditions, aimed to obtain information on the possibilities of restoration of groundwater and surface water. Additionally, a total of six metal cassettes filled with the same soil as in lisimeters were set up to simulate inclination up to 10%, comparative bare ground and ground covered with grass, and to monitor total water runoff and total amount of sediment. The results indicate large differences between the agrohydrological budgets of bare stony soil and loam-clay soils of different depths, while the results of measurements of the total water runoff and amount of sediment indicate that the slope effects can be repaired by grass cover. Keywords: karst, agrohydrology, water erosion, Popovo polje, Bosnia and Herzegovina.



W03.01 -4

DEGRADATION OF ARABLE LANDS BY URBAN SPRAWL IN LEBANON

Talal Darwish^[1], Ghaleb Faour^[1]

^[1]National Center for Remote Sensing, National Council for Scientific Reserach ~ Soil ~ Beirut ~ Lebanon

Land cover and land use change derived from satellite images are two indicators of land management and land degradation. The Lebanese agriculture sector is facing policy problems, products competitiveness, mismanagement of chemical and water input, land abandonment and the fragmentation of agricultural land under heritage and urbanization. Large land use changes and modifications in the area and spatial distribution of annual and perennial crops have been witnessed for the period span between 2000 and 2010. Comparing land cover map with the expansion of urban settlements between 2000 and 2010, showed a total loss of 308 km² of land resources. Among lands converted into concrete, a total of 194 km² (63%) belong to agricultural fields, 53 km² (17.2%) and 50 km² (16.2%) belong to wood land and grassland respectively. Less than 11 km² (3.7%) of recent urban development has expanded on unproductive land. Simultaneously, in Zahle (Central Bekaa) and Nabatiyeh (South) Cazas a respective loss of 12 km² and 17 km² of arable lands by chaotic urban expansion, expanding from 30 to 42 km² and from 34 to 51 km² between 2000 and 2010 respectively. Chaotic urban expansion leaves a large question mark about the implementation of agro ecological and urban zoning in the country. The low precision from land based statistics indicates the necessity to unify the statistical methods integrally using both remote sensing and land survey as prerequisite to better land resources management.



W03.01 -5

EFFECTS OF THE RESTORATION ACTIONS TO COMBAT DESERTIFICATION ON SOILS. THE PRACTICE PROJECT STUDY SITE IN PULA (SARDINIA, ITALY)

Zucca Claudio^[1], Fiori Valeria^[1], Cucca Carlo^[1], Musinu Silvia^[1], Campus Sergio^[2], Madrau Salvatore^[1]

^[1]University of Sassari ~ DIT ~ Sassari ~ Italy ^[2]University of Sassari ~ Forestry School di Nuoro (FS) ~ Nuoro ~ Italy

Land Degradation and Desertification affect much of the world's drylands, resulting in a significant loss of biological and economic productivity. Responding to desertification by improving the efficiency of land and resource management represents a crucial step towards social welfare in drylands. However, the evaluation of the actions to combat desertification remains limited. The PRACTICE EC-FP7 project develops and tests integrated evaluation protocols to assess the effectiveness of restoration practices in a network of study sites distributed among the most LD affected regions of the world. In the Pula reforestation area (Sardinia, Italy) integrated evaluation protocols are being applied, based on the unifying conceptual framework provided by the analysis of the desertification impacts on ecosystem good and services and on human well-being, across different spatial scales. The LFA Landscape Function Analysis (LFA) was taken as the reference method to study the effects of the restoration actions on the soils, by comparing different restoration/management actions: i) non-managed area (control area), ii) self-restoration, iii) thinned reforestation, and iv) non-thinned reforestation (to evaluate the effects of the plantation in absence of subsequent silvicultural interventions). The LFA include a range of soil surface assessment indicators to be estimated along linear transects, to derive an Infiltration/Runoff Index, and a Nutrient Cycling Index. In addition, soils were studied and sampled by horizon, and analysed for SOC, pH, N, and other emerging properties. A morphological description of the litter was made, along with a study of the soil microarthropod community.



W03.01 -6

**INDICATORS OF SOIL AND SEDIMENT LOSS ON A SMALL, DENSELY POPULATED ISLAND:
A CASE STUDY OF MALTA**

Role Avertano*^[1]

^[1]University of Malta ~ Geography ~ Msida ~ Malta

Most regions share common problems when attempting to accurately estimate quantities of soil loss through erosion and this situation is no more real than in Mediterranean islands. This is often due to a gross underestimation of the seriousness of soil erosion and a lack of appreciation of the agricultural sector when compared to more economically significant sectors. In the Maltese case, this problem is compounded by a high population density and sub/urbanization processes coupled with increased environmental pressure and competition from the tourist sector. Soil sealing is accelerating surface-water runoff and the prevailing governmental policy is to facilitate storm water movement through channeling in order to avoid flooding. This has sometimes created hotspots of soil erosion and is also reflected in varying estimates of sediment transport and deposition. Quantitative estimates of soil loss in the Maltese Islands are few and far between. They are also limited to extreme scales: from sets of field studies carried out as academic exercises (limited in time and space) to regional qualitative studies of potential soil erosion risk. This paper focuses on indicators of sediment loss at a drainage basin scale derived mostly from unpublished reports. These can be quite cost effective compared to dedicated long-term studies but they can still offer some potential for effective intervention through policy instruments and provide the basis for a discussion of trends in this phenomenon.



S04.01a - APPLICATION OF PROXIMAL SOIL SENSING (PPS) IN SOIL SCIENCE

Chair Person:

Annamaria Castrignanò, Bari - Italy

Thursday 05 July 2012 from 10:30 to 12:00. Room Olmo

S04.01a -1

GEOSTATISTICAL MONITORING OF SOIL SALINITY IN UZBEKISTAN BY REPEATED EM SURVEYS

Akmal Akramkhanov, Urgench - Uzbekistan

S04.01a -2

CONSISTENCY OF SOIL PARTITION USING GEOELECTRICAL MEASUREMENTS AT TWO DIFFERENT WATER CONDITIONS

Daniela De Benedetto, Bari - Italy

S04.01a -3

A LINEAR MIXED MODEL FOR SOIL WATER CONTENT ESTIMATION BASED ON GEOPHYSICAL SENSING: A COMPARISON WITH KRIGING WITH EXTERNAL DRIFT

Barbara Cafarelli, Foggia - Italy

S04.01a -4

DIGITAL SOIL MAPPING ON HETEROGENEOUS BEDROCK USING ELECTRICAL RESISTIVITY MEASUREMENTS

Florent Hinschberger, Tours - France

S04.01a -5

CONSTRUCTING A LAYERED ELECTRICAL CONDUCTIVITY MODEL FROM A COMBINATION OF PROXIMAL AND PROBE SENSOR DATA

Kristin Piikki, Skara - Sweden

S04.01a -6

SOIL ELECTRICAL CONDUCTIVITY AND PLANT-AVAILABLE NUTRIENTS – A CASE STUDY

Robin Gebbers, Potsdam - Germany



S04.01a -1

GEOSTATISTICAL MONITORING OF SOIL SALINITY IN UZBEKISTAN BY REPEATED EM SURVEYS

Akramkhanov Akmal^[1], Brus Dick^[4], Walvoort Dennis^[3]

^[1]Center for Development Research (ZEF), University of Bonn ~ ZEF-UNESCO Khorezm Project ~ Urgench ~ Uzbekistan ^[2]Wageningen University and Research Centre ~ Alterra ~ Wageningen ~ Netherlands ^[3]Wageningen University and Research Centre ~ Alterra ~ Wageningen ~ Netherlands ^[4]Wageningen University and Research Centre ~ Alterra ~ Wageningen ~ Netherlands

Soil salinity in the lower reaches of Amudarya is a constant threat. The shallow groundwater table contributes to salinization of the rooting zone which is tackled by leaching at the end or beginning of the vegetation season. However, there is growing concern that the efficiency of the leaching with application of high amounts of water is low. The objective of this study is to monitor the temporal trend of salinity over the three-year period from 2008 to 2010. At the end of the vegetation season soil salinity was surveyed with the electromagnetic induction meter EM38 in vertical dipole mode. The EM device was coupled with GPS. Measurements of ECe were used to calibrate a model for log(ECe) with log(EM) as single predictor. The estimated regression coefficients and their covariance matrix were used to simulate 1000 vectors of regression coefficients. The regression residuals were used to fit a pooled, spatial variogram. This variogram was used to simulate for each year 1000 maps of regression residuals. 1000 maps of ECe for the years 2008, 2009 and 2010 were then obtained by geostatistical simulation of 1000 maps of log(EM) per year, transforming these maps with the simulated regression coefficients, adding the maps of simulated regression residuals, and backtransforming (exponentiation). These simulations were used to derive for each year maps of the predicted ECe and of the probability that ECe exceeds the critical threshold of 8 dSm⁻¹. Besides, a map of the predicted linear trend in ECe was constructed, and of its standard error.



S04.01a -2

CONSISTENCY OF SOIL PARTITION USING GEOELECTRICAL MEASUREMENTS AT TWO DIFFERENT WATER CONDITIONS

De Benedetto Daniela^[3], Castrignanò Annamaria^[4], Palumbo Angelo Domenico^[5]

^[1]University of Bari ~ Department of Geology and Geophysics ~ Bari ~ Italy ^[2]CRA ~ SCA ~ Bari ~ Italy ^[3]University of Bari "Aldo Moro" ~ Earth science and geo-environmental ~ Bari ~ Italy ^[4]CRA ~ Research Unit for Cropping Systems in Dry Environments (SCA) ~ Bari ~ Italy ^[5]CRA ~ Research Unit for Cropping Systems in Dry Environments (SCA), ~ Bari ~ Italy

Field water content may be highly variable over a range of temporal and spatial scales. Geophysical sensor data can surrogate direct measurement because their outputs depend upon several soil properties, some of them quite dynamic as water content. The objectives of this paper were: 1) to delineate homogenous soil zones by using geophysical measurements and to investigate the consistency of the soil partitioning at two different water conditions. The surveys were conducted in a bare field in south-eastern Italy after an irrigation and in dry condition. GPR at two frequencies, 600 MHz and 1600 MHz, and EMI surveys were carried out along longitudinal and transverse transects and measures with TDR were collected at the intersections of the transects. All data were submitted to geostatistical analysis and were interpolated, using uni- or multi-variate approaches. To obtain spatially contiguous clusters, a clustering algorithm based on nonparametric estimation of probability density function was applied to the multivariate data set of estimated geophysical sensor outcomes, including spatial coordinates after standardization. The consistency of the soil partition obtained at the two different water conditions was computed through confusion matrix and k statistic. The partition of the area in homogeneous zones was different in the two water conditions probing the negative relationship between EMI and GPR data. The confusion matrix showed an accordance between the two cluster maps of only 50%, due to permanent soil properties of the field (i.e. texture), whereas the other 50% of variation was ascribable to more dynamic properties (i.e. porosity).



S04.01a -3

A LINEAR MIXED MODEL FOR SOIL WATER CONTENT ESTIMATION BASED ON GEOPHYSICAL SENSING: A COMPARISON WITH KRIGING WITH EXTERNAL DRIFT

Cafarelli Barbara^[4], Castrignanò Annamaria^[2], De Benedetto Daniela^[5], Palumbo Angelo Domenico^[2]

^[1]University of Foggia ~ Dipartimento di Scienze Economiche, Matematiche e Statistiche ~ Foggia ~ Italy ^[2]CRA ~ Research Unit for cropping in dry Environments (SCA) ~ Bari ~ Italy ^[3]University of Bari ~ Dipartimento di geologia e geofisica ~ Bari ~ Italy ^[4]University of Foggia ~ Department of Economic, Mathematical and Statistical Science ~ Foggia ~ Italy ^[5]University of Bari "Aldo Moro" ~ Earth science and geo-environmental ~ Bari ~ Italy

Soil water content (SWC) is a critical attribute in Precision Irrigation. Direct measurements are costly and relative sparse, so there is interest in methods to predict SWC at unsampled sites from sampled data. The precision of such predictions can be improved if covariates are incorporated into the predictor. Two efficient ways are: a) linear mixed effect model (LME), in which the spatial processes is obtained by splitting the total variability in a systematic term or mean effect, a spatially correlated component and a random noise, and b) kriging with external drift (KED), a non-stationary geostatistical technique, assuming covariates to have a linear effect on target variable. Geoelectric sensors provide non-invasive information on soil. Their outputs are quite sensitive to SWC, therefore, they can be used as covariates in SWC predictor. The objective of this work was to compare the LME and KED, based on geophysical sensing, to estimate shallow SWC. The surveys were conducted in a south-eastern Italy field, using GPR at two frequencies, 600 and 1600 MHz, EMI and TDR, and 36 soil samples were collected to 20-cm depth for gravimetric SWC measurements. Three LMEs, using three (spheric, exponential and Gaussian) correlation functions were used and compared with KED using a set of cross validation criteria. The mixed models showed a quite similar behaviour even if exponential model outperformed the other two. The covariates used in the mixed models and in KED predictor were different though the results of cross-validation did not show clear differences between the two approaches.



S04.01a -4

DIGITAL SOIL MAPPING ON HETEROGENEOUS BEDROCK USING ELECTRICAL RESISTIVITY MEASUREMENTS

Hinschberger Florent^[1], Chartin Caroline^[1], Bourennane Hocine^[2], Salvador-Blanes Sébastien^[1], Aldana-Jague Emilien^[1], Macaire Jean-Jacques^[1]

^[1]Université François-Rabelais de Tours ~ ISTO, UMR 6113 ~ Tours ~ France ^[2]INRA ~ UR 272 Sciences du sol ~ Olivet ~ France

Geophysics is commonly used to predict soil parameters (e.g. soil thickness, soil constituents and properties) over large areas in addition to punctual information given by soil augering. Among the various geophysical tools, the methods based on electrical resistivity measurements give good results providing that the bedrock is homogeneous. However, in the case of heterogeneous bedrock, the resulting data can be misinterpreted, due to inter-relationships between soil resistivity and some soil properties, which may be related to the bedrock lithology. In this study we use electric and electromagnetic methods to (1) map soil thickness over an area with heterogeneous bedrock and (2) assess the relationships between soil resistivity and some constituents of soils (contents in silt, sand, organic carbon and CaCO₃). The study site corresponds to a 100 ha cultivated hillslope located in the SW Parisian Basin (France) and covering 3 types of the Upper Cretaceous sedimentary formations characterised by contrasted resistivity values. The resistivity of the bedrock was measured using an electromagnetic prospection with an EM31 conductivity meter and 44 electrical soundings, whereas soil resistivity was precisely known from an ARP (Automatic Resistivity Profiling) survey at 3 different depths of investigation. Soil thickness was measured at 650 points by manual augering, and soil analyses were performed at 248 points. Geostatistical analyses were tested to assess the relative influence of the different soil properties on the resistivity data for each bedrock type.



S04.01a -5

CONSTRUCTING A LAYERED ELECTRICAL CONDUCTIVITY MODEL FROM A COMBINATION OF PROXIMAL AND PROBE SENSOR DATA

Piikki Kristin^[1], Söderström Mats^[1], Wetterlind Johanna^[1], Stenberg Bo^[1]

^[1]SLU, Swedish University of Agricultural Sciences ~ Department of Soil and Environment ~ Skara ~ Sweden

Soil apparent electrical conductivity (ECa) can be measured with proximal electromagnetic induction sensors. They are affected by the whole profile and different approaches have been used to extract layered ECa models from the depth-integrated data. One example is to use measurements at multiple heights (1). In the present study, ECa data from a dual-depth proximal sensor (EM38 Mk2 2; Geonics Ltd.) was combined with ECa data from a probe sensor (P4000; Veris technologies Inc.). A similar combination has previously been used for numeric solution of ECa profiles with goal to predict topsoil depth (2). Measurements were made at a 50 hectare field in Sweden. The proximal data (transects 24 m apart) were interpolated to a 10*10 m² grid and the probe data (100 random stratified points) was averaged for three depth intervals (0-20 cm, 40-60 cm and 60-80 cm). Multivariate adaptive regression splines (MARSplines) prediction models were parameterized for each layer using probe ECa as reference data. The two proximal ECa variables and the predicted ECa for any above layer were used as predictors. Twenty probe points omitted from the calibrations were used for validation. The modeling efficiency was 0.73 for the upper layer and 0.79 for the two deep layers. Possible applications are soil type mapping and spatial soil water monitoring in top and sub soil. References 1. Borchers B. et al. 1997. Soil Sci Soc Am J 61, 1004-1009. 2. Sudduth, K. et al. Proceeding for The second global workshop on proximal soil sensing, Montreal, Canada, 2011.



S04.01a -6

SOIL ELECTRICAL CONDUCTIVITY AND PLANT-AVAILABLE NUTRIENTS – A CASE STUDY

Gebbers Robin^[1], Lück Erika^[2]

^[1]Leibniz-Institute for Agricultural Engineering ~ Engineering for Crop Production ~ Potsdam ~ Germany ^[2]University of Potsdam ~ Earth Sciences ~ Potsdam ~ Germany

Detection of soil variability by mapping apparent soil electrical conductivity (ECa) with geo-electrical methods has become popular in soil science and related disciplines. ECa maps are regularly used to predict soil fertility in terms of soil texture, soil water content, concentration of nutrients, salinity, compaction etc. However, correlations between these target parameters and ECa often vary from field to field. In the case of the important plant-available nutrients (PAN) P, K, and Mg studies reported very different results varying from negative to positive correlations. Thus, the objective of this work was to study the relationship between ECa and some PAN (P, K, and Mg) in more detail. ECa data were obtained with a multi-electrode Wenner array (electrode spacing 0.5 m) over multiple depths. Soil samples were collected at 20 position from three depths (0 – 30 – 60 – 90 cm) and analysed for soil texture, cation exchange capacity (CEC), exchangeable ions (K, Mg, Na, Ca) and PAN (P, K, and Mg). Correlations between ECa, CEC and clay content were positive for all soil layers. However, relationships between ECa, CEC and clay on the one hand and plant-available K and Mg on the other hand were different in the three soil layers. The main reason for this seems to be the higher concentration of exchangeable Ca⁺ in the upper soil layers due to liming which has altered of the composition of cations. While liming regimes may vary from field to field correlations between cationic PAN may vary too.



S04.01b - APPLICATION OF PROXIMAL SOIL SENSING (PPS) IN SOIL SCIENCE

Chair Person:

Raphael Viscarra Rossel, Clunies-Ross - Australia

Thursday 05 July 2012 from 13:30 to 15:00. Room Olmo

S04.01b -1

APPLICATION OF NON-INVASIVE METHODS FOR ASSESSING SOIL COMPACTION WITHIN AGRICULTURAL TRAMLINES

Peter Shanahan, Lancaster - United Kingdom

S04.01b -2

RELATIONSHIPS BETWEEN NEAR INFRARED REFLECTANCE (NIR) AND BIOLOGICAL AND CHEMICAL PROPERTIES OF FOREST SOILS IN THE CILENTO AND VALLO DI DIANO NATIONAL PARK (SOUTHERN ITALY)

Claudio Colombo, Campobasso - Italy

S04.01b -3

USING VNIR REFLECTANCE SPECTRA OF DRIED GROUND SOILS TO PREDICT PROPERTIES OF SOILS SCANNED MOIST AND INTACT OF SOILS SCANNED MOIST AND INTACT

Cristine Morgan, College Station - United States

S04.01b -4

COMPARISON OF NEAR- AND MID-INFRARED SPECTRA TO PREDICT SOIL ORGANIC CARBON AND TOTAL NITROGEN

Dinesh Babu Madhavan, Melbourne - Australia

S04.01b -5

LANDSCAPE SCALE DIGITAL SOIL MAPPING USING FIELD SCALE GEOPHYSICAL SENSING DATA

Karsten Schmidt, Tuebingen - Germany

S04.01b -6

THE OPTIMAL CALIBRATION SET SIZE AND THE SAMPLING STRATEGY FOR MODELING SOIL VIS-NIR SPECTRA AT THE FIELD SCALE

Leonardo Ramirez-Lopez, Louvain-la-Neuve - Belgium



S04.01b -1

APPLICATION OF NON-INVASIVE METHODS FOR ASSESSING SOIL COMPACTION WITHIN AGRICULTURAL TRAMLINES

Shanahan Peter^[1], Quinton John^[1], Binley Andrew^[1], James Michael^[1]

^[1]Lancaster University ~ Lancaster Environment Centre ~ Lancaster ~ United Kingdom

Compaction of cultivated soil reduces root penetration, rainwater infiltration, and increases tool draft. Tramline lanes, common features in commercial agriculture, represent localized areas of soil compaction created by heavy farm traffic. Tramlines can also exacerbate runoff and erosion from sloping arable land. The aim of this study is to investigate the impact to soil structure of cultivated soil under tramline wheelings. The objectives are: (1) apply non-invasive means of soil structure analysis to determine the extent of wheeling compaction, and (2) determine the effectiveness of soil compaction mitigation methods in alleviating soil structure compaction. Field trials of non-invasive soil analyses are continuing. We anticipate that the results will improve the accuracy in monitoring soil structure over conventional means of soil analysis. Preliminary results indicate that laboratory soil electrical resistivity measurements on soil cores are sensitive to different levels of compaction. Thus we expect to be able to use field-based electrical imaging techniques as a means of mapping field variation in soil structure. X-ray radiography of core samples provides evidence of bulk density distribution for various treatments, with wheelings significantly increasing soil bulk density to depths of 70 90 mm. Photogrammetry, 3D surface modeling from 2D digital imagery, has been successfully applied in the field to generate digital elevation models of wheeled surfaces allowing for the analysis of soil structure deformation under heavy farm traffic treatments. Results so far indicate reduced deformation under low-ground pressure tyres, with improved accuracy and speed of data acquisition over conventional methods (e.g., pin meters).



S04.01b -2

RELATIONSHIPS BETWEEN NEAR INFRARED REFLECTANCE (NIR) AND BIOLOGICAL AND CHEMICAL PROPERTIES OF FOREST SOILS IN THE CILENTO AND VALLO DI DIANO NATIONAL PARK (SOUTHERN ITALY)

Colombo Claudio^{*[1]}, Palumbo Giuseppe^[1], Baldantoni Daniela^[2], Iovieno Paola^[2], Senatore R^[3], Grosso R.^[3], Alfani Anna^[2]

^[1]Molise University ~ Dipartimento di Scienze Animali Vegetali e dell'Ambiente ~ Campobasso ~ Italy ^[2]Salerno University ~ Dipartimento di Chimica e Biologia ~ Salerno ~ Italy ^[3]Univerità del Sannio ~ Dipartimento di Scienze per la Biologia, la Geologia e l'Ambiente ~ Benevento ~ Italy

Applicability of near infrared reflectance (NIR) spectroscopic technique to integrate the knowledge of soil properties was tested on soils from three different forests in the Cilento and Vallo di Diano National Park (southern Italy). For each forest, 8 samples from the 0-5 cm topsoil layer were analyzed for their reflectance in the wavelength range of 300–2500 nm and for chemical (pH, total organic C, total N, Fe, Mg, Mn, K and Zn available fractions) and biological (microbial and fungal biomass, respiration, FDA hydrolysis and β -glucosidase activity) properties. Biological properties are considered good indicators of soil quality and their interpretation may be supported by optical investigations. In an attempt to extend the current knowledge of Mediterranean forest ecosystems, the present study provides information on different biological, chemical and physical properties of soils from Apennines mountain environments (southern Italy), in holm oak, Turkey oak and beech forests ranging from 400 to 1600 m a.s.l. We observed that most of the investigated parameters were variable, possibly due to the strong differences in parent material, organic matter content and quality, as well as in moisture and thermic regime. The biological properties were correlated with some chemical properties (pH and base saturation), as observed in soils from other types of environment. Altitude and plant cover had a clear effect on the biological and chemical properties. Selected spectroscopic bands were correlated with soil biological activities, making this technique useful for understanding of processes involved in forest soil carbon dynamics.



S04.01b -3

USING VNIR REFLECTANCE SPECTRA OF DRIED GROUND SOILS TO PREDICT PROPERTIES OF SOILS SCANNED MOIST AND INTACT OF SOILS SCANNED MOIST AND INTACT

Morgan Cristine^{*[1]}, Thomasson Alex^[2], Ge Yufeng^[2]

^[1]Texas A&M University ~ Soil& Crop Sciences ~ College Station ~ United States ^[2]Texas A&M University ~ Biological and Agricultural Engineering ~ College Station ~ United States

VNIR spectroscopy is a useful tool for rapid measurement of many soil properties, and it can be used proximally. In proximal sensing, soil is scanned intact, either on a core pulled from the soil or in situ with a probe that penetrates the soil. In either case, soil is scanned under the current moisture conditions. The use of VNIR spectral libraries generated from dried and ground soils to predict soil properties thus presents a problem. To address this challenge, we applied an external parameter orthogonalization (EPO) algorithm to remove the effect of soil moisture and other effects associated with scans of intact soil samples. For data, we used a library of approximately 250 soil spectra recorded under three different soil conditions: field-moist and intact, air-dried and intact, dried and ground. The EPO algorithm was found to be a promising method for removing uncertainties that arise in the application of proximal VNIR spectroscopy of natural soil.



S04.01b -4

COMPARISON OF NEAR- AND MID-INFRARED SPECTRA TO PREDICT SOIL ORGANIC CARBON AND TOTAL NITROGEN

Madhavan Dinesh Babu^[1], Jangammanaidu Krishnaraj Saravanan^[1], Mendham Daniel^[2], Kitching Matt^[3], Weston Chris^[1], Baker Tom^[1]

^[1]The University of Melbourne ~ Forest and Ecosystem Science ~ Melbourne ~ Australia ^[2]Commonwealth Scientific and Industrial Research Organisation ~ Sustainable Ecosystems ~ Hobart ~ Australia ^[3]Department of Primary Industries, Victoria ~ Future Farming Systems Research ~ Melbourne ~ Australia

Near-infrared (NIR) and mid-infrared (MIR) spectroscopy combined with partial least squares regression (PLSR) have been demonstrated as an alternative technique to estimate soil organic carbon (SOC) and total nitrogen (TN). The objective of this study was to evaluate the performance of calibration models developed in soils under land-use changes from NIR and MIR spectral ranges to predict SOC and TN. Soils from a broad range of climate and soil types were collected from 31 paired sites of *Eucalyptus globulus* plantation and adjacent pastures in south-western Australia. Soil samples were scanned from 8000-4000 cm⁻¹ (1250-2500 nm) for NIR spectra and 4000-400 cm⁻¹ (2500-25000 nm) for MIR spectra. The SOC and TN concentrations were determined using dry combustion. A total of 184 soil samples (23 sites) were used to develop the PLSR calibration models, whereas 64 independent samples (8 sites) formed the validation set. The calibration models of NIR spectra were statistically sound, but the validation predictions were poorer [SOC ($R^2_{cal} = 0.90$, $R^2_{val} = 0.54$, RMSEP = 1.13 and Bias = 0.56), TN ($R^2_{cal} = 0.93$, $R^2_{val} = 0.60$, RMSEP = 0.32 and Bias = 0.17)], when compared to robust calibrations and validation predictions of MIR spectra [SOC ($R^2_{cal} = 0.96$, $R^2_{val} = 0.94$, RMSEP = 0.40 and Bias = 0.08), TN ($R^2_{cal} = 0.94$ and $R^2_{val} = 0.93$, RMSEP = 0.13 and Bias = 0.06)]. The MIR spectroscopy was found suitable for precise SOC and TN predictions; however larger sample populations with relevant spectral pre-treatments can improve NIR spectral predictions.



S04.01b -5

LANDSCAPE SCALE DIGITAL SOIL MAPPING USING FIELD SCALE GEOPHYSICAL SENSING DATA

Schmidt Karsten^{*[1]}, Behrens Thorsten^[1], Werban Ulrike^[2], Scholten Thomas^[1]

^[1]University of Tuebingen ~ Department of Geosciences ~ Tuebingen ~ Germany ^[2]UFZ – Helmholtz Centre for Environmental Research ~ Department of Monitoring and Exploration Technologies ~ Leipzig ~ Germany

This talk presents and compares multiple new approaches to landscape scale digital soil mapping using field scale geophysical sensing data (EM and Gamma). The idea is to validate how such data can be used most efficiently to support landscape scale soil texture predictions. All concepts were compared in a low relief area in northern Germany using hyperscale digital terrain analysis as the only predictor. The approaches tested are: a) The Benchmark: no geophysical data used / landscape scale hyper-scale terrain features only b) Using field scale soil calibration model on geophysical data, which has been extrapolated to the landscape. c) Using field scale geophysical calibration model to extend the field scale soil data pool. d) Using extrapolated geophysical data as additional predictors at the landscape scale. e) Using geophysics to extend the field scale soil data pool and using extrapolated geophysical data as additional predictors. Eighty soil samples at two depth intervals were derived to cover the feature space of the geophysical sensor data and for calibrating the soil property models. Validation is based on 20 fully independent soil samples outside the sampling areas to cover the geographical space. Validation shows that modelling approaches a and b perform worst resulting in $R^2 = 0.53$. Modelling approaches c – e show accuracies of up to $R^2 = 0.63$ (e). This significant increase clearly demonstrates the high potential of including field scale geophysical data for landscape scale digital soil mapping to meet the global growing demand of high-resolution soil data.



S04.01b -6

THE OPTIMAL CALIBRATION SET SIZE AND THE SAMPLING STRATEGY FOR MODELING SOIL VIS-NIR SPECTRA AT THE FIELD SCALE

Ramirez-Lopez Leonardo^[1], Demattê Jose^[2], Schmidt Karsten^[3], Behrens Thorsten^[3], Scholten Thomas^[3]

^[1]Université Catholique de Louvain / University of Tübingen ~ Georges Lemaître Centre for Earth and Climate Research, Earth and Life Institute / Institute of Geography, Physical Geography, University of Tübingen ~ Louvain-la-Neuve ~ Belgium ^[2]University of Sao Paulo ~ Soil Science ~ Piracicaba ~ Brazil ^[3]University of Tuebingen ~ Institute of Geography, Physical Geography ~ Tuebingen ~ Germany

Soil routine analyses are very expensive and time consuming. These issues represent key disadvantages for high resolution soil mapping at field scale. Quantification of soil attributes based on vis-NIR spectroscopy is rapid, accurate and more economic than conventional methods. By using a small (but representative) number of soil samples from a given area is possible to calibrate vis-NIR models of soil attributes and then those models to predict soil attributes efficiently in a large number of soil samples belonging to that area. Despite the well known potential of vis-NIR spectroscopy in soil attribute mapping, research on the adequate size of the calibration set has not received enough attention. In this work we investigated the effect of the calibration sampling strategy on the optimal calibration set size (oCSS). We compared three calibration sampling algorithms: Kennard-Stone (KS), fuzzy k-means (FKM) and conditioned latin hypercube (cLHS). These algorithms were used to identify the oCSS for clay content (CC) and exchangeable calcium (Ca++) using Support Vector Regressions (SVR). We collected 1000 samples at two depths in an area of 500 hectares located in Brazil. We concluded that the oCSS is largely affected by the calibration sampling strategy. Our results also suggest that in the context of proximal soil sensing an effective sampling strategy is very important especially when a small number of calibration samples are used.



S04.01c - APPLICATION OF PROXIMAL SOIL SENSING (PPS) IN SOIL SCIENCE

Chair Person:

Claudio Colombo, Campobasso - Italy

Thursday 05 July 2012 from 15:30 to 17:15. Room Olmo

S04.01c -1

OPTIMALISATION OF PASSIVE GAMMARAY SOIL SURVEYS

Eddie Loonstra, Groningen - Netherlands

S04.01c -2

REPEATED GAMMA-RAY MEASUREMENTS USING A MOBILE DEVICE ON A RIVER FLOOD PLAIN AREA

Claudia Dierke, Leipzig - Germany

S04.01c -3

UNDERSTANDING THE GAMMA-RAY SIGNAL OF SOILS - TOWARDS A QUANTITATIVE UNDERSTANDING OF FACTORS, PROCESSES AND PROPERTIES

Ludger Herrmann, Stuttgart - Germany

S04.01c -4

TESTING THE IDENTIFICATION OF GENETIC HORIZONS IN POLISH SOILS WITH THE DIFFUSE REFLECTANCE SPECTROSCOPY

Krzysztof Kusneirek, Poznan - Poland

S04.01c -5

DETECTION OF ANCIENT ACTIVE CHANNEL ZONES USING HYDROGEOPHYSICAL METHODS: AN APPROACH FOR MORE EFFECTIVE CHANNEL RESTORATION

Daniel Altdorff, Leipzig - Germany

S04.01c -6

A RAPID, PORTABLE METHOD FOR ACQUIRING TERRAIN MODELS OF SOIL SURFACES

John Quinton, Lancaster - United Kingdom



S04.01c -1

OPTIMALISATION OF PASSIVE GAMMARAY SOIL SURVEYS

Loonstra Eddie*^[1]

^[1]The Soil Company ~ ~ Groningen ~ Netherlands

Soil, as most substances on earth, is radioactive by nature. The activity concentration of radionuclides in soil can be measured with mobile passive gamma-ray soil sensor systems. This is a complex process in which several factors are of importance in order to retrieve qualitative data with low uncertainty. Basically caused by the fact that radioactive decay from the source "soil" is unpredictable and random, making mobile surveys harder. Optimisation of mobile passive gamma-ray surveys requires a balance of detector design, data processing and field operations. The scintillating material and its size are critical design parameters for the interaction with gamma-rays. The optimum efficiency will be obtained for a large detector volume with high density and high Z-values. The quality of the electronic components as photomultiplier, multichannel analyser and amplifier are relevant as well. The processing of the measured gamma-ray spectrum has to deal with stabilisation due to temperature drift and –more generic- calibration of the detector. Several denoising methods exist to overcome uncertainty caused by external factors as survey speed, detector height, water & rock content in soil. The statistical approach used to estimate soil property maps determines the method of data processing and analysis. The spectrum analysis approach also affects the uncertainty of the outcome. Side effects of external sources such as cosmic radiation can be overcome by calibrating the detector. However, for the negative effects of rainfall or nonsoil objects that consist of minerals on a survey no corrective solution are available. These circumstances simply must be avoided.



S04.01c -2

REPEATED GAMMA-RAY MEASUREMENTS USING A MOBILE DEVICE ON A RIVER FLOOD PLAIN AREA

Dierke Claudia*^[1], Werban Ulrike^[1]

^[1]Helmholtz Centre for Environmental Research - UFZ ~ Monitoring and Exploration Technologies ~ Leipzig ~ Germany

In the past, gamma-ray measurements have been used for geological surveys and deposit exploration using airborne and borehole logging systems. For these applications, the relationships between the measured physical parameter – the concentration of natural gamma emitters ⁴⁰K, ²³⁸U and ²³²Th – and geological origin or sedimentary developments are well described. Based on these applications and knowledge in combination with adjusted sensor systems, gamma-ray measurements are used to derive soil parameters to create detailed soil maps e.g., in digital soil mapping (DSM) and monitoring of soils. Therefore, not only qualitative but also quantitative comparability is necessary. Grain size distribution, type of clay minerals and organic matter content are soil parameters which directly influence the gamma-ray emitter concentration. The concentration is influenced by endogenous processes like soil moisture variation, erosion and deposition of material or cultivation. A time series of gamma-ray measurements was used to observe changes in gamma-ray concentration on a floodplain area in Central Germany. The study area is characterised by high variations in grain size distribution and occurrence of flooding events. For the survey, we used a 4l NaI(Tl) detector with GPS connection mounted on a sledge, which is towed across the field sites by a four-wheel-vehicle. The comparison of data from different dates shows similar structures with small variation between the data ranges and shape of structures. We will present our experiences concerning the measurement under variable field conditions and their impacts on gamma-ray data quality.



S04.01c -3

UNDERSTANDING THE GAMMA-RAY SIGNAL OF SOILS - TOWARDS A QUANTITATIVE UNDERSTANDING OF FACTORS, PROCESSES AND PROPERTIES

Herrmann Ludger^[1], Schuler Ulrich^[2], Erbe Petra^[1], Baritz Rainer^[2], Stahr Karl^[1]

^[1]Institute of Soil Science and Land Evaluation ~ University of Hohenheim (310) ~ Stuttgart ~ Germany ^[2]Federal Institute for Geosciences and Natural Resources (BGR) ~ B2.2 Spatial Information Soil and Water ~ Hannover ~ Germany

Gamma-ray spectrometry is an underestimated technique for soil mapping though it has a higher potential than other ones, since it can deliver information on soil forming factors (parent rock), processes (erosion, clay illuviation) and properties (i.e. texture) and can be applied via proximal as well as remote sensing at the same time. One major reason for its limited application is that so far statistical correlation with properties was applied rather than quantitative understanding of the signal searched for. The paper reviews the dominant factors and processes influencing the gamma-ray signature based on case studies in Thailand and Germany and presents applications for WRB soil reference group, erosion and soil property mapping.



S04.01c -4

**TESTING THE IDENTIFICATION OF GENETIC HORIZONS IN POLISH SOILS WITH THE
DIFFUSE REFLECTANCE SPECTROSCOPY**

Kazmierowski Cezary^[1], Kusneirek Krzysztof^{*[1]}

^[1]Adam Mickiewicz University ~ Department of Soil Science and Remote Sensing of Soils ~ Poznan ~ Poland

A proper description of a soil profile requires an expert knowledge about genetic horizons, but often the soil reconnaissance, analysis and sampling in the field is conducted by inexperienced soil scientists or farmers. The aim of this work is to test how the information brought by the laboratory diffuse reflectance spectroscopy of the air-dried and sieved samples correlates with the actual classification of soil horizons and profiles as well as with some qualitative soil properties. This analysis shows to what extent it is possible to be verify the identification of a given soil horizon sample by an automated analysis. Samples from a variety of soil types, collected in several sampling campaigns across various landscapes of Poland, were taken into consideration, including (according to the WRB): Albeluvisols, Arenosols, Cambisols, Chernozems, Fluvisols, Gleysols, Luvisols, Phaeozems, Regosols, an Rendzic Leptosols. This dataset of soils incorporated several surface and subsurface horizons such as: albic, argic, calcic, cambic, histic, melanic, mollic, to name few. Several methods were used in this study for extracting the spectral information from Vis-NIR spectra measured in the laboratory conditions by ASD FieldSpec3 spectrometer. Apart from using multivariate factorial and clustering methods, widely adopted in soil spectroscopy, also simple analyses of the shape of the spectra using mathematical transformations and indices were conducted.



S04.01c -5

DETECTION OF ANCIENT ACTIVE CHANNEL ZONES USING HYDROGEOPHYSICAL METHODS: AN APPROACH FOR MORE EFFECTIVE CHANNEL RESTORATION

Altdorff Daniel^{*[1]}, Dietrich Peter^[1], Epting Jannis^[2], Huggenberger Peter^[2]

^[1]Helmholtz Centre for Environmental Research - UFZ ~ Department Monitoring and Exploration Technologies ~ Leipzig ~ Germany ^[2]Applied and Environmental Geology University of Basel ~ Department of Environmental Sciences ~ Basel ~ Switzerland

River restoration and applied restoration measures are of increasing importance for integrated water resources management as well as for ecosystem services. However, often river restoration is planned and realized by engineering and constructing aspects only and hydrogeological settings and ancient active channel (ACC) are neglected. As a result desired outcomes of restoration projects are reduced with no significant alteration of stream conditions. An opportunity to reach the full restoration potential is to investigate ancient active stream courses by applying hydrogeophysical. In this study, we investigate the ACC zone in a floodplain of a modified low-mountain river in Switzerland by means of hydrogeophysical data with two different approaches. In the first approach we generate iteratively by means of various electric conductivity (EC) forward models a 3D geological structure model (GSM) for delineation of potential ACC. Thereby we vary the geological input parameters based on the measured data until the synthetic EC maps fit to the real EC values. Subsequently we use the best fitted input data for generation of final GSM. In a second approach we generate a K-means cluster map for the floodplain surface that combines the main characteristics from multilayered subsurface data. The obtained cluster delineates parts of significant different soil conditions and provides therewith an indication for areas above potential ACC. Hence the map distinct between areas of higher and lower flood vulnerability as well as higher and lower possible river affection. A comparison with independent Ground Penetrating Radar data has confirmed the obtained structures of both results.



S04.01c -6

A RAPID, PORTABLE METHOD FOR ACQUIRING TERRAIN MODELS OF SOIL SURFACES

James Mike R^[1], Rodriguez Gonzalez Jesus^[2], Quinton John^{*[1]}, Gomez Jose A^[2]

^[1]Lancaster University ~ Lancaster Environment Centre ~ Lancaster ~ United Kingdom ^[2]Universidad de Córdoba (UCO) ~ Instituto de Agricultura Sostenible (IAS-CSIC) ~ Córdoba ~ Spain

In this paper we demonstrate developments in computer vision technology that now offer soil scientists a new option for acquiring high precision, high accuracy topographic information across a range of scales, using freely available software and little more than a consumer-grade digital camera. The technique is based on collecting multiple photographs of a scene from different positions, but without the relatively strict image acquisition and control point requirements of traditional photogrammetry. Automated 'reconstruction pipeline' software (that can be downloaded from the internet, e.g. <http://www.visual-experiments.com/demos/sfmtoolkit/>) then uses a combined structure-from-motion and multi-view stereo approach (SfM-MVS) to generate dense point clouds of millions of points. For accuracy, and to allow error analysis, additional software (http://www.lancs.ac.uk/staff/jamesm/software/sfm_georef.htm) has been developed to permit georeferencing using observations made within the image set, rather than requiring feature matching within the point cloud. Here, we demonstrate the reconstruction technique on agricultural field sites that have undergone different surface treatments with a roller, chisel plough and mouldboard plough. The SfM-MVS technique produced point clouds with a density of ~50 points cm⁻² were generated, from which DEMs with grid intervals of 5 mm were produced. The DEMs showed RMS residuals of <5.6 mm when compared with data acquired by an in-house laser-based system. A lack of systematic error suggests that SfM-MVS techniques could offer a viable low-cost alternative to laser-based measurement techniques at this (and other) spatial scales, with additional advantages of reduced acquisition time and portability.



S04.02a - REMOTE SENSING TECHNIQUES FOR SOIL CHARACTERIZATION AND MONITORING

Chair Persons:

Tiziana Simoniello, Potenza - Italy

Steven De Jong, Utrecht - Netherlands

Friday 06 July 2012 from 08:30 to 10:00. Room Acero

S04.02a -1

IMPROVING THE SATELLITE-BASED CHARACTERIZATION OF RANGELAND DEGRADATION BY AN ADVANCED MULTIPLE ENDMEMBER SPECTRAL UNMIXING APPROACH

Joachim Hill, Trier - Germany

S04.02a -2

TOWARDS NOVEL APPROACHES FOR COMPILING REMOTE SENSING

Michael Cherlet, Ispra - Italy

S04.02a -3

INTEGRATING ENVIRONMENTAL INFORMATION IN GULLY INITIATION TOPOGRAPHIC THRESHOLDS : APPLICATION TO THREE REGIONS OF WALLONIA (BELGIUM)

Alexandre Maignard, Louvain-la-Neuve - Belgium

S04.02a -4

ESTIMATING RAINFALL EROSIVITY FOR AFRICA WITH TRMM DATA

Anton Vrieling, Enschede - Netherlands

S04.02a -5

SPECTRAL MAPPING OF MEDITERRANEAN SOIL SURFACE CRUSTS

Steven De Jong, Utrecht - Netherlands

S04.02a -6

INTRODUCTION TO INDEXES IN IDENTIFICATION OF SALINE SOILS BY USING OF ASTER AND LISS III DATA

Seyed Kazem Alavipanah, Tehran - Iran, Islamic Republic of



S04.02a -1

**IMPROVING THE SATELLITE-BASED CHARACTERIZATION OF RANGELAND DEGRADATION
BY AN ADVANCED MULTIPLE ENDMEMBER SPECTRAL UNMIXING APPROACH**

Hill Joachim*^[1]

^[1]University of Trier ~ Environmental Remote Sensing & Geoinformatics ~ Trier ~ Germany

Land degradation in semi-arid and sub-humid rangelands is usually dominated by processes of soil degradation/erosion and the associated loss of biotic productivity, tightly coupled through characteristic feedback loops. The use of optical remote sensing systems for monitoring and characterizing such interconnected processes over time requires efficient analytical tools for decoupling the spectral effects of changing soil and vegetation conditions. Since regular (multi-annual) observation strategies will unavoidably be affected by phenological variations it is especially important not only to assess the photosynthetic but the total (i.e. green and dry) biomass changes in comparison to soil characteristics. Standard vegetation indices are not useful for solving this task as they are sensitive to subtle variations of green biomass but largely disturbed by soil and dry vegetation signal components. Spectral mixture analysis (SMA) provides a more efficient interpretative framework. However, SMA is prone to numerical problems and decreasing accuracies in case that spectrally similar endmembers must be considered simultaneously. This study demonstrates how these limitations can be overcome through a computationally efficient strategy for using multiple spectral endmember configurations. The algorithm is validated against spectra of known biophysical characteristics and different soil backgrounds which are simulated through a geometric optics leaf-canopy reflectance model (Prospect-5 - 4SAIL - FLIM). Its application to real satellite observations (Landsat-TM/ETM+ and MODIS) is demonstrated in the context of a study on long-term rangeland degradation in Inner Mongolia (China) initiated within the DeSurvey Project (EU FP6).



S04.02a -2

TOWARDS NOVEL APPROACHES FOR COMPILING REMOTE SENSING

Cherlet Michael^[1], Ivits Eva^[1], Sommer Stefan^[1], Mehl Wolfgang^[1]

^[1]European Commission ~ DG Joint Research Centre ~ Ispra ~ Italy

A new World Atlas on Desertification (WAD) is being compiled under joint coordination of the ECJRC and UNEP. The need for baseline information on the status of desertification and land degradation, along with agreed methodologies has to be addressed urgently. At global scales, information on vegetation/land cover dynamics is a core component to assess the state of desertification and land degradation resulting from a combination of natural/environmental and human/socio-economic drivers. Many studies use Vegetation Indices (VI) as base layer and we enhance this information by calculating phenological metrics from the VI time series to derive further insight on vegetation cover functioning and related land use. In this study, we objectively select phenological metrics best adapted to specific human-ecological systems through an adapted stratification. Their combined variation is analysed related to compositional changes e.g. land use changes, and against inter-annual meteorological fluctuation within the stratification. We rely on a scheme of convergence of evidence of trend and change from combinations of the metrics that are interpreted as descriptors of the dynamics and fluctuation of the Human-Environment system. Derived baseline products describe the status and productive capacity of vegetation/land cover during a reference time period, reflecting the regime of inter-annual fluctuation, together with a likely tendency to maintain the current functional level for the provision of the related ecosystem service. Results are compared to land degradation assessments for selected areas.



S04.02a -3

INTEGRATING ENVIRONMENTAL INFORMATION IN GULLY INITIATION TOPOGRAPHIC THRESHOLDS : APPLICATION TO THREE REGIONS OF WALLONIA (BELGIUM)

Maugnard Alexandre^{*[1]}, Charles Bielders^[1], Senne Van Dyck^[1], H  l  ne Cordonnier^[2], Abdel Ilah Mokadem^[2]

^[1]Universit   catholique de Louvain ~ Earth and Life Institute ~ Louvain-la-Neuve ~ Belgium ^[2]Service Public de Wallonie ~ Direction G  n  rale Op  rationnelle de l'Agriculture, des Ressources Naturelles et de l'Environnement ~ Namur ~ Belgium

Gully erosion is responsible for 20% to 80% of the total soil erosion by water in Belgium and causes serious damages. In order to explain and predict the initiation of gully erosion, many studies have focused on topographic thresholds which depend on the contributing area and slope at the gully head. However, this approach does not integrate specific environmental information such as soil type and land use. Furthermore, several methods exist to determine the threshold. This study proposes a simple methodology to integrate soil and land use information in the topographic thresholds and compares the two main approaches used for drawing gully initiation thresholds. This methodology is applied to 3 agro-pedological regions of Wallonia (Belgium). For each region, a gully database was created by digitizing gullies on the basis of aerial photographs. Slopes and contributing areas at the gully heads as well as land use and soil type in the contributing areas were extracted. Using this information, runoff volumes were calculated using the SCS Curve Number method. Gully initiation thresholds defined using slope and runoff volume are compared with thresholds based on slope and contributing area. The former approach is better able to discriminate among contributing areas that have heterogeneous land uses and soil types. We found that regional differences in topographic and environmental conditions lead to differences in the thresholds. These differences are dependent on the type of thresholding method used. . The observed differences are sensitive to the method used for drawing the threshold.



S04.02a -4

ESTIMATING RAINFALL EROSIVITY FOR AFRICA WITH TRMM DATA

Vrieling Anton*^[1], Sterk Geert^[2], De Jong Steven M.^[2]

^[1]University of Twente ~ Faculty of Geo-Information Science and Earth Observation ~ Enschede ~ Netherlands ^[2]Utrecht University ~ Department of Physical Geography ~ Utrecht ~ Netherlands

Rainfall erosivity is a measure for the erosive force of rainfall. Rainfall kinetic energy determines the erosivity and is in turn greatly dependent on rainfall intensity. Attempts for its large-scale mapping are rare. Most are based on interpolation of erosivity values derived from rain gauge data. For data-poor regions this is not an option. This study examines whether erosivity can be accurately mapped for Africa using 3-hourly TRMM Multi-satellite Precipitation Analysis (TMPA) precipitation data. Using intensity-erosivity relationships and 11 years of TMPA data (1998-2008) we calculated average annual erosivity. We also calculated erosivity from the monthly TMPA data product using the often-applied Fournier and modified Fournier indices. From literature 39 locations with long-term erosivity values were retrieved. Comparison showed that the modified Fournier index attains a much stronger correlation ($r=0.84$) than the results based on 3-hourly data ($r=0.71$). We conclude that 1) the 3-hourly and 0.25-degree TMPA data provide insufficient detail to represent high intensity erosive events, and 2) monthly satellite-based precipitation provides good spatial estimates of average annual erosivity. Furthermore we discuss how satellite assessments of rainfall erosivity could be used in the future for improved monitoring of soil erosion.



S04.02a -5

SPECTRAL MAPPING OF MEDITERRANEAN SOIL SURFACE CRUSTS

De Jong Steven^{*[1]}, Elisabeth Addink^[1], Rens Van Beek^[1]

^[1]Utrecht University ~ Geosciences ~ Utrecht ~ Netherlands

Soil surface crusts frequently occur in Mediterranean areas. They form on bare soil subject to high-intensity rainfall, resulting in a hard, impenetrable layer that impedes infiltration and hampers the germination and establishment of plants. The adverse consequences of overland flow and reduced fertility can lead to erosion and ongoing degradation. Therefore, information on the distribution of surface crusts is essential to combat the undesired effects. In a study area in southern France we compared the physical and hydrological properties of crusts and underlying soil, we identified spectral characteristics (400-2500 nm) of the crusted and non-crusted soil surfaces using high-resolution field spectra, and we investigated the potential of mapping crust occurrence using airborne, hyperspectral images. Crusting markedly reduces the infiltration capacity and crust strength varies between soil types. Spectral differences are small, mainly in albedo values and in absorption band depth and shape. Differences in absorption band features in the spectra of crusts and noncrusted surfaces are small. Spectral feature fitting and linear spectral unmixing algorithms were applied to airborne images to evaluate the possibilities of mapping surface crusts. Crusts could be mapped in fallow, agricultural fields, but the spectral response of natural badlands was too fragmented for crust mapping.



S04.02a -6

INTRODUCTION TO INDEXES IN IDENTIFICATION OF SALINE SOILS BY USING OF ASTER AND LISS III DATA

Alavipanah Seyed Kazem*^[3], Matinfar Hamid Reza^[2], Sarmasti Nader^[3], Jafarbeglou Mansoor^[3], Goodarzi Mehr Saeed^[3]

^[1]tehran university ~ cartography ~ Tehran ~ Iran, Islamic Republic of ^[2] University of Lorestan ~ soil science ~ Tehran ~ Iran, Islamic Republic of ^[3]university of tehran ~ cartography ~ Tehran ~ Iran, Islamic Republic of

Rapid identification and large-scale mapping of salt-affected soils will help improve salinity management in watersheds and ecosystems. Remote sensing data for the reason of broad and integrated view, better capability for calibration and multi spectral and temporal data are useful tools for identifying salt. Salts tends to concentrate on the soil surface in dry and irrigated areas. As salinity increases, more salts will appear at the soil surface, favoring the use of conventional remote sensing tools. Potentiality of various sensors is important in detecting saline soils and salt crusts. Therefore, in this study we evaluated the data of ASTER and LISS III sensors in Playas of DAMGHAN, KASHAN and MAHARLOO regions, IRAN. The first, the imageries corrected and then we used principal component analysis, normalize difference vegetation index and band rationing in detecting of saline soils. In the band rationing method, two indices were applied, normalized difference salt crust index (NDSCI) and ratio salt crust index (RSCI). Investigation of feature space graphs in saline and non-saline soils indicated that NDSCI and RSCI had the best separability. Then, the maps of these soils prepared. In these maps, saline soils with salt crusts were perfectly clear. In applied approaches showed, band rationing and using of these two indexes (NDSIC and RSCI) were very efficient.



S04.02b - REMOTE SENSING TECHNIQUES FOR SOIL CHARACTERIZATION AND MONITORING

Chair Persons:

Stefano Pignatti, Potenza - Italy

Anton Vrieling, Twente - Netherlands Mariagrazia D'Emilio, Napoli - Italy

Friday 06 July 2012 from 10:30 to 12:00. Room Acero

S04.02b -1

SPATIAL AND TEMPORAL TOPSOIL WATER CONTENT MAPPING IN ALPINE AREA BY USING SAR IMAGES

Claudia Notarnicola, Bolzano - Italy

S04.02b -2

NEW DEVELOPMENTS TOWARDS OPERATIONAL SOIL SURFACE CHARACTERIZATION AND MONITORING BASED ON HYPERSPECTRAL IMAGERY: THE HYSOMA TOOLBOX

Sabine Chabrillat, Potsdam - Germany

S04.02b -3

ESTIMATING FIELD SCALE SOIL TEXTURAL PROPERTIES FROM AIRBORNE AND SATELLITE IMAGING SPECTROSCOPY

Raffaele Casa, Viterbo - Italy

S04.02b -4

MAPPING VINEYARD TOPSOIL USING VERY HIGH SPATIAL RESOLUTION IMAGERY IN BURGUNDY, FRANCE

Emmanuel Chevigny, Dijon - France

S04.02b -5

SOIL HYDRAULIC PROPERTIES FROM LOCAL TO REGIONAL SCALE USING REMOTE SENSING AND PHYSICS-BASED MODEL

Binayak Mohanty, College Station - United States

S04.02b -6

QUANTITATIVE RESULTS FROM A NOVEL APPROACH TO REMOTE SENSING OF SOIL MOISTURE CONTENT IN A MICRO PROFILE SECTION UNDER VARIOUS PRECIPITATION ENERGIES

Alon Eliran, Tel Aviv - Israel



S04.02b -1

SPATIAL AND TEMPORAL TOPSOIL WATER CONTENT MAPPING IN ALPINE AREA BY USING SAR IMAGES

Pasolli Luca^[1], Notarnicola Claudia^[2], Bruzzone Lorenzo^[3], Bertoldi Giacomo^[4], Niedrist Georg^[4], Tappeiner Ulrike^[4], Zebisch Marc^[2]

^[1]EURAC-Università di Trento ~ Institute for Applied Remote Sensing-Dep. of Information Engineering and Computer Science ~ Bolzano ~ Italy ^[2]EURAC ~ Institute for Applied Remote Sensing ~ Bolzano ~ Italy ^[3]Università di Trento ~ Dep. of Information Engineering and Computer Science ~ Trento ~ Italy ^[4]EURAC ~ Institute of Alpine Environment ~ Bolzano ~ Jersey

The SOFIA project (ESA AO-6280), supported by the Province of Bolzano in the framework of the IRKIS project, aimed at investigating the effectiveness of new generation SAR imagery for the estimation of topsoil moisture content in mountain environments. In this paper we present the main results of the activity carried out in this framework. A set of 30 fully polarimetric RADARSAT2 SAR images acquired over the Alto Adige area (Northern Italy) during the summer 2010 and 2011 has been analyzed. The data have been processed using an advanced retrieval algorithm based on the Support Vector regression method and ancillary data for obtaining spatially and temporally distributed maps of soil moisture content over alpine pasture and meadows. The output maps have been compared with ground measurements of soil moisture content at different depths as well as precipitation data from meteorological stations. The aim was to assess the effectiveness of the SAR data and the proposed algorithm to derive robust and accurate information on the topsoil moisture status in alpine areas. The achieved results are promising and suggest the effectiveness of the proposed retrieval system in following both the spatial and temporal patterns of the variable of interest. A main limitation encountered is the reduced swath of RADARSAT 2 polarimetric SAR imagery. This prevents the possibility to acquire multiple scenes over the same area with different geometries, in order to minimize the effects of geometric distortions that are common in SAR imagery of mountain areas where the sideslopes have different orientations.



S04.02b -2

NEW DEVELOPMENTS TOWARDS OPERATIONAL SOIL SURFACE CHARACTERIZATION AND MONITORING BASED ON HYPERSPECTRAL IMAGERY: THE HYSOMA TOOLBOX

Chabrillat Sabine^[1], Andreas Eisele^[1], Stephane Guillaso^[2], Eyal Ben-Dor^[3], Martin Bachmann^[4], Hermann Kaufmann^[1]

^[1]GFZ German Research Center for Geosciences ~ Section 1.4 Remote sensing ~ Potsdam ~ Germany ^[2]Berlin University of Technology ~ Computer Vision and Remote Sensing ~ Berlin ~ Germany ^[3]Tel Aviv University ~ The Department of Geography and the Human Environment ~ Tel Aviv ~ Israel ^[4]DLR German Aerospace Center ~ German Remote Sensing Data Center, Applied Spectroscopy workgroup ~ Wessling ~ Germany

Can we develop automatic algorithms for soil mapping based on spectral reflectance? This question comes nowadays at a high relevance level with the upcoming launch of the next generation of hyperspectral satellites (EnMap, Hyper-X, HypSIrI, HypXIM) and the increasing demand for the availability/accessibility of hyperspectral soil products from the geoscience community. The availability of automatic toolboxes will be a major step toward the operational use of soil hyperspectral products for Earth's surface processes monitoring and modelling, allowing non-experienced users to access new information with non-expensive software packages where repeatability of the results is an important prerequisite. In the frame of the EU-FP7 EUFAR (European Facility for Airborne Research) project and EnMap science program, higher performing soil algorithms were developed as demonstrators for end-to-end processing chains with harmonized quality measures. For this, the HYSOMA (Hyperspectral SOil MAPper) software interface was developed at the GFZ German Research Center for Geosciences. It focuses on the fully automatic generation of semi-quantitative soil maps for key soil parameters such as soil moisture, soil organic carbon, soil minerals (iron oxides, clay minerals, carbonates). The validation of the HYSOMA soil products based on ground truth data showed correlations from R² of 0.6 (clay) up to >0.9 (moisture). The HYSOMA is IDL-based and distributed for free under the idl-virtual machine. It is integrated in DLR hyperspectral processing chain, and (in process) in EUFAR Toolbox. In this presentation, we will show the HYSOMA interface, methods used, and case studies demonstrating the capabilities of the software.



S04.02b -3

ESTIMATING FIELD SCALE SOIL TEXTURAL PROPERTIES FROM AIRBORNE AND SATELLITE IMAGING SPECTROSCOPY

Casa Raffaele^{*[3]}, Castaldi Fabio^[3], Pascucci Simone^[2], Palombo Angelo^[2], Pignatti Stefano^[2]

^[1]University of Tuscia ~ Dipartimento di Scienze e Tecnologie per l'Agricoltura, le Foreste, la Natura e l'Energia (DAFNE) ~ Viterbo ~ Italy ^[2]Consiglio Nazionale delle Ricerche ~ IMAA ~ Potenza ~ Italy ^[3]University of Tuscia ~ DAFNE ~ Viterbo ~ Italy

Imaging spectroscopy of bare soils has been shown to have considerable potential for the estimation of properties such as soil texture, determined by clay, silt and sand fractions. Such information would allow the improvement of agronomic management, on the basis of rapid and cost-effective assessment of soil spatial variability. In the present study, images were acquired, by airborne MIVIS (430 – 1270 nm) and space-borne CHRIS-PROBA (415 – 1050 nm) sensors, over bare soil fields in Maccarese, Central Italy, at different dates in 2010 and 2011. Concurrently, extensive soil sampling was carried out for lab determination of soil particle size fractions. Soil analysis data were used to derive maps of measured clay, silt and sand, by means of kriging. Soil data were linked to the spectral signature of corresponding CHRIS or MIVIS pixels. Spectra, corrected and pre-treated, were used to calibrate prediction models for the estimation of clay, silt and sand, through partial least-square regression (PLSR). The performance of the predictions was subsequently evaluated by employing an independent dataset, acquired over an adjacent field. Accuracy of predictions was assessed from several statistics, such as bias, root mean square error of prediction and ratio of standard error of prediction to sample standard deviation (RPD). The results revealed the importance of the conditions in which the images were acquired, such as the pattern of soil moisture. This aspect explained why, despite a more limited spectral range and a lower spatial resolution of CHRIS as compared to MIVIS, better predictions were obtained.



S04.02b -4

MAPPING VINEYARD TOPSOIL USING VERY HIGH SPATIAL RESOLUTION IMAGERY IN BURGUNDY, FRANCE

Chevigny Emmanuel^[1], Amélie Quiquerez^[1], Christophe Petit^[3], Pierre Curmi^[4]

^[1]UMR CNRS 5594 ARTeHIS ~ Université de Bourgogne ~ Dijon ~ France ^[2]UMR CNRS LGL-TPE 5276 ~ Université Claude Bernard ~ Lyon ~ France ^[3]UMR 7041 ArScAn ~ Université Paris 1 ~ Paris ~ France ^[4]UMR CNRS Agroécologie Dijon ~ Université de Bourgogne, AGROSUP, INRA ~ Dijon ~ France

Vineyards are known to undergo substantial soil loss in comparison with other types of agricultural land. In this context, local observation of soil loss highlights a high degree of spatial heterogeneity resulting from intra-plot topsoil variability. Studying the relationship between soils and their degradation is therefore crucial in this situation where soil sustainability is threatened. We developed a method based on very high spatial resolution (VHSR) image analysis into visible domain to map vineyard topsoil in Burgundy (France). Aerial images were acquired by the unmanned helicopter Drelia at a 2 cm spatial resolution. After pre-processing images (georeferencing, mosaicing...), we applied principal components analysis to identify several soil surface characteristic classes SSC on images mosaic. Soil surface mapping obtained from images analyze was combined with soil surface descriptions and soil profiles to define soil types by physical and chemical characteristics. Soil sampling was done according the spatial distribution of SSC. For each class, random samples were collected to identify physical (stoniness, soil color, grain-size distribution and clay mineralogy) and chemical (organic matter, nitrogen, iron and total carbonate contents) parameters that characterized soil types in these vineyard hillslopes. By allowing soil surface states to be mapped with a centimeter resolution, this approach provides novel insights and possibilities for documenting soil patterns and for exploring and predicting soil evolution through space and time on hillslopes.



S04.02b -5

SOIL HYDRAULIC PROPERTIES FROM LOCAL TO REGIONAL SCALE USING REMOTE SENSING AND PHYSICS-BASED MODEL

Mohanty Binayak*^[1]

^[1]Texas A&M University ~ Biological and Agricultural Engineering ~ College Station ~ United States

Ensemble hydrologic fluxes (including evapotranspiration, infiltration, shallow ground water recharge) within and across the vadose zone reflect the evolution of soil moisture at a particular spatial scale (field, watershed, or region) and can be “effectively” represented by one or more linear/nonlinear hydrologic scale parameters. Overarching the above concepts, we hypothesized that effective soil hydraulic property in the root zone at the footprint-scale is an effective indicator for combined soil, topography, and vegetation heterogeneities in land-atmosphere interaction models at different spatial scales. To test this overarching scientific hypothesis we utilize state-of-the-art remotely sensed (RS) soil moisture data at multiple resolutions with a newly developed inverse model including a soil-water-atmosphere-plant model and advanced parameter estimation techniques. Effective root zone soil hydraulic parameters estimated using deterministic or stochastic inverse modeling approach (top-down) will be tested and compared for relative performance against numerical-cum-measurement upscaling schemes (bottom-up) for steady and transient conditions inclusive of various soil textures and structures, small and large scale topographic features, and a range of land covers and root distributions. Predictive watershed scale modeling will test our hypothesis that “effective” hydraulic properties with larger RS footprint-scale measurement support are better predictors than “upscaled” hydraulic properties using local-scale measurements and scaling rules, based on estimated hydrologic fluxes (runoff/stream flow, ET, and soil moisture) and their uncertainties.



S04.02b -6

QUANTITATIVE RESULTS FROM A NOVEL APPROACH TO REMOTE SENSING OF SOIL MOISTURE CONTENT IN A MICRO PROFILE SECTION UNDER VARIOUS PRECIPITATION ENERGIES

Eliran Alon^{*[1]}, Goldshleger Naftaly^[2], Yahalom Asher^[3], Ben-Dor Eyal^[4], Agassi Menachem^[2]

^[1]Tel Aviv University ~ Porter School of Environmental Studies ~ Tel Aviv ~ Israel ^[2]Ministry of Agriculture and Rural Development ~ Soil Erosion Research Station ~ Rupin ~ Israel ^[3]Ariel University Center ~ Electrical and Electronics Engineering ~ Ariel ~ Israel ^[4]Tel Aviv University ~ Geography and Human Environment, Remote Sensing Laboratory ~ Tel Aviv ~ Israel

We present a first low-cost measurement of the micro-profile of soil moisture-content in the upper root zone. The method is based on millimetre waves, providing improved resolution of the sub-surface concurrent with surface mapping. Development and use of the tools described herein will make it easier to understand processes governing the soil-water interface, such as crust. Point-by-point soil sampling within a field is time-consuming and expensive. Hyperspectral remote sensing in the VIS-NIR-SWIR range (0.4-2.5 μm) is only capable of surface sensing. Ground-penetrating radar (GPR), operating in the range 10 MHz to 5 GHz, penetrates loess soil, for example, to a depth of up to 30 m; however, its resolution at root zone tends to be limited to about 5 to 10 cm. Millimetre waves offer resolution on the order of millimetres and penetration depths on the order of centimetres, thus providing the optimal trade-off between the two parameters. Backscattering of millimetre waves from two soils with different levels of moisture content was measured at 94 GHz. The results show soil-moisture content to be correlated with the standard deviation of the angular variation of the backscattering coefficient of millimetre-wave radiation. The detection depth can be extended with the use of higher incident power from 10 cm currently to include the entire root zone. In the horizontal dimension, the addition of the millimetre-wave technique to existing ones should enable focusing on small regions of interest on the order of 1 m².



S04.03 - SOIL MICRO-HETEROGENEITY: NOVEL MEASUREMENT TECHNIQUES, MODELLING AND MACROSCOPIC IMPACTS

Chair Persons:

Philippe C. Baveye, Troy - United States

Veronica Morales, Abertay - United Kingdom

Friday 06 July 2012 from 08:30 to 10:00. Room Alloro

S04.03 -1

REVEALING SOIL FEATURES AND PROCESSES USING NANOSIMS

Carmen Hoeschen, Freising-Weihenstephan - Germany

S04.03 -2

PROBING SOIL MICROHETEROGENEITY BY NUCLEAR MAGNETIC RESONANCE (NMR)

Sabina Haber-Pohlmeier, Aachen - Germany

S04.03 -3

DYNAMICS OF ROOT RESPONSES TO WATER HETEROGENEITY IN SOIL USING NEUTRON RADIOGRAPHY

Abbas Dara, Potsdam - Germany

S04.03 -4

NETWORK MODELS TO INVESTIGATE THE ROLE OF SOIL STRUCTURAL HETEROGENEITY ON MICROBIAL INVASION

Francisco J. Perez-Reche, Dundee - United Kingdom

S04.03 -5

QUANTIFYING DISTURBANCE OF SOIL STRUCTURE AT MICROBIAL SCALES IN THE PREPARATION OF BIOLOGICAL SECTIONS

Thilo Eickhorst, Bremen - Germany

S04.03 -6

MODELING AND RECONSTRUCTION OF SOIL MICROSTRUCTURE USING STATISTICAL PHYSICS METHODS AND SIMULATED ANNEALING

Marina Karsanina, Moscow - Russian Federation



S04.03 -1

REVEALING SOIL FEATURES AND PROCESSES USING NANOSIMS

Hoeschen Carmen^{*[1]}, Mueller Carsten W.^[1], Lugmeier Johann^[1], Koelbl Angelika^[1], Koegel-Knabner Ingrid^[1]

^[1]Technische Universität München ~ Lehrstuhl für Bodenkunde ~ Freising-Weihenstephan ~ Germany

Soils are structurally highly heterogeneous systems down to submicron scales. Although processes as the formation of soil interfaces and aggregates which are relevant for the sorption of organic matter are well characterized for the bulk soil, an adequate technique to analyse them in-situ at relevant scale is required. We discuss the state of the art NanoSIMS technology employed at TU München to characterize soil micro-scale interfaces in intact soil aggregates. The NanoSIMS 50L instrument providing a high lateral resolution enables us to study elemental / isotopic distributions at submicron ranges in soil samples. The aim of the present study was to track the fate of fresh OM in intact soil aggregates. Aggregates from a labelling experiment with litter enriched in ¹⁵N were analyzed. The soil material sampled in spring was derived from a cropland (Cambisol) topsoil in Southern Germany on which mustard litter enriched in ¹⁵N was added in fall. The results illustrate that the ¹⁵N-labelled organic matter can be located in micron sized hot spots within the intact soil aggregates. In contrast to first assumptions the ¹⁵N was tracked in mineral rich spheres and not in particulate OM within the soil aggregate. Our data demonstrate that NanoSIMS is a promising tool to visualize soil features which determine specific soil processes at until now unresolved spatial scale.



S04.03 -2

PROBING SOIL MICROHETEROGENEITY BY NUCLEAR MAGNETIC RESONANCE (NMR)

Haber-Pohlmeier Sabina^[4], Watzlaw Jan^[2], Pohlmeier Andreas^[3], Blümich Bernhard^[4]

^[1]RWTH Aachen University ~ ITMC ~ Aachen ~ Saint Barthélemy ^[2]RWTH Aachen University ~ IWE-1 ~ Aachen ~ Germany ^[3]Research Centre Jülich ~ IBG-3 ~ Jülich ~ Germany ^[4]RWTH Aachen University ~ ITMC ~ Aachen ~ Germany

Soils as heterogeneous systems possess a broad range of functions in the environment, most of them related to water content and fluxes. Among the non-invasive techniques, nuclear magnetic resonance (NMR) methods are particularly convenient since they probe directly the substance of interest: Water. Besides spectroscopy, NMR can be applied in soils as relaxometry, where information about the local dynamics of water in pores is obtained allowing further conclusions about pore sizes and connectivities[1], or as imaging which resolves these parameters spatially. Here we present NMR results obtained with two modified NMR setups. First, the common rf-coil for volume excitation is replaced by a microcoil which probes an area of about 1 mm² and is inserted directly into natural soil material placed in a Halbach magnet. Using relaxometry methods local water content and dynamics can now be monitored locally. The second setup uses a contact-free sensor, the NMR-MOUSE [2], which probes moisture profiles beyond its surface in 200 µm thick slices down to a depth of 2.5 cm. This set-up is extended by a micro-gradient system which additionally allows to obtain high resolution 2D images from the selected slices. The aim is to investigate the interface between soil and roots: the rhizosphere. 1. Haber, A., Haber-Pohlmeier, S. et al., Relaxation-relaxation experiments in natural porous media with portable Halbach magnets. *Vadose Zone J.*, 2010. 9: 893 - 897. 2. Blümich, B., Casanova, F., et al., Small Scale NMR of Porous Media. *New Journal of Physics*, 2011(13): 015003.



S04.03 -3

DYNAMICS OF ROOT RESPONSES TO WATER HETEROGENEITY IN SOIL USING NEUTRON RADIOGRAPHY

Dara Abbas^{*[1]}, Andrea Carminti^[2], Ahmad Moradi^[3], Sascha Oswald^[1], Peter Vontobel^[5]

^[1]University of Potsdam / Institute of Earth and Environmental Science ~ Water and Matter Transport in Complex Landscapes ~ Potsdam ~ Germany ^[2]Georg-August-Universität Göttingen ~ Department of Crop Sciences ~ Göttingen ~ Germany ^[3]University of California Davis ~ Department of Land, Air and Water Resources ~ Davis, California ~ United States ^[4]Paul Scherrer Institut -PSI ~ SINQ/PSI ~ Villigen ~ Switzerland ^[5]Paul Scherrer Institut -PSI ~ Swiss Spallation Neutron Source / SINQ ~ Villigen ~ Switzerland

*Heterogeneous water availability is a typical characteristic of soils. Water content in soil is spatially variable and also has a large temporal dynamics. Despite the intrinsic heterogeneity of soil-plant water relations, we know little about the ways how plants respond to local environmental properties. To monitor root responses soil water heterogeneity and effects of water heterogeneity on root water uptake we used neutron radiography, especially suited to detect water distribution, to non-invasively image root growth and 2-D soil water distribution as time-lapsed images. Lupin plants were grown in 30*25*1 cm³ aluminum containers. The root zone was partitioned to nine compartments separated by capillary barriers. Two weeks after planting, watering was stopped in the right side while the middle and left compartments were kept wet. Daily changes in water content and root distribution in each compartment have been monitored by neutron radiography for 15 days. Neutron radiography showed that the interactions between roots and surrounding soil significantly varied over time and there is a significant response of roots to soil water distribution. Root growth in the drying compartment remained equal to that in the wet compartment, until the conditions became limiting. For a particular range of low water content, root growth in dry parts was even higher than in the wet parts. This demonstrates that plants make an effort to occupy more soil volume, probably for extracting more water before conditions become even more limiting. This root response could be observed even in individual roots that crossed both, dry and wet compartments.*



S04.03 -4

NETWORK MODELS TO INVESTIGATE THE ROLE OF SOIL STRUCTURAL HETEROGENEITY ON MICROBIAL INVASION

Perez-Reche Francisco J.*^[1], Taraskin Sergei N.^[2], Otten Wilfred^[1], Viana Matheus P.^[3], Costa Luciano Da F.^[3], Gilligan Christopher A.^[4]

^[1]University of Abertay Dundee ~ Simbios Centre ~ Dundee ~ United Kingdom ^[2]University of Cambridge ~ Department of Chemistry ~ Cambridge ~ United Kingdom ^[3]Universidade de Sao Paulo ~ Instituto de Fisica de Sao Carlos ~ Sao Carlos ~ Brazil ^[4]University of Cambridge ~ Department of Plant Sciences ~ Cambridge ~ United Kingdom

Soil hosts a stunning wealth of biological activity from a large number of species including bacteria, protozoa, and fungi. The dynamics of spread of microorganisms is an important determinant in multiple processes such as the nutrient cycling within soil, the dynamics of plant diseases or even the entire ecosystem functioning. Studying the spatial distribution of microbes in soil is important but challenging due to the opacity of soil and the complexity of biological and environmental factors involved in microbial spread. We are interested in investigating to what extent soil structural heterogeneity at the pore level affects macroscopic microbial invasions. Using a network representation for real soil samples and mathematical models for microbial spread, we show that structural heterogeneity may have a very significant influence on the size of microbial invasions. In particular, neglecting the soil structural heterogeneity may lead to undesired underestimation of microbial invasion. We explain our findings in terms of a crucial interplay between heterogeneity in microbial transmission and heterogeneity in the topology of soil networks. The main influence of network topology is linked to the existence of long channels in soil networks that act as bridges for transmission of certain types of microbes between distant parts of soil. Overall, our theoretical work demonstrates that the shape, size, and interconnection of pores in addition to type of microorganisms, presence of water, and other characteristics influencing the exploration of the soil pore space are the key factors determining the extend of microbial invasion in soil.



S04.03 -5

QUANTIFYING DISTURBANCE OF SOIL STRUCTURE AT MICROBIAL SCALES IN THE PREPARATION OF BIOLOGICAL SECTIONS

Eickhorst Thilo^[4], Pajor Radoslaw^[2], Baveye Philippe^[3], Otten Wilfred^[2]

^[1]University of Bremen ~ Soil Science ~ Bremen ~ Germany ^[2]University of Abertay Dundee ~ The SIMBIOS Centre ~ Dundee ~ United Kingdom ^[3]Rensselaer Polytechnic Institute ~ Dept of Civil and Environmental Engineering ~ Troy, NY ~ United States ^[4]University of Bremen ~ Dept. of Soil Science ~ Bremen ~ Germany

The mechanisms of microbe-soil interactions and their influence on geochemical processes are poorly understood. Recently, molecular techniques have been introduced to study these sites at the micro-scale by staining the colonizing microbes in 2D-sections of resin impregnated soil. In parallel the analysis of element distributions in undisturbed soil has been combined with non-invasive X-ray computed tomography, which for small samples approximates spatial scales relevant to microorganisms. Restrictions can be found for the insertion of specific probes in order to detect soil microorganisms requiring undisturbed soil samples of less than 15mm in diameter. The underlying assumption of biological thin sections is that these are an undisturbed reflection of the soil microhabitat. To ensure that samples used for this purpose can be regarded as undisturbed as found in nature, the sampling procedures have been evaluated at scales relevant to microorganisms and improved. The degree of disturbance was assessed with the use of X-ray CT. Movements of soil particles in 3D as well as porosity and connectivity were analysed during sampling in different soils. Thin-walled aluminium rings showed to cause minimal disturbances on the scale relevant for the microbial habitat in soil. Nevertheless, naturally formed cracks were influenced significantly whereas the arrangement of particles and pore space in areas in between remained stable. An additional analysis of the same samples is conducted after resin impregnation showing how this process influences the preservation of the soil structure. This study presents technical requirements allowing the investigation of soil heterogeneity on the microscale and its influence on bio-geochemical processes.



S04.03 -6

MODELING AND RECONSTRUCTION OF SOIL MICROSTRUCTURE USING STATISTICAL PHYSICS METHODS AND SIMULATED ANNEALING

Karsanina Marina^{*[1]}, Gerke Kirill^[1], Vasiliev Roman^[2], Skvortsova Elena^[3]

^[1]Institute of Geospheres Dynamics ~ Geomechanics and Fluidodynamics Laboratory ~ Moscow ~ Russian Federation

^[2]Vladimir State University ~ Department of Applied Mathematics and Physics ~ Vladimir ~ Russian Federation

^[3]Dokuchaev Soil Science Institute ~ Micromorphology and Soil Physics Laboratory ~ Moscow ~ Russian Federation

There are three main approaches to model or reconstruct (using some limited information or properties) some porous media: 1) statistical methods (correlation functions and simulated annealing, multi-point statistics, entropy methods), 2) sequential methods (sphere or other granular packs), and 3) morphological methods. In this contribution we analyze all these methods and show that correlation functions have some substantial advantages. Main results and discussions include: 1) characterization and classification of soil 2D and 3D structure using different correlation functions (two-point probability, linear and cluster functions), 2) reconstruction of soil structure based on its correlation functions, 3) reconstruction of 3D soil structure from 2D cut(s), 4) reconstruction quality control using morphological and other statistical methods, 5) approaches to deal with soil anisotropy and hierarchical levels. All examples come from real soil samples obtained via conventional thin-sectioning or X-ray microtomography.



S04.04 - LANDSCAPE-SCALE MODELLING OF SOIL PROCESSES IN AGROECOSYSTEMS

Chair Persons:

Christian Walter, Rennes - France

Björn Tetzlaff, Jülich, Germany

Monday 02 July 2012 from 15:30 to 17:45. Room Alloro

S04.04 -1

LANDSCAPE MODELLING - BRIDGING STRUCTURE AND PROCESS

Michael Sommer, Münchenberg - Germany - Invited

S04.04 -2

SPATIO-TEMPORAL MODELING OF SOIL EROSION AND SOIL CARBON CONTENT AT THE LANDSCAPE SCALE IN THE CONTEXT OF GLOBAL CHANGE

Marine Lacoste, Rennes - France

S04.04 -3

THE FUTURE OF ENVIRONMENTAL SUSTAINABILITY IN IRRIGATED AREAS: SOIL VARIABILITY AND CLIMATE CHANGE. A ITALIAN CASE STUDY AT LOCAL SCALE

Antonello Bonfante, Ercolano (NA) - Italy

S04.04 -4

A COUPLED SOIL PROCESS AND FERTILISATION MODEL TO PREDICT NUTRIENT SOIL CONCENTRATIONS IN REGIONAL AGROECOSYSTEMS

Dominique Gärtner, Zürich - Switzerland

S04.04 -5

CARBOSOIL, A LAND EVALUATION MODEL FOR MAXIMIZING CARBON SEQUESTRATION IN MEDITERRANEAN SOILS

María Anaya-Romero, Seville - Spain

S04.04 -6

THE SOIL MAP PARADIGM: THE PRODUCTION OF VERIFIABLE DIGITAL LANDSCAPE PROJECTIONS VERSUS COMPLEX-CODED EXPERT VIEWS

Rainer Baritz, Hannover – Germany - Invited



S04.04 -7

A REGRESSION KRIGING APPROACH TO PREDICT SOIL SURFACE PROPERTIES IN A MEDITERRANEAN BASIN

Michael Blaschek, Kiel - Germany

S04.04 -8

DERIVATION OF POTENTIALLY DRAINED AREAS IN THE STATE OF SCHLESWIG-HOLSTEIN/GERMANY

Petra Kuhr, Jülich - Germany

S04.04 -9

ANALYSIS OF THE IMPACT OF EROSION ON AGRICULTURAL LANDSCAPE EVOLUTION: LANDSOIL MODEL DEVELOPMENT AND SENSITIVITY ANALYSIS

Rossano Ciampalini, Montpellier - France



S04.04 -1

LANDSCAPE MODELLING - BRIDGING STRUCTURE AND PROCESS

Sommer Michael*^[1], Walter Christian^[2]

^[1]Leibniz Ctr Agr Landscape Res ZALF ~ Inst Soil Landscape Research ~ Münchenberg ~ Germany ^[2]INRA, Agrocampus Ouest ~ UMR SAS (Sol Agronomie Spatialisation) ~ Rennes ~ France

Soils are four dimensional natural bodies with the key characteristic of spatio-temporal variation in state properties and processes. This holds true for a large span of spatial scales, but landscape scale has received more and more attention, mainly because this is the spatial scale where man-made activities take place, e.g., agriculture, forestry. Soil landscapes are critical, because of the match in spatial scale with activities of man. In the talk we will give a short overview on definitions and principles of landscape analysis including processes, drivers, and structures. Different types of landscape scale modelling will be addressed. Few examples on the coupling between structure and process dynamics will highlight the importance of landscape scale. Combining progress in analysing soil landscape structures with detailed process studies (including modelling) improves our understanding of regional and global biogeochemical processes and should strengthen soil science in the earth sciences community.



S04.04 -2

SPATIO-TEMPORAL MODELING OF SOIL EROSION AND SOIL CARBON CONTENT AT THE LANDSCAPE SCALE IN THE CONTEXT OF GLOBAL CHANGE

Lacoste Marine^{*[1]}, Viaud Valérie^[1], Michot Didier^[2], Walter Christian^[2]

^[1]INRA ~ UMR 1069 SAS INRA/Agrocampus-Ouest ~ Rennes ~ France ^[2]Agrocampus-Ouest ~ UMR 1069 SAS INRA/Agrocampus-Ouest ~ Rennes ~ France

The soil erosion and the decrease in soil organic carbon (SOC) content have been identified in 2006 by the European Commission as two of the major threats on European soils. Soil erosion and SOC are closely related, and their spatial variability and temporal dynamics are strongly affected by natural and anthropogenic processes occurring at the landscape scale. This study aims to model simultaneously the soil depth evolution (erosion and accumulation) and the SOC dynamics at the landscape scale over 100 years. The study area was situated within a complex agricultural hedgerow landscape (NW France), with varying soil parent material, slopes, soil depth, field size and land use. We estimated in a previous study the initial depth of soil and SOC stocks. We used a soil evolution model, coupling a SOC dynamics model based on RothC and a soil erosion and accumulation model called Landsoil model. We modeled the soil evolutions under two climate scenarios: a stationary scenario where climate is similar to that observed in the past 30 years, and a climate change scenario corresponding to the A1B emissions scenario of the Intergovernmental Panel on Climate Change. Moreover, different scenarios of land use and farming practices were applied. We will discuss the combined effects of land use, farming practice and climate on soil evolution (soil depth and SOC), considering both the general evolution of the soil properties at the study site scale and their spatial distribution.



S04.04 -3

THE FUTURE OF ENVIRONMENTAL SUSTAINABILITY IN IRRIGATED AREAS: SOIL VARIABILITY AND CLIMATE CHANGE. A ITALIAN CASE STUDY AT LOCAL SCALE

Bonfante Antonello*^[1], Basile Angelo^[1], De Mascellis Roberto^[1], Impagliazzo Adriana^[2], Manna Piero^[3], Orefice Nadia^[1], Terribile Fabio^[3]

^[1]National Research Council of Italy (CNR) ~ Institute for Mediterranean Agricultural and Forestry Systems (ISAFOM) ~ Ercolano (NA) ~ Italy ^[2]University of Naples Federico II ~ Dept. Agricultural Engineering and Agronomy ~ Portici (NA) ~ Italy ^[3]University of Naples Federico II ~ Department of Soil, Plant, Environmental and Animal Production Sciences ~ Portici (NA) ~ Italy

The effect of climate change on the sustainability of irrigated agricultural systems will be different from area to area depending from some factors as: (i) water availability, (ii) crop water demand (iii) soil hydrological behavior and (iv) irrigation management strategy. The adaptation of irrigated crop systems to future climate change can be evaluated by means of physically based model which simulate the soil-water-plant and atmosphere system. In the irrigated areas, the irrigation strategy determines whether and how climate signal is observed. When water availability is not limited, and crop water requirements can be fully met by irrigation, the influence of a (moderately) warmer and drier climate on production can be offset by irrigation. Therefore climate signal translates into higher water consumption. The interaction between climate change, soil spatial variability, irrigation strategies and crop responses to water availability (maize, fennel) at local scale was examined in the present work. Simulation studies were performed in an area of 183 ha of Sele plain (Southern Italy), characterized by an high soil spatial variability (17 representative soils was described), by means of agrohydrological model CropSyst (crop growth, water and nitrate soil balance were calibrated and validated). Two scenarios were considered, current climate (1961-1990) and future climate (2021-2050), the latter from a statistical downscaling technique applied to GCMs. Different irrigation schedules, optimal (realized by the model) and local irrigation management (fixed irrigation), were simulated. Crop production and nitrogen leaching determined by different climatic scenarios, soil and irrigation management were analyzed.



S04.04 -4

A COUPLED SOIL PROCESS AND FERTILISATION MODEL TO PREDICT NUTRIENT SOIL CONCENTRATIONS IN REGIONAL AGROECOSYSTEMS

Gärtner Dominique^{*[1]}, Della Peruta Raniero^[1], Keller Armin^[1]

^[1]Swiss Soil Monitoring Network (NABO) ~ Federal Research Station for Agroecology and Agriculture (Agroscope ART) ~ Zürich ~ Switzerland

Many environmental models have been developed to understand the soil system at landscape scale. Often these models include environmental variables of the biophysical systems such as soil, vegetation, climate or hydrosphere, but neglect the spatial heterogeneity of agricultural management practices. In addition, the spatial units of the process based environmental model usually don't match the ones of the agricultural system, e.g. fields or farms. Therefore, one main challenge of modelling nutrient cycling in agricultural soils at landscape scale is to include geo-referenced land management practices. We developed a regional spatially explicit fertilization model that provides animal manure and mineral fertiliser application rates and fertiliser types at landscape scale at a spatial resolution of one hectare for Swiss agroecosystems. The model is based on geo-referenced Swiss farm census data and Swiss land use statistics. The model was applied for the agricultural soils of the Canton Fribourg, Switzerland (77.000 ha), managed by 3376 farms. The fertilization model calculates the nutrient inputs for the time period 1980-2007 on an annual basis. The fertilization model is linked to a simplified soil process model that simulates the fate of the nutrients in soil in the long-term. Coupling both models provides a better insight of both the soil system and nutrient cycling in agroecosystems at the landscape scale.



S04.04 -5

CARBOSOIL, A LAND EVALUATION MODEL FOR MAXIMIZING CARBON SEQUESTRATION IN MEDITERRANEAN SOILS

Anaya-Romero María^[1], Muñoz-Rojas Miriam^[1], Pino Rafael^[2], Jordán Antonio^[3], Zavala Lorena M^[3], De La Rosa Diego^[4]

^[1]Evenor-Tech, CSIC Spin-off, Instituto de Recursos Naturales y Agrobiología de Sevilla (CSIC), Avda. Reina Mercedes, 10, 41012, ~ R+D+i ~ Seville ~ Spain ^[2]Universidad de Sevilla. C. Tarfia s/n, 41012 ~ Departamento de Estadística e Investigación Operativa. Facultad de Matemáticas. ~ Seville ~ Spain ^[3]Universidad de Sevilla, C/Profesor García González, 1, 41012 ~ MED_Soil Research Group. Dpto. de Cristalografía, Mineralogía y Química Agrícola, Facultad de Química ~ Seville ~ Spain ^[4]Instituto de Recursos Naturales y Agrobiología de Sevilla (CSIC), Avda. Reina Mercedes, 10, 41012 ~ Land Evaluation Unit ~ Seville ~ Spain

According to the Kyoto Protocol, land use (LU) planning must consider strategies to maximize soil C stock (SCS) through LU change and management practices. This research presents a land evaluation tool (Carbosoil) for predicting soil capacity for storing organic carbon, as a new component of MicroLEIS DSS. The pilot study area was a Mediterranean region (Andalusia, Southern Spain) during 1956-2007. Input data were obtained from different data sources and include 1689 soil profiles from Andalusia (S Spain). Previously, detailed studies of changes in LU and vegetation carbon stocks, and soil organic carbon (SOC) dynamic were carried out. Previous results showed the influence of LU, climate (mean temperature and rainfall) and soil variables related with SOC dynamics. For instance, SCS decreased in Cambisols and Regosols by 80% when LU changed from forest to heterogeneous agricultural areas. Taking this into account, the input variables considered were LU, site (elevation, slope, erosion, type-of-drainage, and soil-depth), climate (mean winter/summer temperature and annual precipitation), and soil (pH, nitrates, CEC, sand/clay content, bulk density and field capacity). The available data set was randomly split into two parts: training-set (75%), and validation-set (25%). The model was built by using multiple linear regression. The regression coefficient (R^2) obtained in the calibration and validation of Carbosoil was >0.9 for the considered soil sections (0-25, 25-50, and 50-75 cm). The validation showed the high accuracy of the model and its capacity to discriminate the most suitable areas for maximizing C sequestration under different climate, LU and soil management scenarios.



S04.04 -6

THE SOIL MAP PARADIGM: THE PRODUCTION OF VERIFIABLE DIGITAL LANDSCAPE PROJECTIONS VERSUS COMPLEX-CODED EXPERT VIEWS

Baritz Rainer*^[1]

^[1]Federal Institute for Geosciences and Natural Resources (BGR) ~ Groundwater and Soil ~ Hannover ~ Germany

Modern GIS techniques allow the processing of large amounts of high resolution soil data: large areas covered by high resolution soils maps (e.g. 1:50,000) can be easily processed, and large amounts of plot-level measurements can be accurately upscaled using high-resolution digital elevation models. Both kinds of data exist in Europe in astonishing densities, but yet are not available. The number of map applications producing policy-relevant spatial information at continental and national level is often limited to a set of simple pedo-transfer rules. The comparability of data sets is also limited, especially beyond country borders, terminologies not described, and mapping rules usually not documented. This makes it difficult to validate soil landscape delineations, and legacy mapping data thus seem to be of limited value for example to cross-validate digital soil mapping. Recently, other approaches such as the use of radiometric data sets are becoming re-discovered, and satellite data for the mapping of soil properties in areas sparsely covered by vegetation are being intensively investigated. Data harmonization activities, the building of new data bases, has largely ceased in Europe; at parallel, initiatives for developing new high-resolution data sets based on digital soil mapping including remote sensing seem to gain importance. This presentation will attempt for building a conceptual umbrella over the possible future of soil data development, harmonization, networking and data exchange in Europe.



S04.04 -7

A REGRESSION KRIGING APPROACH TO PREDICT SOIL SURFACE PROPERTIES IN A MEDITERRANEAN BASIN

Blaschek Michael^[1], Swen Meyer^[2], Ludwig Ralf^[2], Duttmann Rainer^[1]

^[1]Christian-Albrechts-University Kiel ~ Department of Geography ~ Kiel ~ Germany ^[2]Ludwig-Maximilians-University Munich ~ Department of Geography ~ Munich ~ Germany

Environmental planning and modelling is highly dependent on reliable information about the spatial distribution of physical and chemical soil properties. In order to obtain continuous soil data in high resolution various pedometric techniques have been applied successfully on different scales and in different types of landscape. The main objective of this study was to compare regression kriging (RK) with several basic deterministic and geostatistical approaches to predict physical and chemical topsoil properties in an undulating, 16km²-sized river catchment near Ussana (Sardinia, Italy). We further investigate whether the application of more complex non-spatial digital soil mapping techniques such as artificial neural networks or regression-tree models may lead to better prediction outcome. The survey based on 197 point measurements from a locally adjusted stratified random sampling and a set of co-variables derived from a 10m resolution DEM (SAR) and a geological map at 1:25000 scale. Model efficiency is evaluated by the normalized root mean square error based on leave-one-out cross-validation and maps of spatially distributed errors. First results indicate that RK performs best wherever ancillary attributes were moderately correlated to the target variable. For instance, the spatial prediction of total C could be improved by 7% compared to ordinary kriging with an explained variance of approximately 41%. Thus, assuming readily available continuous information on soil forming factors such as geology and relief, hybrid methods like RK are fast, efficient and comprehensible tools to provide modellers and decision makers with soil-related parameters of high quality.



S04.04 -8

DERIVATION OF POTENTIALLY DRAINED AREAS IN THE STATE OF SCHLESWIG-HOLSTEIN/GERMANY

Kuhr Petra*^[1], Tetzlaff Björn^[1]

^[1]Forschungszentrum Jülich GmbH ~ IBG 3 ~ Jülich ~ Germany

Especially in modeling of nutrient inputs into groundwater and surface waters artificial drainage systems are a main input pathway for nutrients. In large scale analyses information about the spatial distribution of artificial drained areas are missing. With general information from soil data, land use data and relief parameter, areas can be located where artificial drainage is most likely. In the federal state of Schleswig-Holstein no area covering soil data were available. Therefore the needed parameters had to be derived from three different scaled data sets. These data were field scaled data from land taxation in the 1960s, which is only covering field sites with arable land and grassland. A second data set was a digital soil map at the scale of 1:25.000 which provided the most valuable information but was only existent for half of the state area. The third data set was a small scaled soil map at the scale of 1:200.000. This map was covering the total area of Schleswig-Holstein but it was too imprecise to be used in nutrient modeling due to the small scale. In this study we used the three different soil data sets under consideration of additional information about relief and actual land use to derive area covering data sets with information about soil type, groundwater influence and stagnant moisture. Together with land use parameters and the localization of drainage channels these parameters could be used in the analyses of parameter combinations which are typical for artificial drainage.



S04.04 -9

ANALYSIS OF THE IMPACT OF EROSION ON AGRICULTURAL LANDSCAPE EVOLUTION: LANDSOIL MODEL DEVELOPMENT AND SENSITIVITY ANALYSIS

Ciampalini Rossano^[2], Follain Stéphane^[3], Le Bissonnais Yves^[4]

^[1]IRD-Montpellier ~ INRA-IRD-SupAgro, UMR-LISAH, 2 place Viala ~ Montpellier ~ France ^[2]IRD ~ UMR-LISAH, 2 place Viala ~ Montpellier ~ France ^[3]Montpellier SupAgro ~ UMR-LISAH, 2 place Viala ~ Montpellier ~ France ^[4]INRA ~ UMR-LISAH, 2 place Viala ~ Montpellier ~ France

Modelling is an appropriate methodology for understanding space-time evolution in soil and landscape processes. Such modelling presumes the ability to produce quantitative models of soil redistribution in the landscape to test the effects of different scenarios of land management and climate evolution. The LandSoil model (Landscape design for Soil conservation under soil use and climate change) is designed for the analysis of agricultural landscape evolution at a fine spatial resolution scale [1-10 meters] and a mid-term temporal scale [10-100 years]. Based on the Stream model, LandSoil is suitable for simulations from parcel to catchment scale. It is spatially distributed, event-based, and considers water and tillage erosion processes. Specificity of the model is the use of a dynamic representation of the agricultural landscape through parameters such as a monthly representation of soil surface properties, hydrologic pathways and accounting a climate component based directly on rainfall events. We present the characteristics of the model, sensitivity analysis to the main erosion processes parameters and its application to a scenario study on a Mediterranean site. Sensitivity analysis shows the importance both of soil surface properties and flow connectivity on catchment soil redistribution, allowing make decisions and planning soil and water conservation strategies. Catchment scale simulations on a degraded scenario, maximising the hydraulic conductivity whit the removal of all the grass bands between fields, indicate a global increase of the soil erosion rate (+29%), with spatial variability depending on the specific soil use type and a significant loss of trapping efficiency at field borders (-81%).



S04.05a - ASSESSING SOIL SYSTEMS AND FUNCTIONS BY MODELING INTERACTIVE PROCESSES

Chair Person:

Jacques Diederik, Brussels - Belgium

Wednesday 04 July 2012 from 08:30 to 10:00. Room Alloro

S04.05a -1

ROOT-MEDIATED MOBILIZATION OF SOIL PHOSPHATES: WHAT DID WE LEARN FROM MECHANISTIC MODELLING?

Frederic Gerard, Montpellier - France

S04.05a -2

ARBUSCULAR MYCORRHIZA – CONNECTING CARBON AND PHOSPHOROUS DYNAMICS IN SOIL

Joachim Kleinmann, Leipzig - Germany

S04.05a -3

A THEORETICAL APPROACH TO PREDICTING SHIFTS IN PLANT-MYCORRHIZAL INTERACTIONS AND SOIL CARBON FEEDBACKS

Jessica A. M. Bryant, Knoxville - United States

S04.05a -4

COMPARING MODELING APPROACHES FOR CLAY MIGRATION

Eric Michel, Avignon - France

S04.05a -5

A 3D MULTI-SCALE VIRTUAL STRUCTURE TO MODEL AND SIMULATE CONCURRENT PROCESSES OF SOIL EVOLUTION

Sophie Legu  dois, Nancy - France

S04.05a -6

A DUAL POROUS MODEL TO PREDICT THE EFFECTS OF SOIL STRUCTURE ON DENITRIFICATION AND N₂O EMISSION

G.peter Matthews, Plymouth - United Kingdom



S04.05a -1

ROOT-MEDIATED MOBILIZATION OF SOIL PHOSPHATES: WHAT DID WE LEARN FROM MECHANISTIC MODELLING?

Gerard Frederic^{*[1]}

^[1]INRA ~ UMR Eco&Sols ~ Montpellier ~ France

Phosphorus is limiting plant growth in many soils. The perspective of scarcity of the P-ore (phosphate rock) reserves urges us to find an alternative to P fertilization, or at least to decrease it while keeping the same yield. An option is to solubilise soil P (i.e. to increase P availability) by relying on the interactions between roots activity (exudation of proton/hydroxyl, organic ligands, etc.) and P-containing soil constituents. However, P-mobilizing processes and mechanisms are poorly known and understood. Mechanistic modelling can be profitably used to fill this gap. The present communication is aimed at reviewing our recent works where we propose a mechanistic equilibrium model for simulating P availability in soil and rhizosphere. We studied neutral oxisols with contrasted mineralogical composition and P fertilization levels. A new root-mediated process, the uptake of Ca ions, was found to play a key role, as it markedly increased P availability in the rhizosphere of Durum wheat as pH increased. Model's validity was demonstrated by modelling P availability over a range of pH values and salt concentrations.



S04.05a -2

ARBUSCULAR MYCORRHIZA – CONNECTING CARBON AND PHOSPHOROUS DYNAMICS IN SOIL

Kleinmann Joachim^{*[1]}, Zielinski Frank^[2], Banitz Thomas^[1], Frank Karin^[1], Johst Karin^[1], Fester Thomas^[2]

^[1]Helmholtz Centre for Environmental Research - UFZ ~ Ecological Modelling ~ Leipzig ~ Germany ^[2]Helmholtz Centre for Environmental Research - UFZ ~ Environmental Microbiology ~ Leipzig ~ Germany

Arbuscular mycorrhizal (AM) fungi are ubiquitous in terrestrial ecosystems and can colonize more than 80 % of all terrestrial plants. Therefore this plant-fungal symbiosis represents one of the most important soil-atmosphere interfaces and couples the nutrient fluxes of carbon (C) and phosphorous (P). However, not much is known so far about the resulting C and P-dynamics and their interactions with related soil organisms. To close this gap, we started a spatially explicit modelling approach, which simulates the growth of extraradical mycelia of AM fungus *Glomus intraradices* (DAOM 197198) in dependence of C and P availability. Due to its obligate biotrophism, we assume *Daucus carota* (wild carrot) as plant partner, implicitly simulated as a P-C exchange point. The fungus acquires P from the soil, uses it as growth nutrient, stores it in spores and exchanges surpluses for C, which is further needed for P uptake and maintenance. Depending on the underlying mechanisms, the model results in different C and P-dynamics. This enables us, together with corresponding experiments, to identify possible mechanisms of resource use and interaction. We observed that limiting factors of growth are changing in time and space, and identified three stages of C and P use in the fungus: (1) Growth: C and P are predominantly used as nutrients. (2) P-Uptake: C is predominantly used for P acquisition. (3) Sporulation: C and P are stored in spores. These three stages facilitate understanding of C and P-fluxes in this soil-plant-fungus system and the resulting interacting dynamics of these nutrients.



S04.05a -3

A THEORETICAL APPROACH TO PREDICTING SHIFTS IN PLANT-MYCORRHIZAL INTERACTIONS AND SOIL CARBON FEEDBACKS

Bryant Jessica A. M.^{*[1]}, Post Wilfred M.^[2], Classen Aimee T.^[1]

^[1]University of Tennessee ~ Ecology and Evolutionary Biology ~ Knoxville ~ United States ^[2]Oak Ridge National Laboratory ~ Environmental Sciences Division ~ Oak Ridge ~ United States

Interactions between plants and their symbiotic mycorrhizal fungi are at the interface of above and belowground systems and their interactions can influence soil carbon (C) dynamics. Plants allocate a portion of their C to mycorrhizae, where it becomes hyphal biomass; in return, mycorrhizal fungi increase plant water and nutrient uptake. However, when plants become stressed the symbiosis can breakdown. When plants are stressed they reduce their C allocation to mycorrhizae; mycorrhizae then shift to gain C via soil organic matter (SOM) degradation. This can cause a soil C shift where the plant-mycorrhizal interaction becomes a source of C to the atmosphere instead of a sink. The magnitude of the effect of ectomycorrhizal C acquisition, whether from plants or SOM, is crucial to predicting soil C efflux and storage. We developed a theoretical model that predicts soil C dynamics following a shift in the plant-mycorrhizal C interaction. Following a reduction in C allocation to roots, our model predicts changes over time in five C pools: aboveground biomass, roots, litter, fungal biomass, and soil. Analysis of model dynamics allowed us to identify the range of parameter values required for the interaction between plant allocated C, ectomycorrhizal metabolism, and soil C for the system to switch to a C source. Preliminary parameter sensitivity analysis shows that decreases in C allocation to roots and mycorrhizal fungi significantly alters all of the C pools represented in the model.



S04.05a -4

COMPARING MODELING APPROACHES FOR CLAY MIGRATION

Michel Eric^[1], Finke Peter^[2], Cornu Sophie^[3]

^[1]INRA ~ UMR1114 INRA-UAPV Environnement Méditerranéen & Modélisation des Agro-Hydrosystèmes ~ Avignon ~ France ^[2]Ghent University ~ Geology and Soil Science ~ Gent ~ Belgium ^[3]INRA ~ UR1119 Géochimie des Sols et des Eaux ~ Aix-en-Provence ~ France

Operational models to simulate clay migration over pedogenesis (multi-millennium) timescales are rare, and utilize concepts for mobilization, transport and immobilization of colloidal matter that were developed and tested for applications at limited temporal extents only. Comparison of different concepts at both short and pedogenesis timescales is needed to evaluate the detail of process description needed at both scales. We compared the functional clay mobilization approach by Jarvis et al. (1999) to the mechanistic approach by Michel et al. (2010) by embedding both approaches in the SoilGen model (Finke, 2011). The models were compared with respect to the accuracy with which they could reproduce short time lab experiments as well as by their ability to produce a E-Bt horizon sequence in loess soils and the accuracy of simulated clay content profiles after 15000 years of soil formation. Finke, P.A. in press. Modeling the genesis of luvisols as a function of topographic position in loess parent material. Quaternary International. <http://dx.doi.org/10.1016/j.quaint.2011.10.016> Jarvis, N.J., Villholth, K.G., Ulén, B. 1999. Modelling particle mobilization and leaching in macroporous soil. European Journal of Soil Science 50: 621-632 Michel, E., Majdalani, S., Di-Pietro, L. 2010. How Differential Capillary Stresses Promote Particle Mobilization in Macroporous Soils: A Novel Conceptual Model. Vadose Zone J. 9:307-316



S04.05a -5

A 3D MULTI-SCALE VIRTUAL STRUCTURE TO MODEL AND SIMULATE CONCURRENT PROCESSES OF SOIL EVOLUTION

Leguédais Sophie^[1], Marilleau Nicolas^[6], Cambier Christophe^[7], Capowiez Yvan^[4], Cortet Jérôme^[1], Duponnois Robin^[9], Perrier Edith^[6], Salifou Nouhou^[1], Schwartz Christophe^[1], Watteau Françoise^[1], Blanchart Eric^[8]

^[1]INRA/Université de Lorraine ~ UMR 1120 LSE ~ Nancy ~ France ^[2]IRD ~ UMMISCO ~ Bondy ~ France ^[3]IRD ~ UMMISCO ~ Dakar ~ Senegal ^[4]INRA ~ PSH ~ Avignon ~ France ^[5]IRD ~ Eco&Sol ~ Montpellier ~ France ^[6]IRD/UPMC ~ UMMISCO ~ Bondy ~ France ^[7]IRD/UPMC ~ UMMISCO ~ Dakar ~ France ^[8]IRD ~ UMR Eco&Sols ~ Montpellier ~ France ^[9]IRD ~ LSTM ~ Montpellier ~ France

The evolution of soil structure is one main feature of pedogenesis. Biological processes such as faunal or root bioturbation influence the structure of the soil ecosystem. However the soil biological activity is also largely impacted by the spatial organisation of soil (aggregation, pore connectivity). Simulation-based approach is an interesting way to explore the interactions between an evolving soil structure and bioturbation activity as well as to assess the sustainability of soil systems. Our main objective is to develop a 3D multi-scale model to represent the evolution of soil structure. It is a generic soil structure allowing calibration on various measured data (mineral and organic size distribution, bulk density...) and the choice of the constituting elements (mineral and organic matters, pores, nutrients...). Virtual processes can be introduced in this structure to model soil functioning. Our applied case study concerns soil rehabilitation by soil construction (constructed Technosol). Firstly, this work deals with the representativeness of an existing structure model: the APSF (Arborescent-Pore-Solid-Fractal). It is a discrete pattern-based soil design. The preliminary exploration analysis shows that the calibration of the APSF on size distributions and bulk densities is very sensitive. Comparison with measured data on pore network could allow a better assessment of the parameters. Secondly, we integrated the APSF into a multi-agent system (MAS) in order to model the interactions of soil structure with anecic earthworms. We will present the developed model based on SWORM (Simulated Worm) as well as its first results. Hints to model root growth in MAS are also presented.



S04.05a -6

**A DUAL POROUS MODEL TO PREDICT THE EFFECTS OF SOIL STRUCTURE ON
DENITRIFICATION AND N₂O EMISSION**

Matthews G.peter^[1], Laudone Giuliano^[1], Gregory Andrew^[2], Whalley Richard^[2], Cardenas Laura^[3], Bird Nigel^[2]

^[1]University of Plymouth ~ School of Geography, Earth and Environmental Sciences ~ Plymouth ~ United Kingdom

^[2]Rothamsted Research ~ Department of Sustainable Soils and Grassland Systems ~ Harpenden ~ United Kingdom

^[3]Rothamsted Research ~ Department of Sustainable Soils and Grassland Systems ~ North Wyke ~ United Kingdom

We describe a dual porous model of soil, constructed with the Pore-Cor network model and its successor Porexpert, that closely reproduces the entire water retention characteristic together with meso and macro-porosity, and aggregate size distribution. In order to use the model for the a priori biophysical simulation of denitrification, we constructed a single critical percolation channel, adjacent to which between 1 and 10 micro-porous 'hot-spot' zones of biological activity were positioned. Nitrification and denitrification reactions within the hotspots were assumed to follow Michaelis-Menten kinetics. The pore network was fully saturated following addition of an aqueous 'amendment' of nitrate and glucose which started the reactions. Diffusion coefficients for Fickian and Crank-Nicolson calculations were taken from the literature, and corrected for tortuosity. Adjustment of the rate coefficient and oxygen threshold concentrations, within the context of a sensitivity analysis, gave carbon dioxide, nitrous oxide and molecular nitrogen emission curves in good agreement with previous experimental measurements, and revealed information about the positional relationship of hotspots relative to the critical percolation path. This work was part of the Soil Programme for Quality and Resilience (SPQR) of the UK Biotechnology and Biosciences Research Council (BBSRC). Main references: A dual-porous, inverse model of water retention for the study of bihydrological processes in soil. European Journal of Soil Science, forthcoming Special Issue on Soil Physics. A model to predict the effects of soil structure on denitrification and N₂O emission. Journal of Hydrology, in press (2011) doi:10.1016/j.jhydrol.2011.08.026



S04.05b - ASSESSING SOIL SYSTEMS AND FUNCTIONS BY MODELING INTERACTIVE PROCESSES

Chair Person:

Helaina Black, Aberdeen - United Kingdom

Wednesday 04 July 2012 from 10:30 to 12:00. Room Alloro

S04.05b -1

MODELING CARBON DYNAMICS AND MCPA DEGRADATION AT THE SOIL-LITTER INTERFACE

Holger Pagel, Stuttgart - Germany

S04.05b -2

BIOGEOCHEMICAL PROCESSES AND HOTSPOTS IN HETEROGENEOUS VADOSE ZONE

Binayak Mohanty, College Station - United States

S04.05b -3

COMPARISON OF TWO MODELLING APPROACHES FOR WATER TRANSFER IN THE SOIL-VEGETATION-ATMOSPHERE CONTINUUM

Anaïs Gueaus, Montpellier - France

S04.05b -4

SCENARIO MODELLING OF ECOSYSTEM SERVICE PROVISION WITH A NEW SOIL MODEL (MOSES)

Matt Aitkenhead, Scotland - United Kingdom

S04.05b -5

LANDSCAPE DESIGN FOR SOIL CONSERVATION UNDER LAND USE AND CLIMATE CHANGE

Christian Walter, Rennes - France



S04.05b -1

MODELING CARBON DYNAMICS AND MCPA DEGRADATION AT THE SOIL-LITTER INTERFACE

Pagel Holger^[1], Poll Christian^[2], Ingwersen Joachim^[1], Kandeler Ellen^[2], Streck Thilo^[1]

^[1]University of Hohenheim, Institute of Soil Science and Land Evaluation ~ Biogeophysics ~ Stuttgart ~ Germany

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*The detritosphere (soil close to soil-litter interface) is characterized by a high availability of litter-derived organic substrates stimulating microbial growth and activity. To improve the understanding of regulation mechanisms, which are responsible for stimulated pesticide (here MCPA) degradation in the detritosphere, we developed a new model. The model simulates transport and degradation of pesticides and accounts for the sizes of 12C, 13C and 14C carbon pools as well as the activities of the total and specific soil microbial communities. Fungal MCPA degradation was modelled by a co-metabolic kinetic approach. A global sensitivity analysis was performed to identify the high-leverage model parameters. The most crucial role for model dynamics played the fraction of decomposed litter C transferred to soil and the initial bacteria/ fungi ratio. For model calibration, we conducted a microcosm experiment with 14C-MCPA (50 mg kg⁻¹) amended soil. We set up three experimental treatments: i) maize litter (control), ii) MCPA and iii) MCPA + maize litter. The litter was placed on top of small disturbed soil cores and the microcosms were incubated at 20 °C for 20 days. During incubation we analysed total CO₂, 13C-CO₂ and 14C-CO₂. Soil cores were sampled on five dates using a stratified sampling scheme and analysed for MCPA, dissolved organic carbon, microbial biomass, 16s rDNA and the functional gene *tfdA* as a proxy for the population of bacterial MCPA degraders. We will present the new model and discuss simulations and parameter sensitivities against the background of the data from the microcosm experiment.*



S04.05b -2

BIOGEOCHEMICAL PROCESSES AND HOTSPOTS IN HETEROGENEOUS VADOSE ZONE

Mohanty Binayak*^[1]

^[1]Texas A&M University ~ Biological and Agricultural Engineering ~ College Station ~ United States

A fundamental issue in predicting fate and transport of contaminants in subsurface systems is the complex interaction between transport and redox processes. These predictions are further complicated by variable flow dynamics, transient redox states, and structural heterogeneity of the unsaturated zone. Thus, the objective of this study is to evaluate the effect of varying hydrologic conditions on coupled biogeochemical processes in soil columns with known structural heterogeneity and background geochemistry. In particular, redox geochemistry within repacked homogeneous sand and loam columns is compared with a layered sand-over-loam configuration. Numerical perturbations corresponding to rainfall intensity, water chemistry (pH), and variations in hydrologic boundary conditions are conducted using HP1. Modeling results indicate that the dominant biogeochemical process is advective transport for homogeneous sand, reduction of iron from nitrate for homogeneous loam, and iron and sulfate reduction for the layered column. Findings suggest that redox gradients in the homogeneous columns are controlled by the type of hydrologic boundary condition (infiltration, drainage, etc.) whereas textural layering is paramount in controlling redox gradients in the layered column. This textural interface enhances biogeochemical activity in the layered column and highlights the need to incorporate structural heterogeneity in contaminant fate and transport models.



S04.05b -3

COMPARISON OF TWO MODELLING APPROACHES FOR WATER TRANSFER IN THE SOIL-VEGETATION-ATMOSPHERE CONTINUUM

Guaus Anaïs^{*[2]}, Bsaibes Aline^[3], Auffray Valérie^[3], Lebon Eric^[4], Gérard Frédéric^[2]

^[1]INRA ~ UME Eco&Soils ~ Montpellier ~ France ^[2]INRA ~ UMR Eco&Sols ~ Montpellier ~ France ^[3]ITK ~ ~ Montpellier ~ France ^[4]INRA ~ UMR Lepse ~ Montpellier ~ France

As part of a R&D project aiming at providing vineyard managers with a computer-based decision support system for optimizing irrigation, we discuss the validity of two modeling approaches for water transfers in the soil-plant-atmosphere continuum. The two models are an empirical 'bucket-like' model and a mechanistic model based on the 1D Richards' equation. The practical context implying that soil-water parameters are poorly estimated, both models are compared in terms of accuracy and parameterization cost. The models are coupled to the same canopy growth, radiation absorption, evaporation and transpiration models, and the predawn leaf water potential (PLWP) is used as the indicator of soil-water deficit. The parameters of both models are estimated with pedotransfer functions from the single texture and the only additional input for the 1D model is root repartition versus depth. A multi-factor sensitivity analysis relative to the input parameters of the soil-vegetation-atmosphere coupling shows that the hard-to-obtain rooting depth is the key factor of the PLWP sensitivity. It also shows that the computation of PLWP with the 1D model is robust against root distribution uncertainty, so that root distribution can be fixed to a mean value. The accuracy of the two models is evaluated in vineyards varying in soil type, rooting depth and irrigation procedure in the Languedoc region (France), by comparing simulated to measured values of vine transpiration and PLWP. Provided the calibration of rooting depth, both models give results coherent with field measurements, with no significant improvement when the more physical mechanistic model is used.



S04.05b -4

SCENARIO MODELLING OF ECOSYSTEM SERVICE PROVISION WITH A NEW SOIL MODEL (MOSES)

Aitkenhead Matt*^[1]

^[1]*The James Hutton Institute ~ Computation & Information Sciences ~ Scotland ~ United Kingdom*

A new process-based soil model (MOSES – Modelling Soil Ecosystem Services) is described. The model is designed to provide information about a soil profile at approximately 1-cm depth resolution, on a 1 minute timestep. Conceptualisation of the model has targeted a set of soil ecosystem service-related functions, including carbon sequestration, water buffering and biomass productivity. A wide range of physical, chemical and biological processes have been implemented within the model, and output parameters are interpreted in relation to a range of ecosystem services. Validation of the model against detailed time-series field measurements at a number of sites has shown it to be effective at simulating a number of specific parameters. We have carried out a number of scenario simulations on changing land cover and climate for a range of different soil types/environmental conditions, and have shown how potentially useful MOSES could be for evaluating potential land management and environmental changes in relation to the provision of multiple ecosystem services. The trade-offs between different services changes under different scenarios, demonstrating the ability to explore candidate land management strategies for the optimisation of ecosystem service provision.



S04.05b -5

LANDSCAPE DESIGN FOR SOIL CONSERVATION UNDER LAND USE AND CLIMATE CHANGE

Walter Christian*^[1], Stéphane Follain^[2], Didier Michot^[1], Sébastien Salvador-Blanes^[3], Valérie Viaud^[1], Jean-Paul Bakyono^[3], Hocine Bourennane^[4], Caroline Chartin^[3], Rossano Ciampalini^[2], Guillaume Coulouma^[2], Alain Couturier^[4], Joel Daroussin^[4], Youssef Fouad^[1], Blandine Foucaud-Lemerrier^[1], Florent Hinschberger^[3], Marine Lacoste^[1], Yves Lebissonnais^[2], Jean-Jacques Macaire^[3], Philippe Merot^[1], Guy Richard^[4], Olivier Evrard^[5]

^[1]INRA - AGROCAMPUS OUEST ~ UMR 1069 SAS ~ Rennes ~ France ^[2]INRA - SUPAGRO Montpellier ~ UMR LISAH ~ Montpellier ~ France ^[3]University of Tours ~ UMR 6113 ISTO Université Tours ~ CNRS ~ Tours ~ France ^[4]INRA ~ UR Science du Sol ~ Orléans ~ France ^[5]CEA - CNRS - University of Versailles-StQuentin ~ UMR 8212 LSCE ~ Gif-sur-Yvette ~ France

Soils and landscapes evolve simultaneously. Soil evolution is controlled by redistribution and transformation processes influenced by topographic and climatic parameters, with also a major contribution of management strategies. The perennial landscape features have a strong influence on soil spatial distribution (geometry) and soil genesis. Building landscapes which enhance soil resilience to degradation processes and increase soil services appears as a promising way to adapt to forthcoming climatic and land use evolutions. The presentation aims to synthesize major results from a research program nicknamed Landsoil which focused on the evolution of agricultural soils over medium time scales (decades to centuries) in relation to changing conditions of land use and climate. Precise study of the soil 3D organization in three contrasted landscapes (Brittany, Touraine, Languedoc-Roussillon) enabled to link soil redistribution in space to landscape components (field geometry, hedges or ditches network) and their past evolution. A dynamic and high resolution spatial modeling approach was developed coupling erosion processes and soil organic matter evolution and was calibrated over past evolution using dating techniques (Cs137, C14, OSL). The resulting Landsoil model was afterwards applied in a prospective manner under different scenarios of land use and climate change over the 21th century. Indicators of soil vulnerability and soil resilience were defined and tested by the comparison of several prospective scenarios applied on a same landscape and by comparison of the contrasted landscapes.



S04.06 - CURRENT ISSUES AND APPLICATIONS OF SOIL MONITORING

Chair Persons:

Dominique Arrouays, Paris - France

Ben Marchant, Rothamsted - United Kingdom

Wednesday 04 July 2012 from 13:30 to 15:00. Room Alloro

S04.06 -1

A HYBRID DESIGN-BASED AND MODEL-BASED SAMPLING APPROACH TO ESTIMATE THE TEMPORAL TREND OF SPATIAL MEANS OF SOIL PROPERTIES

Dick Brus, Wageningen - Netherlands

S04.06 -2

THE VARIABILITY OF SOIL BULK DENSITY, AND ITS IMPLICATIONS FOR SOIL MONITORING.

Murray Lark, Nottingham - United Kingdom

S04.06 -3

AN EFFICIENT DESIGN FOR MONITORING FOREST SOILS

Rock Ouimet, Quebec City - Canada

S04.06 -4

PEAT DROUGHT RISK IN A CHANGING CLIMATE

Laura Poggio, Aberdeen - United Kingdom

S04.06 -5

LONG-TERM SOIL MONITORING IN GERMANY: IDENTIFICATION OF TEMPORAL AND SPATIAL PATTERNS

Carsten Schilli, Wuppertal - Germany

S04.06 -6

MONITORING SOIL CARBON – IS THERE A RIGHT ANSWER?

Helaina Black, Aberdeen - United Kingdom



S04.06 -1

A HYBRID DESIGN-BASED AND MODEL-BASED SAMPLING APPROACH TO ESTIMATE THE TEMPORAL TREND OF SPATIAL MEANS OF SOIL PROPERTIES

Brus Dick*^[1]

^[1]WUR/Alterra ~ Soil ~ Wageningen ~ Netherlands

This paper launches a hybrid sampling approach, entailing a design-based approach in space followed by a model-based approach in time, for estimating temporal trends of spatial means or totals. The underlying space{time process that generated the soil data is only partly described, viz. by a linear mixed model for the temporal variation of the spatial means. The model contains error terms for model inadequacy (model or process error) and for the sampling error in the estimated spatial means. The linear trend is estimated by Generalized Least Squares. The covariance matrix is obtained by adding the matrix with design-based estimates of the sampling variances and covariances and the covariance matrix of the model errors. The model parameters needed for the latter matrix are estimated by REML. The error variance of the estimated regression coefficients can be decomposed into the model variance of the errorless regression coefficients and the model expectation of the conditional sampling variance. In a case study on forest soil eutrophication, inclusion of the model error led to a considerable increase of the error variance for most variables. In the topsoil the contribution of the process error to the standard error of the estimated trend was much larger than that of the sampling error. For pH there was no contribution of the model error. Important advantages of the presented approach over the fully model-based approach are its simplicity and robustness to model assumptions.



S04.06 -2

THE VARIABILITY OF SOIL BULK DENSITY, AND ITS IMPLICATIONS FOR SOIL MONITORING.

Lark Murray^{*[1]}, Rawlins Barry^[1], Robinson David^[2], Robinson Inma^[2], Tye Andrew^[1]

^[1]British Geological Survey ~ ~ Nottingham ~ United Kingdom ^[2]Centre for Ecology and Hydrology ~ ~ Bangor ~ United Kingdom

Bulk density is a fundamental soil property. It is important in soil monitoring and inventory because of its significance as a quality indicator and because of its usefulness in predicting harder-to-measure soil properties through pedotransfer functions. It is also essential for the conversion of gravimetric soil data to a volumetric basis, which is necessary for the calculation of nutrient or carbon stocks. Historically not all soil inventories have recorded bulk density, but recent recommendations for national-scale monitoring networks include it among the variables to be measured. Two questions need to be addressed. First, can soil bulk density be predicted with adequate precision by pedotransfer functions when direct observations are not available? Second, how many measurements of bulk density must be made at each site in a monitoring network to provide information of adequate precision? We address these questions in this paper, paying particular attention to how error in estimated bulk density propagates through the calculation of soil carbon stocks. We report an evaluation of some common pedotransfer functions for soil bulk density at national scale in England and Wales, and at local scale in two intensively measured sites, one on peats and organo-mineral soils in the uplands of Wales and one on mineral soils in arable use in Eastern England. Data on bulk density from these two study sites were analysed with linear mixed models, and we report the implications of these results for sampling requirements at site scale.



S04.06 -3

AN EFFICIENT DESIGN FOR MONITORING FOREST SOILS

Ouimet Rock*^[1]

^[1]Ministère des Ressources naturelles et de la Faune ~ Direction de la recherche forestière ~ Quebec City ~ Canada

Forest soils are particularly difficult to monitor because of their great variability in natural ecosystems. Moreover, sampling forest soils precludes the future use of the exact sampling points since sampling causes a disturbance that confounds the prior sampling effect with the time effect. Even the distance of the sampling point from neighbouring trees is reflected in the chemical properties of the sample. To be able to detect soil changes over time, we designed a new spatial sampling scheme for the Quebec Forest Ecosystem Study and Monitoring Network (RESEF). It provides control over spatial, tree, and time variations, permitting unbiased soil monitoring assessment over the long term (design lifespan: ~200 yrs). Its unique design contrasts with other forest soil monitoring projects that have been carried out in eastern North America. Installation of the monitoring set up started in 2002, and the second round of sampling starts in 2012 (sampling interval: 10 years). The typical sampling site is a square 400 m². Trees are positioned and their characteristics are measured. Particular attention is spent to characterize dead standing and fallen trees. The statistical treatment of the monitoring data is now more straightforward, with the possibility to include appropriate variance and covariance component structures in the analyses such as spatial and time dependencies. Effects of environmental variables such as microtopography, distance from trees, and space can thus be isolated from the time effect. Sample and lab analysis method archival is also an important, but neglected, aspect that will be discussed.



S04.06 -4

PEAT DROUGHT RISK IN A CHANGING CLIMATE

Poggio Laura^[1], Gimona Alessandro^[1], Aalders Inge^[1], Hough Rupert^[1]

^[1]The James Hutton institute ~ Aberdeen ~ United Kingdom

Global warming might change the hydrology of upland blanket peats in Scotland with increased risk of drought and release of the stocked carbon. It is therefore important to model the risk of drought in peat areas with estimation of the damage potential. In this study Bayesian Networks (BN) were linked to a Geographical Information System (GIS) to facilitate the spatial explicit modelling of all the relevant parameters. Remote sensing data were integrated in the framework to define input data. The framework was developed using open source software supporting the Open Source Geospatial Foundation (OSGeo). The model was applied to Dava bog in the North-East of Scotland where a historical survey is available providing detailed data on peat depth and water content. The changes in water content as seen from MODIS were modelled as a function of the depth of the peat in 2003 a dry year as example of future extreme events. The preliminary results show that it is possible link BN with GIS to model spatially explicit variables and demonstrate the usefulness of including remote sensing data for monitoring of soil in a climate change context.



S04.06 -5

LONG-TERM SOIL MONITORING IN GERMANY: IDENTIFICATION OF TEMPORAL AND SPATIAL PATTERNS

Schilli Carsten*^[1], Lischeid Gunnar^[2], Marahrens Stephan^[3], Rinklebe Joerg^[1]

^[1]University of Wuppertal ~ Soil- and Groundwatermanagement ~ Wuppertal ~ Germany ^[2]Leibniz Centre for Agricultural Landscape Research (ZALF) ~ Institute of Landscape Hydrology ~ Muencheberg ~ Germany ^[3]German Federal Environmental Agency ~ soil state and soil monitoring ~ Dessau ~ Germany

The long-term soil monitoring program in the Federal Republic of Germany exists since 1985 and it covers approximately 800 sites under different land use. More than 60 biological, physical and chemical parameters were measured at soil samples of different horizons to a depth of up to two meters. During long-term soil monitoring a large and heterogenic data set was generated. In this study, we have analyzed the soil monitoring data of entire Germany the first time using multivariate statistics. Our study aimed on the identification of temporal and spatial pattern influencing the contents of organic carbon, nitrogen, pH as well as cadmium, chromium, copper, lead, nickel, and zinc. We have used as statistical approach the Self-Organizing Map (artificial neuronal network) with Sammons Mapping was used. Thereby different spatial and temporal pattern could be identified. As main drivers of the heavy metal content in soils of Germany we have identified the parent material and the deposition. The identified temporal trends could be divided, depending on land use. There are clear hints of decreasing heavy metal contents in arable soils and increasing contents in afforested soils with time. The used approach is general enough to describe the spatial influence of e.g. parent material and land use specific temporal trends for the entire area of Germany, while being still suitable to visualize the general impacts at a single site.



S04.06 -6

MONITORING SOIL CARBON – IS THERE A RIGHT ANSWER?

Black Helaina^{*[1]}, Lilly Allan^[2], Chapman Stephen^[1], Owen Jason^[2]

^[1]The James Hutton Institute ~ Ecological Science ~ Aberdeen ~ United Kingdom ^[2]The James Hutton Institute ~ Environmental Sciences ~ Aberdeen ~ United Kingdom

Soil carbon is high on a number of agendas. From governments to carbon markets to farmers, people want to know how to measure soil carbon, and whether results from monitoring changes in soil carbon changes are reliable enough to be used in decision-making. In this talk, we take a look the results obtained from a range of different UK monitoring schemes where soil carbon has been measured and where changes in soil carbon have been estimated over extended timescales (20 to 30 year time periods). These schemes include the National Soil Inventory for Scotland, the National Soil Inventory for England and Wales, Countryside Survey, the Resurvey of British Woodlands and the AFBI Soil Survey of Northern Ireland (AFBI). Using data from these schemes, we explore the implications of survey design, sampling strategies, sampling techniques, analytical approaches and conversion factors on the estimation of soil carbon stock (t/ha) and content (g/kg) and in estimating changes in soil carbon over time. From these experiences, we propose a range of actions that could be implemented by the soil science community to improve the estimation, reproducibility and comparability of soil carbon data from soil monitoring programmes.



S04.07 - SYNCHROTRON RADIATION IN SOIL SCIENCE: APPLICATIONS AND METHOD DEVELOPMENT

Chair Persons:

Melissa Anne Denecke, Karlsruhe - Germany

Thilo Behrends, Utrecht - Netherlands

Thursday 05 July 2012 from 10:30 to 12:00. Room Alloro

S04.07 -1

CHEMICAL SPECIATION OF TRACE ELEMENTS IN SOILS USING X-RAY ABSORPTION SPECTROSCOPY

Andreas Voegelin, Duebendorf - Switzerland - Invited

S04.07 -2

RECENT ADVANCES IN HARD X-RAY FLUORESCENCE MAPPING AND TOMOGRAPHY OPEN NEW AVENUES FOR BIOGEOCHEMICAL RESEARCH.

Erica Donner, Adelaide - Australia

S04.07 -3

SHEDDING SYNCHROTRON LIGHT ON INTERNAL STRUCTURES OF SOILS - APPLICATIONS OF ADVANCED X-RAY MICROSCOPY

Stephan Peth, Kiel - Germany - Invited

S04.07 -4

SYNCHROTRON X-RAY AND ELECTRON MICRO-PROBE STUDY OF CONTAMINATED DREDGED SEDIMENTS.

Antonine Poitevin, Orleans - France

S04.07 -5

SOFT X-RAY SPECTROMICROSCOPY OF NATURAL ORGANICS AFFECTING ACTINIDE MOBILITY – AN OVERVIEW

Markus Plaschke, Karlsruhe - Germany

S04.07 -6

ARSENIC SPECIATION AND MOBILITY IN MINING-AFFECTED RIVER FLOODPLAIN SOILS: X-RAY ABSORPTION SPECTROSCOPY AND COLUMN STUDIES

Ruben Kretzschmar, Zurich - Switzerland



S04.07 -1

CHEMICAL SPECIATION OF TRACE ELEMENTS IN SOILS USING X-RAY ABSORPTION SPECTROSCOPY

Voegelin Andreas*^[1]

^[1]Eawag ~ Water Resources + Drinking Water ~ Duebendorf ~ Switzerland

Knowledge on the chemical speciation of trace elements is essential for the mechanistic understanding and accurate quantitative description of the biogeochemical processes that control their mobility and bioavailability in pristine and contaminated soils. Over the last 20 years, synchrotron-based X-ray absorption spectroscopy (XAS) has developed into a invaluable tool for the investigation of trace elements in soils because it allows determining the oxidation state, local coordination and speciation of a target element in-situ even at trace concentrations and in a highly heterogeneous matrix like soil. Quick-scanning and micro-focused XAS in addition enable studies at high temporal and spatial resolution, respectively. In combination with complementary analytical methods, XAS thus offers unique molecular-level insight into trace element sorption, precipitation, and transformation reactions in well-defined model systems as well as in natural soils. Examples for the application and usefulness of XAS for the study of trace elements will be presented, and future challenges and requirements with respect to the use of XAS for investigating trace element speciation and transformation in soils will be discussed.



S04.07 -2

**RECENT ADVANCES IN HARD X-RAY FLUORESCENCE MAPPING AND TOMOGRAPHY
OPEN NEW AVENUES FOR BIOGEOCHEMICAL RESEARCH.**

Donner Erica^[1], Koppitke Peter^[2], De Jonge Martin^[3], Howard Daryl^[3], Ryan Chris^[4], Carey Anne-Marie^[5], Paterson David^[3], Naidu Ravi^[1], Lombi Enzo^[1]

^[1]University of South Australia ~ Centre for Environmental Risk Assessment and Remediation ~ Adelaide ~ Australia

^[2]The University of Queensland ~ School of Agriculture and Food Science ~ St Lucia ~ Australia ^[3]Australian Synchrotron ~ X-ray Fluorescence Microscopy ~ Melbourne ~ Australia ^[4]Commonwealth Scientific and Industrial Research Organisation (CSIRO) ~ Earth Science and Resource Engineering ~ Clayton ~ Australia ^[5]University of Aberdeen ~ Institute of Biological and Environmental Sciences ~ Aberdeen ~ United Kingdom

Environmental samples such as soils, plant materials, and biosolids are extremely diverse but share a tendency towards heterogeneity. This poses methodological challenges when investigating biogeochemical processes as large data sets are required to thoroughly explore the system complexity. Laterally-resolved synchrotron x-ray fluorescence (XRF) microspectroscopy has become a key method for the in situ investigation of micronutrients and inorganic contaminants in complex environmental samples. This presentation will demonstrate how recent advances in detector technology are drastically reducing dwell times during scanning, and hence bringing new possibilities to environmental research. Fast scanning allows major issues such as radiation damage of hydrated plant samples to be circumvented, and also significantly reduces temporal beamtime requirements, enabling images to be acquired in minutes rather than hours. It also makes particularly time-consuming techniques such as XRF microtomography increasingly feasible. This is a very powerful technique allowing 2D virtual cross sections and 3D elemental distributions to be imaged in situ in environmental samples such as plant organs. Another very promising new technique that will be demonstrated is XANES imaging, a method for speciation mapping that has recently been trialed for the first time on environmental samples. This technique requires micro-XRF mapping to be conducted at multiple (approximately 80) x-ray beam energies, and due to unreasonable beamtime requirements was not practicable prior to the advent of fast detection systems. Environmental applications of hard XRF mapping are clearly set to grow as the advent of fast detection facilitates the deployment of increasingly powerful imaging techniques.



S04.07 -3

SHEDDING SYNCHROTRON LIGHT ON INTERNAL STRUCTURES OF SOILS - APPLICATIONS OF ADVANCED X-RAY MICROSCOPY

Peth Stephan*^[1]

^[1]Christian-Albrechts-University ~ Soil Science ~ Kiel ~ Germany

The first applications of synchrotron radiation (SR), which long has been perceived (energetically) as a “waste product”, date back to the mid 1960s. Fundamental and applied research using SR was initially focused in the fields of physics, chemistry, crystallography, and material sciences and later extended to medicine, biology and geosciences. About 20 years ago the first soil scientist began to use SR to study in-situ soil processes. Today more than 50 Light Sources are in operation worldwide offering excellent opportunities to conduct soil research with a variety of SR-based techniques. Synchrotron radiation can be used in many different ways. Besides spectroscopy and fluorescence analysis, synchrotron-based X-ray absorption tomography (SR-?CT) has become a useful tool in soil research. Flannery and his colleagues (Flannery et al. 1987) introduced SR-?CT as a “new form of microscope” providing 3-dimensional images of internal structures with an excellent signal-to-noise ratio and a spatial resolution comparable to that obtained in light microscopes. This presentation outlines the principles of SR-?CT and summarizes some potential applications in soil research going beyond what is achievable with industrial tube-based X-ray systems. A major goal of X-ray microtomography is to obtain an insight into small scale 3D pore networks. Examples for the quantitative analysis of network morphologies, their dynamics with environmental conditions and their influence on spatial heterogeneities of soil compositions will be demonstrated and discussed.



S04.07 -4

SYNCHROTRON X-RAY AND ELECTRON MICRO-PROBE STUDY OF CONTAMINATED DREDGED SEDIMENTS.

Poitevin Antonine^[1], Louis Hennet^[2], Catherine Lerouge^[3], Guillaume Wille^[4], Philippe Bataillard^[3]

^[1]BRGM - CNRS ~ CEMHTI ~ Orleans ~ France ^[2]CNRS ~ CEMHTI ~ Orleans ~ France ^[3]BRGM ~ EPI ~ Orleans ~ France ^[4]BRGM ~ MMA ~ Orleans ~ France

Sediments originating from periodic dredging of waterways were traditionally disposed of in storage sites without any precautions or treatments. There may be some environmental concerns especially when the dredged material comes from historically contaminated areas such as the North French coal basin. This study aims to characterize the metal mobility in deposited dredged sediment by combining chemical and spectroscopic techniques. Electron probe micro-analyse (EPMA) combined with microbeam x-ray fluorescence (μ XRF) at Synchrotron sources were used to identify Zn and Pb carriers. In particular Zn and Pb distributions in thin-section samples were determined by μ -XRF elemental mappings. EPMA was used to determine the distribution of light elements for which the energy of the emission lines is below 4 keV (Si, S, P...). The presence of reduced (sulphides) and oxidized (sulphates, oxihydroxides) phases strongly suggests that the redox state is one of the major parameters controlling the metal mobility. Therefore x-ray absorption spectroscopy experiments were also performed to study the oxidation state in both bulk samples and on selected regions of interest in thin section samples. In this work, the potential effects of the sample preparation were also studied and will be presented.



S04.07 -5

SOFT X-RAY SPECTROMICROSCOPY OF NATURAL ORGANICS AFFECTING ACTINIDE MOBILITY – AN OVERVIEW

Plaschke Markus^[1], Jörg Rothe^[1], Thorsten Schäfer^[1], Kathy Dardenne^[1], Melissa A. Denecke^[1], Horst Geckeis^[1]

^[1]KIT ~ INE ~ Karlsruhe ~ Germany

Securing nuclear repository safety requires profound understanding of molecular processes determining the mobility of released radionuclides (i.e., actinides). In this context systematic spectromicroscopy studies have been performed over the last decade. Scanning Transmission X-ray Microscopy (STXM) is an appropriate tool to visualize natural organics and their interactions with metal cations or mineral phases providing excellent spatial resolution down to the nm-level combined with high chemical sensitivity. This chemical speciation information can be obtained from K- or L-edge NEXAFS (Near Edge X-ray Absorption Fine Structure). STXM/NEXAFS investigations are performed at three different endstations: (1) X-1A-STXM, NSLS, USA, (2) PoLux-STXM, SLS, Switzerland, (3) ALS-MES-STXM, LBNL, USA. Moreover, STXM benefits from the ability to characterize environmental samples in thin films of aqueous suspensions or in thin sections. The studies cover various aspects of natural organics and their interactions with metal ions and mineral phases: (a) basic research on model compounds (e.g., polyacrylic acid (PAA)), (b) metal ion interaction with conditioned humic acid (HA) and (c) organic-mineral associations in natural systems (e.g., claystone). Appropriate model compounds are selected helping to assign spectral features in the more complex natural matter. A distinct metal ion complexation effect is visible both in the C1s-NEXAFS of PAA and HA metal ion complexes depending on sample pH. Metal cations are enriched in a HA minority fraction as determined in Eu(III)-HA aggregates. Furthermore, HA are found associated and fractionated on certain mineral phases, e.g., Al-oxides. Characteristic organic-mineral associations are also observed in claystone samples originating from a possible repository site.

S04.07 -6

ARSENIC SPECIATION AND MOBILITY IN MINING-AFFECTED RIVER FLOODPLAIN SOILS: X-RAY ABSORPTION SPECTROSCOPY AND COLUMN STUDIES

Kretzschmar Ruben^[1], Petar Mandaliev^[1], Christian Mikutta^[1], Kurt Barmettler^[1], Tsvetan Kotsev^[2]

^[1]ETH Zurich ~ Institute of Biogeochemistry and Pollutant Dynamics ~ Zurich ~ Switzerland ^[2]Bulgarian Academy of Sciences ~ National Institute of Geophysics, Geodesy and Geography ~ Sofia ~ Bulgaria

The floodplains of many rivers worldwide are contaminated due to mining and/or industry. We investigated the spatial distribution and chemical speciation of arsenic (As) in soils of the floodplain of the river Ogosta, NW-Bulgaria, a major tributary to the lower Danube. Ogosta river has been heavily polluted with As and other trace elements by mining of Au, Fe, and Pb/Ag ores, with the largest release of ore waste slurries between 1964 and 1979. Soil samples were collected in selected soil profiles and along transects across the floodplains. Arsenic speciation was investigated by bulk As K-edge X-ray absorption spectroscopy (XAS). Additionally, thin sections of undisturbed soils were examined by micro-X-ray fluorescence (μ -XRF) spectrometry and μ -XAS and selected soils were size-fractionated to explore the elemental composition, mineralogy, and As speciation in different particle size fractions. Soil As concentrations in the floodplain ranged from 40 to 37,400 mg kg⁻¹. Bulk and micro-XAS, combined with ascorbate-extractions, revealed that most As was present as As(V) sorbed to poorly-crystalline Fe(III)-oxyhydroxides, with smaller amounts of As bound in arsenopyrite. The most highly contaminated soils probably also contained smaller amounts of ferric arsenates, as indicated by the extremely low molar Fe/As ratios (<4) in the fine particle size fractions (<20 μ m). We are currently investigating the mobility of As in these soils under oxic and anoxic conditions using column experiments. The biogeochemical processes controlling As mobility in these soils will be discussed.



S05.01a - SOIL ORGANIC MATTER AMENDMENTS: IMPACTS, BENEFITS, AND RISKS

Chair Persons:

Claudio Ciavatta, Bologna - Italy

César Plaza, Madrid - Spain

Tuesday 03 July 2012 from 10:30 to 12:00. Room Olmo

S05.01a -1

DIGESTATES FROM BIOGASPRODUCTION: CHEMICAL COMPOSITION AND EFFECTS ON PRIMING IN SOILS

Doreen Zirkler, Berlin - Germany

S05.01a -2

IMPACT OF ANAEROBIC DIGESTATES ON SOIL PHYSICAL QUALITY BY MEANS OF MICROSTRUCTURAL SHEAR STRENGTH

Doerthe Holthusen, Kiel - Germany

S05.01a -3

UNDERSTANDING PHOSPHORUS (P) DYNAMICS IN SOILS AMENDED WITH APPLICATION OF DIFFERENT ORGANIC AMENDMENTS USING THE DIFFUSIVE GRADIENTS IN THIN-FILMS (DGT) TECHNIQUE

David Kane, Cranfield - United Kingdom

S05.01a -4

ENVIRONMENTAL IMPACT OF USING ORGANIC FERTILIZERS ON PERENNIAL BIOMASS CROPS

Athyna Cambouris, Quebec - Canada

S05.01a -5

LONG TERM EFFECT OF COMPOST AMENDMENT IN COMMERCIAL PEACH ORCHARD: EFFECT ON SOIL FERTILITY AND TREE, NUTRITIONAL STATUS

Elena Baldi, Bologna - Italy

S05.01a -6

RESIDUE CHEMISTRIES OF SOLE AND MIXED ORGANIC AMENDMENTS AND THEIR EFFECTS ON SOIL MICROBIAL ACTIVITIES AND BIOCHEMICAL PROPERTIES

Samuel Partey, Manchester - United Kingdom



S05.01a -1

DIGESTATES FROM BIOGASPRODUCTION: CHEMICAL COMPOSITION AND EFFECTS ON PRIMING IN SOILS

Zirkler Doreen^{*[1]}, Kaupenjohann Martin^[1]

^[1]TU Berlin ~ Department of Soil Science ~ Berlin ~ Germany

Recently, the biogas sector is growing rapidly and covers an increasing share of the energy supply. However, the production of biomass for fermentation competes against food production for agricultural space. Thus, the fermentation of organic residues should be preferably developed. Nutrient cycles can be closed by bringing digestates to the soils. So far, little is known about the variability of the elemental composition of these digestates over time and their effects on soil organic matter. We analysed the annual pattern of the concentrations of C, Ca, Cd, Cu, Fe, K, Mg, Mn, Mo, N, Ni, P, Pb, S, Se and Zn in digestates from sewage sludge (sew), slurry (sl), maize silage (ma) and a sewage-sludge-mash-fat-mixture (mix). According to their origin material, digestates show a wide range of element concentrations. The annual variation of some element concentrations of digestates from one particular origin may, however, be as high as the variability of these element concentrations between digestates of different origin. C/N ratios increased in the order $sew < mix < sl < ma$. Recently, respiration experiments with the digestates and a loamy-sandy soil are conducted to study if priming is induced. $\delta^{13}C$ -analyses shall identify the source of emitted CO_2 (digestate- or soil-derived). In a second respiration experiment, we vary the bioavailable C- and N-concentrations in the digestates in order to test, which of the factors is responsible for priming.



S05.01a -2

IMPACT OF ANAEROBIC DIGESTATES ON SOIL PHYSICAL QUALITY BY MEANS OF MICROSTRUCTURAL SHEAR STRENGTH

Holthusen Doerthe^{*[1]}, Jonas-Schasse Silke^[1], Horn Rainer^[1]

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Within the EC the use of agricultural products in biogas plants has strongly increased due to the directive 2001/77/EC that contains ambitious targets for the share of renewable resources in energy production. Many of the EC states implemented the directive via feed-in support. In Germany, especially the amendment of the national act in 2004 caused economic incentives for the use of maize for anaerobic digestion. Hence, the amount of plants in Germany more than doubled from 2003 to 2009. The produced sludges are commonly used as fertilizers with high N availability without questioning. However, their impact on physical soil quality seriously lacks knowledge. Some authors already reported deterioration of soil structure in the wake of digestate application especially on sandy soils, and related this effect to high amounts of soluble potassium ions, a pH-lowering impact as well as a priming effect of soil organic carbon. Also, the physical behavior of the sludges themselves is only poorly understood. In our investigations we tested the impact of two digestates percolating through artificial soil samples by means of rheometry (microstructural soil shear strength) and determined destructive (at high concentrations of digestate) as well as stabilizing effects (at low concentrations) on soil stability. In addition, the analysis of the flow behavior of the sludges themselves revealed distinct thixotropy as well as shear-thinning with regard to application. Those facts help to improve the sustainable management of digestates as valuable amendments without spoiling the soil's ability to provide a fertile foundation for plant production.



S05.01a -3

UNDERSTANDING PHOSPHORUS (P) DYNAMICS IN SOILS AMENDED WITH APPLICATION OF DIFFERENT ORGANIC AMENDMENTS USING THE DIFFUSIVE GRADIENTS IN THIN-FILMS (DGT) TECHNIQUE

Kane David*^[1]

^[1]Cranfield University ~ Environmental Science and technology ~ Cranfield ~ United Kingdom

Global P resources are limited, and as they are exploited, they are gradually depleting. Each year over 85% of mined phosphate rock is used in agriculture as a fertiliser for crops or as an additive to animal feed. Organic amendments can provide a sustainable alternative to traditional inorganic fertilisers, however the concentration of phosphorus in organic amendments is variable and its availability when applied to soils is relatively unknown. Knowledge of their P availability can reduce reliance on inorganic fertilisers in agriculture. Currently the most common and widely used soil tests to measure soil P are extraction techniques (e.g. Olsen-P); however the P measured by such techniques may not reflect P in a readily available form. The Diffusive Gradients in Thin-films (DGT) technique is an alternative P test which can measure the form of P available to the plant. If the DGT technique can improve understanding of soil P dynamics following application of organic amendments, it can be used as a tool to make phosphorus use in agriculture more sustainable. The objectives of the current study are as follows (1) To quantify available P pools in soil associated with application of superphosphate (SP) and different organic amendments (cattle slurry(SLRY), cattle manure (FYM) and green waste compost(GW)) and estimate the timescale required to make P available. (2) To quantify soil response to added P in relation to different application rates (0, 80, 120 kg/ha P) of the various organic amendments. (3) To measure microbial biomass P by conventional means, using DGT.



S05.01a -4

ENVIRONMENTAL IMPACT OF USING ORGANIC FERTILIZERS ON PERENNIAL BIOMASS CROPS

Cambouris Athyna^{*[1]}, Noura Ziadi^[1], Gilles Bélanger^[1], Gaétan Parent^[2]

^[1]Agriculture and Agri-Food Canada ~ Research ~ Quebec ~ Canada ^[2]Agriculture and Agri-Food Canada ~ Agri-Environment Service Branch ~ Quebec ~ Canada

Perennial herbaceous crops are considered to be the future of the bioenergy industry. Our objective was to evaluate the environmental impact of using inexpensive and widely available organic fertilizers on perennial crops for the production of biomass on marginal land. Two species were established in 2008 [switchgrass (*Panicum virgatum* L.) and reed canarygrass (*Phalaris arundinacea* L.)] as main plots of a split-plot experimental design. Fertilizer treatments as sub-plots were a factorial combination of three N sources [(ammonium nitrate (AN), pig manure (PM), and municipal biosolid (MB))] applied in spring of 2009 at three N rates (40, 80, and 120 kg total N ha⁻¹) plus a control treatment with no N. Lysimeters (0.60-m depth) were installed in four treatments (control, and each N source at 120 kg N ha⁻¹) before the application of organic and mineral fertilizers and remained in place during the entire growing season. Soil water was sampled from the lysimeters every two weeks to determine NO₃-N concentrations. Soil was sampled (0-0.6 m) on each plot immediately after crop harvesting to measure residual soil nitrates (RSN). At the end of the first production year, RSN were 67 kg NO₃-N ha⁻¹ with no significant difference between N sources or N rates. Soil water nitrate concentrations with switchgrass were always greater (4.0 vs. 1.9 mg NO₃-N L⁻¹) than with reed canarygrass with no effect of N sources or rates. No negative environmental impact of the use of PM or MB was observed after one year of production.



S05.01a -5

LONG TERM EFFECT OF COMPOST AMENDMENT IN COMMERCIAL PEACH ORCHARD: EFFECT ON SOIL FERTILITY AND TREE, NUTRITIONAL STATUS

Baldi Elena^[1], Toselli Moreno^[1], Marcolini Graziella^[1], Quartieri Maurizio^[1], Sorrenti Giovambattista^[1], Marangoni Bruno^[1], Cirillo Elio^[2]

^[1]Università di Bologna ~ Dipartimento di Colture Arboree ~ Bologna ~ Italy ^[2]Univeristà di Bologna ~ Dipartimento di Scienze e Tecnologie agrarie ~ Bologna ~ Italy

The objectives of the present experiment were to evaluate, in the long term (12 years), the effect of organic fertilization on soil fertility and tree nutrition in a commercial orchard of Stark RedGold. Trees were subjected, since their plantation, to the following treatments: 1. unfertilized control, 2. mineral fertilization including P and K applied at planting and N split in two applications at 40 days after full bloom (60%) and in September (40%) and repeated yearly; 3. cow manure supplied at planting at 10 t ha⁻¹ and from the 4th year at the rate of 5 t dw ha⁻¹ per year in spring; 4. compost supplied at the same rate of cow manure; 5. compost supplied at a rate of 5 t dw ha⁻¹ year⁻¹, and 10 t dw ha⁻¹ year⁻¹(6), both split as for treatment 2. With few exceptions, nitrate and ammonium-N soil concentrations were unaffected by treatments. Microbial C, total N and soil organic matter were increased by application of compost at high rate. With some exceptions, leaf nutrient concentrations were not affected by treatments. Cumulative yield increased as a consequence of high rate of compost if compared with unfertilized control. Unlike thinned fruits, naturally abscised leaves and pruning wood from mineral and high compost plots had a higher nutrient concentrations than the other treatments. These results indicate that yearly application of compost at 10 t ha⁻¹ does not increase the risk of nitrate pollution, instead it promotes a tree growth and production similar to mineral fertilization.



S05.01a -6

RESIDUE CHEMISTRIES OF SOLE AND MIXED ORGANIC AMENDMENTS AND THEIR EFFECTS ON SOIL MICROBIAL ACTIVITIES AND BIOCHEMICAL PROPERTIES

Partey Samuel¹

^[1]University of Manchester ~ Faculty of Life Sciences ~ Manchester ~ United Kingdom

*While there is significant evidence that the addition of organic residues to soils can improve overall soil fertility, it is unclear as to what organic residues will have the most beneficial impact. The use of residue chemistry as an index for assessing organic resource quality is highly reported and has been linked to organic matter decomposition and nutrient release patterns. However, less is reported on the direct linkages between organic residue chemistry and soil biogeochemistry and how the impact varies between sole and mixed organic residues. In this research, we investigated the residue chemistries of *Tithonia diversifolia*, *Vicia faba* and *Zea mays* (either applied alone or in combination) and how they affected and related to soil microbial activities and biochemical properties. The results revealed significant differences in chemical composition among the species and affirmed that organic materials impact differently on soil microbial and biochemical properties based on their chemistry. Carbon, polyphenol, C: P and lignin: N ratios had the greatest impact on soil microbial activities and biochemical properties. The levels of biological activities were comparable in sole and mixed amendments but N mineralization and availability increased significantly in *V. faba* and *T. diversifolia* amendments. The results also demonstrated that basal respiration, microbial biomass carbon and the activities of β -glucosidase and β -glucosaminidase are sensitive indicators of nitrogen availability and organic C levels in soils.*



S05.01b - SOIL ORGANIC MATTER AMENDMENTS: IMPACTS, BENEFITS, AND RISKS

Chair Persons:

César Plaza, Madrid - Spain

Claudio Zaccone, Foggia - Italy

Tuesday 03 July 2012 from 13:30 to 15:00. Room Olmo

S05.01b -1

NITROGEN FERTILIZER REPLACEMENT VALUE OF HEAT-DRIED MUNICIPAL BIOSOLIDS

Dan M. Sullivan, Corvallis - United States

S05.01b -2

*RELATIONSHIPS BETWEEN GREEN WASTE COMPOST APPLICATION TO ARABLE SOILS
AND NITROUS OXIDE EMISSIONS*

Kirsty Watson, Bedford - United Kingdom

S05.01b -3

ANIMAL MANURE APPLICATION AND SOIL C STORAGE: A GLOBAL META-ANALYSIS

Denis Angers, Québec - Canada

S05.01b -4

*ORGANIC C BALANCE AND DYNAMIC OF MICROBIAL POPULATIONS IN A SOIL AMENDED
WITH LIVESTOCK-DERIVED ORGANIC MATERIALS*

Daniela Pezzolla, Perugia - Italy

S05.01b -5

MICROBIAL EXTRACELLULAR POLYMERIC SUBSTANCES (EPS) IN SOIL

Marc Redmile-Gordon, London - United Kingdom

S05.01b -6

BIOCHAR : A HUMIC PRECURSOR

Michael H.B. Hayes, Chemical and Environmental Sciences - Limerick - Ireland



S05.01b -1

NITROGEN FERTILIZER REPLACEMENT VALUE OF HEAT-DRIED MUNICIPAL BIOSOLIDS

Sullivan Dan M.*^[1]

^[1] Oregon State University ~ Crop & Soil Science ~ Corvallis ~ United States

*Municipal wastewater treatment facilities in the Pacific Northwest, USA have been upgraded to produce heat-dried biosolids, instead of dewatered or slurry biosolids. Heat-dried biosolids have greater value to farmers and urban markets because they can be pelleted, stored, transported, bagged and used by consumers with traditional fertilizer spreading equipment. Several researchers have recently reported very high nitrogen (N) availability from heat-dried biosolids (> 60% of total N). Our research evaluated the N fertilizer replacement value of heat-dried biosolids produced by an Andritz dryer (operating at inlet temp of 455 to 480 C) relative to a standard inorganic N fertilizer (urea; 46-0-0) in three field trials (2009-11). The test crop was rain-fed soft-white winter wheat (*Triticum aestivum*) seeded in fall and harvested the following summer. Biosolids were broadcast on the soil surface in fall at seeding, or in early spring at tillering growth stage at Corvallis, OR USA (Oct-Mar precip > 700 mm). Urea was applied in spring only (standard agronomic practice). Trials were conducted at new field locations in each year. Nitrogen fertilizer replacement value of biosolids averaged 35% with fall application, and 45% with spring application, as determined by relative grain N uptake for biosolids vs. urea treatments. We conclude that N fertilizer replacement value for heat-dried biosolids was close to that estimated by our current university guidance for air-dried biosolids (30 to 40% of biosolids total N in first year after application).*



S05.01b -2

**RELATIONSHIPS BETWEEN GREEN WASTE COMPOST APPLICATION TO ARABLE SOILS
AND NITROUS OXIDE EMISSIONS**

Watson Kirsty^[1], Sakrabani Ruben^[1], Ritz Karl^[1]

^[1]Cranfield University ~ School of Applied Sciences ~ Bedford ~ United Kingdom

Rising global population paired with increasing environmental awareness has put pressure on the agricultural sector to increase yield whilst maintaining or reducing its environmental footprint. It is estimated that within the UK, agriculture contributes 66% of all N₂O emissions, with around 61% of this resulting from soil emissions. Furthermore the increasing costs of ammonium nitrate is forcing the re-examination of more traditional organic fertilisers, however, the unpredictable nature of the quantity and timing of nitrogen release acts as a barrier to their widespread commercial adoption. Therefore it is necessary to look at impact of green waste compost (GWC) and inorganic fertiliser use within the conceptual frame work of synchronising crop demand with N supply in order to maximise N use efficiency and thereby reduce N losses. Field trials were established at 2 sites: Elveden, Suffolk (established in 2010) and Morley, Norfolk (established in 2007). Trials consisted of 2 treatments, inorganic fertiliser and inorganic fertiliser and GWC (35t/ha) with treatment plots of 6m x 12m, with four replicates. Both sites were planted with cereal crops; spring barley and winter wheat respectively. The Morley site demonstrated a clear treatment effect with compost amended plots exhibiting significantly lower (p-value < 0.0000) N₂O emissions than the control plots with emissions of 157 and 249 gN₂O-N ha⁻¹ d⁻¹ respectively. However this treatment effect was not evident at the Elveden field site, implying a relationship with GWC application duration. The anomalous weather conditions during the 2010/2011 growing season are likely to have influenced results.



S05.01b -3

ANIMAL MANURE APPLICATION AND SOIL C STORAGE: A GLOBAL META-ANALYSIS

Angers Denis^[1], Maillard Emilie^[1]

^[1]Agriculture and Agri-Food Canada ~ Soils and Crops Research centre ~ Québec ~ Canada

The positive effect of animal manure application on soil organic C (SOC) has been known for centuries. However, there is a large variability in the response of soils to manure application, and environmental factors and manure characteristics controlling this response are still poorly defined. Improving the quantification and understanding the variability of this response will contribute to select management practices, improve national SOC inventories and validate SOC models. This study provides a review of the influence of animal manure application on SOC stocks based on a meta-analysis of 64 publications (totalling 71 sites and 242 observations). Based on meta-analytic procedures, the study indicates that the main factors that contribute to increasing SOC stocks following manure application are: land use, animal origin, manure storage method, and climatic zone. Specifically, the analysis (1) indicates that the positive impact of manure application on SOC stocks is more pronounced in perennial than annual cropping systems; (2) suggests that cattle manure leads to greater SOC accumulation than pig; (3) underscores that solid results in greater SOC stocks than liquid manure; (4) suggests that manure application carried out in the oceanic and humid continental climate zones results in larger SOC accumulation than in humid subtropical climate. This study provides meta-analytic data that can be used to refine the C change factors for national greenhouse gas inventories provided by IPCC for manure management.



S05.01b -4

ORGANIC C BALANCE AND DYNAMIC OF MICROBIAL POPULATIONS IN A SOIL AMENDED WITH LIVESTOCK-DERIVED ORGANIC MATERIALS

Pezzolla Daniela^{*[1]}, Turchetti Benedetta^[2], Buzzini Pietro^[2], Albertini Emidio^[2], Agnelli Alberto^[1], Gigliotti Giovanni^[1]

^[1]University of Perugia ~ Department of Agricultural and Environmental Sciences ~ Perugia ~ Italy ^[2]University of Perugia ~ Department of Applied Biology ~ Perugia ~ Italy

The increase of CO₂ emissions is currently considered the most relevant issue causing the climatic changes. The balance of organic C into the soil is affected by of inputs and outputs and the amendment of agricultural soils by livestock-derived organic materials (LD-OM) is one of the tools for increasing input of organic C. Soil amendment can affect soil microbial activity, in terms of consistence of microbial biomass and in terms of both prokaryotic and eukaryotic microbial diversity. The results about the C balance and microbial activity in the soil amended with LD-OM are herein reported. When compared with an undisturbed soil (US), the addition of LD-OM determined an early increased CO₂ emission (first 10 days), which resulted in lower release afterwards, as well as the amount of water soluble organic matter, which is the most easily degradable by microorganisms. LD-OM amended soil exhibits a low amount of soluble organic matter than US, whereas microbial biomass was higher in US. The level of culturable prokaryotic and eukaryotic microbiota in amended soil was higher in the early phases for yeasts and filamentous fungi, whereas bacterial flora substantially unchanged. The unculturable portion of both prokaryotic and eukaryotic microbial populations have also been evaluated. Moreover, a next generation sequencing approach was employed. Total microbial DNA was isolated from 8 soil samples (control and amended) and subjected to 454 sequencing with the aim of monitoring the changes in microbial community structure due to amendants. Results are under statistical evaluation and will be presented and discussed.



S05.01b -5

MICROBIAL EXTRACELLULAR POLYMERIC SUBSTANCES (EPS) IN SOIL

Redmile-Gordon Marc^{*[2]}

^[1]Rothamsted Research ~ Sustainable soils and grassland systems ~ London ~ United Kingdom

Many benefits of amendments to soil are due to by-products such as exocellular proteins and polysaccharides (EPS) exuded by the microbial biomass during the breakdown of labile organics. EPS are known to convey improved colony adhesion, habitat heterogeneity, and biochemical function to soil biota. This is thought to benefit soil characteristics, e.g. structure, nutrient cycling, and contaminant immobilisation. Moreover, EPS provides desiccation tolerance, which is expected to improve water-use-efficiency and extend periods of agricultural productivity. To assess these impacts, a method to quantify EPS is required. Existing methods of extraction from soil co-extract intra-cellular materials and humified organic matter. Here we compare several techniques to extract EPS from soils of two contrasting managements (grassland and bare fallow), with and without 2mg glycerol carbon addition g⁻¹ soil. Extractions included autoclaving with 20mM citrate or 0.5M H₂SO₄ and a cold extraction with cation exchange resin (CER). Changes in cellular ATP were used as an indicator of cell-lysis (Redmile-Gordon et al., 2011). Extracting with CER did not affect microbial ATP, and extracted the greatest proportion of sugars developed in response to glycerol substrate. This extract is thus thought to be most representative of de-novo exocellular polysaccharides of microbial origin. Quantifying this fraction is important to distinguish between the relative contributions of organic amendments and microbial products to soil characteristics. Further work with stable isotopes is underway to identify amino acids and monosaccharides constituting de-novo EPS developed from a variety of substrate additions to soil.



S05.01b -6

BIOCHAR : A HUMIC PRECURSOR

Hayes Michael H.B. ^{*[1]}

^[1]University of Limerick ~ Carbolea Research Group ~ Chemical and Environmental Sciences ~ Limerick ~ Ireland

The extraordinary fertility of the Terra Preta soils, amended by pre-Columbian Indians of the Amazon Region with pyrolysed organic refuse and biomass, has focused world-wide interest on the potential of biochar (or char from biomass) to enhance plant growth and promote the proliferation of beneficial soil organisms. Many recent studies have shown the presence of biochar in highly fertile soils. The dark colour of the Mollisol soils (the source of the IHSS soil standard) of the Midwestern US is attributable to char from burning vegetation in centuries past. The aromatic resonance in the NMR spectra of the humic and fulvic acids of these soils is characteristic of biochar, and resin technology has isolated a partially oxidised biochar from more recently formed humic substances. Because of its role in soil fertility and in carbon sequestration, biochar has the potential to become an important commercial product. It is inevitable that the industry will be regulated. Our studies show that the desirable properties of biochar are related to the source material, to the temperature and time of pyrolysis, and to the soil that it amends. Retention of aspects of the plant cell architecture is important. Biochar from lignocellulosic biomass is non mutagenic, but pyrolysis of proteinaceous and other materials gives mutagens. Highly beneficial Arbuscular Mycorrhizal fungi (AMF) that enable plant uptake of fixed phosphate, and Azospirillum (nitrogen fixing) species colonize porous biochars.



S05.01c - SOIL ORGANIC MATTER AMENDMENTS: IMPACTS, BENEFITS, AND RISKS

Chair Persons:

Claudio Zaccone, Foggia - Italy

Claudio Ciavatta, Bologna - Italy

Tuesday 03 July 2012 from 15:30 to 17:30. Room Olmo

S05.01c -1

GREEN MANURE AND BIOWASTE COMPOST IMPACTS ON SOIL QUALITY UNDER ORGANIC POTATO PRODUCTION IN NOVA SCOTIA, CANADA

Mehdi Sharifi, Truro - Canada

S05.01c -2

IMPACT OF AMENDMENTS ON BIOLOGICAL FUNCTIONS OF A PAH CONTAMINATED SOILS TREATED BY CHEMICAL OXIDATION

Fabien Laurent, Vandoeuvre les Nancy - France

S05.01c -3

BIOCHAR APPLICATION IN TEMPERATE SOILS: LESSONS LEARNED FROM FIELD AND LAB

Sonja Schimmelpfennig, Giessen - Germany

S05.01c -4

HOW BIOCHAR CONTRIBUTES TO INCREASE AGRICULTURAL YIELDS? A STUDY ABOUT THE LINK BETWEEN BIOCHAR AND ETHYLENE.

Irene Criscuoli, San Michele all'Adige (TN) - Italy

S05.01c -5

BIOCHAR CARBON SEQUESTRATION: THE EFFECTS OF FEEDSTOCK AND TEMPERATURE OF PYROLYSIS ON CHEMICAL AND PHYSICAL STABILITY

Meghana Rao, Portland - United States

S05.01c -6

BIOCHAR – A POSSIBLE SOURCE OF ORGANIC POLLUTANTS?

Katja Wiedner, Halle - Germany



S05.01c -7

USING A MULIVARIATE APPROACH TO DERIVE A GENERALISED UNDERSTANDING TO PREDICT THE FUNCTIONS OF BIOCHAR IN SOIL

Saran Sohi, Edinburgh - United Kingdom



S05.01c -1

GREEN MANURE AND BIOWASTE COMPOST IMPACTS ON SOIL QUALITY UNDER ORGANIC POTATO PRODUCTION IN NOVA SCOTIA, CANADA

Sharifi Mehdi^[1], Lynch Derek^[2], Hammermeister Andrew^[2], Burton David^[1]

^[1]Nova Scotia Agricultural College ~ Environmental Sciences ~ Truro ~ Canada ^[2]Nova Scotia Agricultural College ~ Plant and Animal Sciences ~ Truro ~ Canada

The impact of green manures and biowaste composts on soil quality were evaluated in a potato rotation during 2008 and 2010. The preceding crops were (G1) oats underseeded with red clover (ORC)-carrots-ORC-red clover (RC); (G2) beans followed by buckwheat (BBu)-carrots-ORC-RC; (G3) ORC-BBu-carrots-oats/pea/vetch mixture (OPV); and (G4) ORC-carrots-BBu-OPV. Fertility treatments (applied only in the potato year) included: non-amended (control), municipal food waste compost (MSFW; 7 Mg DM ha⁻¹), composted paper mill biosolids (PMB; 14 Mg DM ha⁻¹) or P and N synthetic fertilizers (FERT) used for reference. Soil quality indicators were measured in the top 15 cm of the potato hill at the tuber initiation stage and averaged across years. The amount of carbon (C) that added to the soil was 4.1 and 2.7 Mg ha⁻¹ for RC and OPV, and 3.3 and 1.1 Mg ha⁻¹ for PMB and MSFW, respectively. Soil quality parameters were not affected by crops rotation except for total organic C (TOC) which highest levels were measured for the RC+PMB compared with other treatments (43 vs. 32 Mg ha⁻¹). Highest amounts of particulate organic matter (POM)-C were measured for PMB (8.6 Mg ha⁻¹) followed by MSFW, FERT and control. The total organic N (TON) and POM-N were highest for MSFW~PMB (6.2 and 0.80 Mg ha⁻¹) followed by FERT and control. Highest and lowest microbial quotient values were measured for MSFW and PMB, respectively (0.71 vs. 0.45%). Microbial biomass C and acid phosphatase activity were not affected by biowaste treatment. Green manure maintained while compost improved soil quality.



S05.01c -2

IMPACT OF AMENDMENTS ON BIOLOGICAL FUNCTIONS OF A PAH CONTAMINATED SOILS TREATED BY CHEMICAL OXIDATION

Laurent Fabien^[1], Julie Ducros^[1], Christophe Schwartz^[2], Sophie Guimont^[3], Jean-Christophe Renat^[3], Jean-Louis Morel^[2], Corinne Leyval^[1]

^[1]Laboratoire des Interactions Microorganismes Minéraux Matières organiques dans les sols ~ 54500 ~ Vandoeuvres les Nancy ~ France ^[2]Laboratoire sol et Environnement ~ 54500 ~ Vandoeuvres les Nancy ~ France ^[3]Valterra Depollution et Réhabilitation ~ 54500 ~ Vandoeuvres les Nancy ~ France

In order to remediate soil pollution, different techniques have been developed in the last decades. However, such techniques may have negative effects on soil physical, chemical and biological properties, and affect soil fertility and biological activity. Post-treatment soil construction using wastes and by-products may provide means to restore primary functions of the soil. The "OXYSOL" project aimed to develop in situ chemical oxidation of PAH contaminated soils combined with a post-treatment restoration of soil properties. Microcosm and lysimeter experiments were performed with different soils treated by chemical oxidation and amended with adapted mixtures of technogenic materials. The microcosm experiment was set up for 5 months in a growth chamber with a PAH spiked soil and an industrial PAH contaminated soil, both treated with Fenton's reaction, then amended or not with a mixture of paper mill sludge and compost. Beside the fate of pollutants, the following parameters were monitored: microbial density, diversity and activity, soil fertility, ecotoxicity and plant germination and growth. The results showed different responses after chemical oxidation treatment depending on soil characteristics. Parameters like pH, microorganism's density, enzymatic activity, organic carbon, available phosphorus were affected, and leachate toxicity was observed. The strong pH decrease for the spiked soil lead to unfavourable conditions for biological activity. Following the addition of post-chemical-treatment amendments the capacity of plants to grow on the treated soils was restored and there was a systematic increase of biological activity.



S05.01c -3

BIOCHAR APPLICATION IN TEMPERATE SOILS: LESSONS LEARNED FROM FIELD AND LAB

Schimmelpfennig Sonja*^[1], Kammann Claudia^[1]

^[1]Justus-Liebig-University ~ Experimental plant ecology ~ Giessen ~ Germany

We incubated grassland soil (Clay loam, pH 5,8) with three different substrates: untreated miscanthus (feedstock), hydrothermal carbonized miscanthus (hydrochar) and pyrolyzed miscanthus (biochar). The addition of the substrates was carried out with respect to the TOC-content of the soil (3%), which has been increased by 20% with the help of the substrates. To simulate real grassland conditions, we added slurry as fertilizer twice during the experimental period. Greenhouse gas fluxes (CO₂, N₂O und CH₄) have been measured on a weekly basis since initiation of the experiment. It could be shown that with feedstock and biochar, CO₂ emissions increased significantly, whereas addition of biochar did not influence CO₂ fluxes. Gas sampling was complemented by isotope analyses to determine the source (soil/additive) of the oxidized carbon. Concerning N₂O and CH₄-emissions, the addition of hydrochar and biochar led to a significant reduction in N₂O emissions, whereas all substrates increased the methane oxidation potential of the soil. The experiment was complemented by CEC and Nmin analyses combined with evaluation of the growth performance of Lolium perenne. These results from the incubation study were compared with first results from a biochar field trial on a grassland site near Giessen with similar parameters. Weekly greenhouse gas measurements were accompanied by isotopic measurements to determine long term biochar stability. We compare changes in biomass growth and species composition with ecosystem respiration and try to identify changes in soil parameters due to biochar amendments by means of TOC, Nmin content and aggregate structure analyses.



S05.01c -4

HOW BIOCHAR CONTRIBUTES TO INCREASE AGRICULTURAL YIELDS? A STUDY ABOUT THE LINK BETWEEN BIOCHAR AND ETHYLENE.

Criscuoli Irene^{*[1]}, Miglietta Franco^[1], Si-Ammour Azeddine^[2], Bertazza Gianpaolo^[3]

^[1]Fondazione Edmund Mach ~ FoxLab ~ San Michele all'Adige (TN) ~ Italy ^[2]Fondazione Edmund Mach ~ CRI-Research and Innovation Centre ~ San Michele all'Adige (TN) ~ Italy ^[3]Ibimet-Cnr ~ Ibimet-CNR ~ Bologna ~ Italy

*Biochar, a charcoal used as a soil amendment, is reported to increase crop yields. However, mechanisms behind this effect are not yet fully understood. Recent studies showed that biochar increases the production of ethylene (C₂H₄), a phytohormone, suggesting an ethylene-mediated mechanism by which biomass yields are increased. In order to verify this observation a pot experiment was performed with *Arabidopsis thaliana* ecotype Col-0, which shows elongation and early germination in the presence of ethylene, and the *etr1-3* mutant, which is insensitive to ethylene. Seeds were sown in sealed jars in a soil amended with 0, 5 and 10% of biochar. After 15 days we observed hypocotyl and petiole elongation and earlier plant germination in the wild-type compared to the ethylene insensitive mutant. The difference between the mutant *etr1-3* and its wild type was more evident at higher biochar concentrations, suggesting that ethylene production is due to biochar. These observations have been verified and confirmed through ethylene assessment with a GC fitted with a FID detector. This presentation will illustrate the key results of our study, discussing how ethylene effects might eventually translate into potential benefits in field application of biochar.*



S05.01c -5

BIOCHAR CARBON SEQUESTRATION: THE EFFECTS OF FEEDSTOCK AND TEMPERATURE OF PYROLYSIS ON CHEMICAL AND PHYSICAL STABILITY

Rao Meghana*^[3]

^[1]Oregon State University ~ Soil Science ~ Beaverton, Oregon ~ United States ^[2]Jesuit High School ~ Sophomore ~ Portland ~ United States ^[3]Jesuit High School ~ Crop and Soil Research ~ Portland ~ United States

This novel research studied effects of feedstock and temperature of pyrolysis on chemical and physical stability of biochar. Biochar, carbon-rich charcoal soil amendment, is a potential carbon-negative solution to reduce atmospheric carbon. Biochar stores 50% of the of the plant's carbon dioxide in carbon sinks with a predicted half-life of millenniums. Long-term stability is currently undetermined. Biochar was made in a Top-lit Updraft (TLUD) stove (360-420°C) and Fluidyne Pacific Class Gasifier (above 420°C) using Douglas fir chips, Hydrostraw (grass), and methane digester pellets. Proximate analysis determined moisture, volatile matter, and ash content. Chars were ultrasonicated, simulating physical stress over centuries. A Total Organic Carbon Analyzer measured lost carbon and nitrogen. Chemical stability was determined by mass lost through oxidation. The stability of carbon in grass and pellet chars increased with temperature; wood char decreased. After ultrasonication, TLUD pellet char lost 1.68% initial total carbon (TC), the highest across all chars, and .44% total nitrogen (TN). Wood 550°C lost the least TC (.01%) and .3% TN. Wood was the most carbon stable, then grass and pellets. The physical and chemical stability did not correlate. Wood 550C lost 80% mass after chemical oxidation. Grass lost the least mass (avg 17%), then pellets (avg 23%), lastly wood (avg 56%). The results demonstrate feedstock and temperature of pyrolysis affect the stability of biochar. Extended research is currently being done on the effect of particle size on stability, determining a rate of oxidation, and effects of freezing and thawing as a function of water-accessible volume.



S05.01c -6

BIOCHAR – A POSSIBLE SOURCE OF ORGANIC POLLUTANTS?

Wiedner Katja*^[1], Glaser Bruno^[1]

^[1]Martin-Luther-University Halle-Wittenberg ~ Soil Biogeochemistry ~ Halle ~ Germany

Besides the positive effects of biochar in soils, biochar could be also an undesirable source of toxic substances like polycyclic aromatic hydrocarbons (PAHs) and polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs). Due to the persistence and toxicity, it is of great importance to obtain a good understanding of their sources such as feedstocks or production processes. For this purpose, we determined the PAHs, PCDDs and PCDFs as well as general chemical properties (elemental composition, pH, electric conductivity, black carbon and ash content) of diverse biochars and hydrochars produced from different feedstocks and production processes. Our study showed the following results: the total EPA-PAH amounts of all tested biochars ranges between 0.1 and 1.4 mg PAH kg⁻¹. The PCDD/Fs contents of the biochars and hydrochars vary from 5.95 to 14.2 ng/kg. The amounts are also under the boundary value adjusted to the german sewage sludge ordinance. In contrast, the concentrations of PAHs in the hydrochars vary strongly from 0.5 to 12 mg PAH kg⁻¹. According the German Bundes-Bodenschutzverordnung (BBodSchV), critical precautionary values for soils with a humus content > 8% and ≤ 8% are 10 and 3 mg PAH kg⁻¹ (dry mass), respectively. Following the BBodSchV, PAH threshold values of some examined hydrochars were exceeded. The results indicate the great importance to specify a legal framework for biochar as soil amendment. Therefore, more research is needed concerning the formation of organic pollutants with respect to biochar production before adding it into agricultural used areas.



S05.01c -7

USING A MULIVARIATE APPROACH TO DERIVE A GENERALISED UNDERSTANDING TO PREDICT THE FUNCTIONS OF BIOCHAR IN SOIL

Sohi Saran^{*[1]}, Cross Andrew^[1], Peters Clare^[1]

^[1]UK Biochar Research Centre ~ School of GeoScience ~ Edinburgh ~ United Kingdom

Various trends in certain features of biochar have been reported when comparing systematic sets of material produced by a single set of equipment. However, a generalised, predictive understanding of how feedstock and biomass conversion parameters will determine the function of biochar products in soil, in terms of carbon storage, nutrient and water cycling and, ultimately, crop performance or yield, is lacking. This compromised the ability to demonstrate the extent and limits of its utility in soil management. To address this critical gap we developed a set of novel laboratory assays and applied them to more than 30 samples of biochar. None of the biochar samples were selected such that no sample had more than one production parameter in common with more than one other sample, each sample was from a different facility and encompassed a complete range of processes. The assays seek to provide a comprehensive, comparative assessment of five key functions of biochar in soil, seeking to mimic the behaviour of biochar in the field environment over periods of time relevant to each function. Multivariate statistical analysis was applied to the results, firstly to assess the level of co-correlation between the functional properties that were assessed across the sample set, secondly to examine the relative contributions to total variance for each assay and overall, attributable to feedstock type certain process settings affecting the products of pyrolysis. Results from this analysis will be presented together with an assessment of its utility and suggestions for targeting further work.



S05.02 - IMPACTS OF SOIL AMENDMENTS ON TRANSFORMATION AND SORPTION OF BIOLOGICALLY ACTIVE SUBSTANCES IN SOIL

Chair Persons:

Robert Kreuzig, Braunschweig - Germany

Ruben Sakrabani, Cranfield - United Kingdom

Thursday 05 July 2012 from 15:30 to 17:15. Room Mirto

S05.02 -1

IMPACTS OF SOIL AMENDMENTS ON FATE AND BEHAVIOR OF POLLUTANTS IN SOIL

Robert Kreuzig, Braunschweig - Germany

S05.02 -2

CHARACTERIZING THE HETEROGENEITY OF PIG SLURRY AND RESULTING EFFECTS ON TRANSPORT OF PHARMACEUTICAL ANTIBIOTICS IN SOIL

Sören Thiele-Bruhn, Trier - Germany

S05.02 -3

PHYSICOCHEMICAL AND SORPTION PROPERTIES OF THERMALLY-TREATED SEDIMENTS WITH HIGH ORGANIC MATTER CONTENT

Pan Bo, Kunming - China

S05.02 -4

EFFECT OF BIOCHAR PROPERTIES AND WEATHERING ON SORPTION OF THE SWINE ANTIBIOTIC SULFAMETHAZINE IN BIOCHAR-AMENDED SOILS

Joseph Pignatello, New Haven - United States

S05.02 -5

THE USE OF BIOCHAR TO MINIMIZE THE BIOAVAILABILITY OF POLYCHLORINATED BIPHENYLS (PCBS) AT CANADIAN BROWNFIELD SITES

Mackenzie Denyes, Kingston - Canada

S05.02 -6

INFLUENCE OF SEWAGE SLUDGE TREATMENT AND APPLICATION TO AN ACID AND A NEUTRAL SOIL ON THE GROWTH AND METAL UPTAKE OF BRASSICA NAPUS

Marco Contin, Udine - Italy



S05.02 -7

IMPACTS OF SOIL AMENDED SUPERABSORBENT POLYMERS ON THE EFFICIENCY OF IRRIGATION MEASURES IN JORDANIAN AGRICULTURE

Amjad Al Tarawneh, Braunschweig - Germany



S05.02 -1

IMPACTS OF SOIL AMENDMENTS ON FATE AND BEHAVIOR OF POLLUTANTS IN SOIL

Kreuzig Robert^[1]

^[1]Technische Universität Braunschweig ~ Institute of Environmental and Sustainable Chemistry ~ Braunschweig ~ Germany

In agricultural production, soil amendments are used to improve soil quality. Besides mineral fertilizers or green manures, sewage sludges, liquid manures and liquid fermentation wastes are applied as organic fertilizers due to their contents of organic matter and plant nutrients. Furthermore, the effect of biochar amendment is studied for biosequestration or atmospheric carbon storage. Finally, cross-linked polyacrylates are applied as superabsorbent polymers to absorb plant available water and thus to particularly optimize irrigation systems in aride regions. Besides benefits, environmental risks are to be taken into consideration as well. Thus, sludges and manures may be contaminated either by heavy metals and persistent organic pollutants. Superabsorbent polymers are furthermore well-known as a persistent material able to absorb heavy metals and salts to counteract heavy metal and salt stress of plants. However, the impact of those soil amendments on fate and behavior of inorganic and organic soil pollutants and on the microbial community in soil is rather disregarded or completely unknown until today. In order to close this gap in knowledge, advanced test systems have to be designed, particularly when risk assessment of regulatory procedures, e.g., for pharmaceuticals or biocides, is based exclusively on laboratory testing.



S05.02 -2

CHARACTERIZING THE HETEROGENEITY OF PIG SLURRY AND RESULTING EFFECTS ON TRANSPORT OF PHARMACEUTICAL ANTIBIOTICS IN SOIL

Thiele-Bruhn Sören*^[1], Arenz-Leufen Martina^[1], Aust Marc-Oliver^[1], Hofmann Diana^[2], Gallé Tom^[3], Leinweber Peter^[4]

^[1]Universität Trier ~ Bodenkunde ~ Trier ~ Germany ^[2]Forschungszentrum Jülich ~ IBG-3 ~ Jülich ~ Germany ^[3]CRP-Henri Tudor ~ CRTE ~ Luxembourg ~ Luxembourg ^[4]Universität Rostock ~ IfL - Bodenkunde ~ Rostock ~ Germany

Pharmaceutical antibiotics reach arable soil as contaminants of manure used as agricultural fertilizer. Manure was previously shown to affect the sorption and mobility of antibiotics in soil. However, manure or slurry are extremely heterogeneous matrices, varying with live stage of animals, feeding and manure collection management of the farm. The different manure composition has strong implications on the fate of xenobiotics in soil. To follow up this heterogeneity, pig slurry from different farms and animal live stages was analysed. To this end, physical size fractionation of slurry samples was done and general physicochemical parameters such as total OC and N, DOC and DON etc. were determined. On top of that a more in-depth investigation of the chemical composition of slurry was performed using (i) pyrolysis-field ionisation mass spectrometry (Py-FIMS) of manure fractions and (ii) high resolution Fourier transform ion cyclotron resonance (ESI-FT-ICR-MS) for the analysis of manure fractions leaching from soil columns. The analyses revealed that the chemical composition differs between manure particle size fractions that are differently prone to transport in soil. Also, manure composition itself is altered upon soil transport. Combined with soil column experiments on transport of antibiotics from different structural classes, these data show the interaction between solute, soil and manure properties on the transport of antibiotics in soil.



S05.02 -3

PHYSICOCHEMICAL AND SORPTION PROPERTIES OF THERMALLY-TREATED SEDIMENTS WITH HIGH ORGANIC MATTER CONTENT

Bo Pan*^[1]

^[1]Kunming University of Science & Technology ~ Faculty of Environmental Science & Engineering ~ Kunming ~ China

Sediment samples with high organic carbon contents (22.04% and 8.46%) were collected and thermally treated using a method analogous to biochar production. The obtained thermally-treated sediments (TTSs) showed a much higher degree of carbon capture in comparison to biochar derived from common biomass, indicating potential use of TTSs in soil amendment and carbon sequestration. Their sorption with organic contaminants was also investigated using sulfamethoxazole (SMX) as a model sorbate. SMX sorption increased greatly with pyrolytic temperature. Desorption ratio of the adsorbed SMX in TTSs generally decreased with increased pyrolytic temperature and with decreased solid-phase concentrations. The thermodynamic analysis showed that the higher entropy increase (positive ΔS) was well related with the decreased desorption ratio with increased solid-phase concentration for the original sediments. The fate-controlling effect of contaminants in TTS application for soil amendment should be evaluated combining sorption/desorption and sorption thermodynamic studies.



S05.02 -4

EFFECT OF BIOCHAR PROPERTIES AND WEATHERING ON SORPTION OF THE SWINE ANTIBIOTIC SULFAMETHAZINE IN BIOCHAR-AMENDED SOILS

Pignatello Joseph^{*[1]}, Teixido Marc^[2], Beltran Jose L.^[2], Granados Merce^[2]

^[1]Connecticut Agricultural Experiment Station ~ Environmental Sciences ~ New Haven ~ United States ^[2]Universitat de Barcelona ~ Departament de Química Analítica ~ Barcelona ~ Spain

The widespread use of veterinary antibiotics results in contamination of soil via grazing and manure application, leading to concern about antibiotic resistance transfer to pathogens in soil. Biochar—a form of black carbon derived from biomass waste pyrolysis—has attracted interest as a beneficial soil amendment. Since black carbon can be a potent adsorbent of organic compounds, we postulated that biochar addition would reduce bioavailability of antibiotics through enhanced adsorption. To test this, we studied adsorption of the heavily used sulfonamide antibiotic, sulfamethazine (SMT), to soils amended with different commercial biochar prototypes at levels of 1 or 2% by weight. The biochar-water distribution coefficient (K_{bc}) of SMT ranged as low as 10^1 to as high as 10^6 L/kg, depending on SMT concentration and the biochar source. By comparison, the octanol-water partition coefficient K_{ow} is $10^{0.27}$, and the organic carbon-water partition coefficient K_{oc} for the soil tested is $10^{1.4}$. The K_{bc} trended with percent C, C/H mole ratio, N₂ B.E.T. surface area, CO₂ micropore surface area, and CO₂ microporosity. Sorption to the soil-biochar mixture increased in most cases in relation to the biochar amendment rate and the K_{bc} . Pre-equilibration (weathering) of soil-biochar-water mixtures for 28 d prior to SMT addition suppressed sorption relative to the non-weathered mixture by up to an order of magnitude due to biochar pore blockage by soil humic substances. This work demonstrates the potential for biochar to reduce bioavailability of antibiotics in soil but illustrates the important effect of attenuation that occurs with weathering.

S05.02 -5

THE USE OF BIOCHAR TO MINIMIZE THE BIOAVAILABILITY OF POLYCHLORINATED BIPHENYLS (PCBS) AT CANADIAN BROWNFIELD SITES

Denyes Mackenzie^{*[1]}, Zeeb Barbara^[1], Rutter Allison^[2]

^[1]The Royal Military College of Canada ~ Chemistry and Chemical Engineering ~ Kingston ~ Canada ^[2]Queen's University ~ School of Environmental Science ~ Kingston ~ Canada

*Biochar is a carbon rich by-product produced from the pyrolysis of organic matter. In recent years, studies have focused on the potential to use activated carbon to sorb organic pollutants in sediments and soils. However, little data exists on the potential of using biochar, which as a consequence of its production, is a greener and more cost effective material than activated carbon. A greenhouse experiment, carried out in two levels (136 µg/g and 3.1 µg/g) of polychlorinated biphenyl (PCB)-contaminated soil, indicated that biochar added at 2.8% (w/w) to soil reduced shoot and root concentration in the known phytoextractor *Curcubita pepo* ssp. *pepo* (pumpkin) by up to 23% and 77%, respectively. Biochar also reduced the PCB concentration in *Eisenia fetida* (redworm) tissue by 52%. A subsequent field scale study was conducted at a Canadian Brownfield site (i.e. an abandoned industrial facility) contaminated with >50 µg/g PCBs using two different types of biochar added at 2.8% (w/w). In this same trial granulated activated carbon (GAC) was added at 2.8% (w/w) to serve as a positive control and assess the efficiency of biochar to sorb PCBs. Preliminary results show that biochar amendments improved soil quality, increased harvestable plant wet weights, and decreased the bioavailability of PCBs to both *C. pepo* and *E. fetida* at rates comparable to GAC. Thus, biochar has potential to serve as an amendment to decrease the bioavailability of PCBs in the soil, and may have potential to be used in Brownfield remediation strategies.*



S05.02 -6

INFLUENCE OF SEWAGE SLUDGE TREATMENT AND APPLICATION TO AN ACID AND A NEUTRAL SOIL ON THE GROWTH AND METAL UPTAKE OF BRASSICA NAPUS

Contin Marco^[3], Izosimova Alexandra^[2], De Nobili Maria^[3]

^[1]UNIVERSITY OF UDINE ~ DEPARTMENT OF AGRICULTURE AND ENVIRONMENTAL SCIENCES ~ UDINE ~ Italy

^[2]Agrophysical Research Institute ~ Department of field experiments and chemical land reclamation ~ Saint-Petersburg ~ Russian Federation ^[3]University of Udine ~ Department of Agriculture and Environmental Sciences ~ Udine ~ Italy

The use of sewage sludge in agriculture is an attractive alternative disposal technique as this waste is rich in organic C as well as macro- and micro-nutrients. However, its application can cause accumulation of toxic elements in soil and their transfer to plants and animals. The addition of FeCl₃ as coagulant for P removal, can result in the precipitation of Fe (hydr)oxides that are known to be strong metals adsorbents, but could interfere with organic matter mineralization and affect nutrient release. The aim of our study was to quantify the effect of FeCl₃ treatment of sewage sludge on growth and accumulation of potentially toxic elements of plants. Brassica napus was cultivated in pots for 50 days on an acid soil (pH 4.5) and on a calcareous soil (pH 7.8) added with 25 g kg⁻¹ native sewage sludge and sewage sludge treated with FeCl₃ as coagulant. The influence of sludge application on dry matter accumulation of Brassica napus was described with logistic functions. Both types of sludge improved dry matter accumulation significantly. Sludge coagulation with Fe did not affect plant growth in both soils, but in the acid soil its application enhanced the accumulation of Zn, Cd, Mn and Ni in plants. On the opposite, in the neutral soil this effect was not observed with the exception of Cd, which was higher in plants treated with Fe coagulated sludge on the 20-30 days of growth; this difference disappeared thereafter. Iron uptake was unexpectedly not influenced by sludge treatments.



S05.02 -7

IMPACTS OF SOIL AMENDED SUPERABSORBENT POLYMERS ON THE EFFICIENCY OF IRRIGATION MEASURES IN JORDANIAN AGRICULTURE

Al Tarawneh Amjad^[1], Kreuzig Robert^[1], Bahadir Müfit^[1], Batarseh Mufeed^[2]

^[1]Technische Universität Braunschweig ~ Institute of Environmental and Sustainable Chemistry ~ Braunschweig ~ Germany ^[2]Mutah University ~ Prince Faisal Center for Dead Sea, Environmental and Energy Research ~ Karak ~ Jordan

Water scarcity is the most important natural constraint to Jordan socio-economic development and has particularly negative impacts on the agricultural production due to proceeding desertification. Therefore, the Jordanian water strategy emphasized the use of reclaimed water to replace third amount of fresh water currently used for irrigation measures. Additionally, the irrigation efficiency in sandy soil can be enhanced by the application of superabsorbent polymers. These highly cross-linked potassium-polyacrylates increase the water holding capacity of soil by absorbing plant available water. The sorption of inorganic pollutants may furthermore contribute to reduce heavy metal and salt stress to plants. Hence, this study performed within the DAAD funded Exceed Project "Sustainable Water Management in Developing Countries" aims to investigate the simultaneous application of reclaimed irrigation water and superabsorbent polymers in test-field scale. For this purpose, eggplants are cultivated in sandy soil amended by 0, 0.2 and 0.4 % of superabsorbent polymers and irrigated using fresh and reclaimed water. Heavy metals as well as microorganisms are analyzed in irrigation water, soil and plants. The latter are differentiated into leaves, stems, roots and fruits and analyzed for heavy metal accumulation. During the vegetation period, growth parameters and biomass production of test plants are additionally determined. In additional pot and laboratory tests, the impacts of superabsorbent polymers on the water availability to plants and on sorption of heavy metals in soil are studied.



S05.03a - BIOCHAR EFFECTS ON SOIL PROPERTIES, PROCESSES AND FUNCTIONS

Chair Person:

Frank Verheijen, Aveiro - Portugal

Thursday 05 July 2012 from 08:30 to 10:00. Room Acero

S05.03a -1

TIERRA NEGRA ANDALUZA – AN EXAMPLE HOW BIOCHAR APPLICATION MAY ALTER SOIL ORGANIC MATTER COMPOSITION ON A LONG TERM SCALE

Heike Knicker, Sevilla - Spain

S05.03a -2

A META-ANALYSIS OF THE EFFECTS OF BIOCHAR APPLICATION TO SOILS ON CROP PRODUCTIVITY

Simon Jeffery, Laveno - Italy

S05.03a -3

THE BIOCHAR EFFECT: PLANT GROWTH PROMOTION AND RESISTANCE TO BIOTIC STRESSES

Ellen R. Graber, Bet Dagan - Israel

S05.03a -4

BIOCHAR EFFECTS ON ARID AND SEMI-ARID SOIL CHEMICAL AND MICROBIAL PROCESSES

Jim Ippolito, Kimberly, Idaho - United States

S05.03a -5

“OVERVIEW OF USDA-ARS BIOCHAR RESEARCH: IMPACTS ON SOIL QUALITY, CONTAMINANT BINDING, AND REDUCTIONS IN GREENHOUSE GASES EMISSIONS”

Jeff Novak, Florence, SC - United States

S05.03a -6

THE EFFECTIVENESS OF USING BIOCHAR FOR PALM OIL ESTABLISHMENT IN DIFFERENT SOIL TYPES IN COSTA RICA

Tamara Benjamin, West Lafayette - United States



S05.03a -1

TIERRA NEGRA ANDALUZA – AN EXAMPLE HOW BIOCHAR APPLICATION MAY ALTER SOIL ORGANIC MATTER COMPOSITION ON A LONG TERM SCALE

Knicker Heike^{*[1]}, González Vila Francisco J.^[1], Clemente Salas Luis^[1]

^[1]IRNAS-CSIC ~ Department of Biogeochemistry ~ Sevilla ~ Spain

The “Tierra negra andaluza” represents a Vertisol which occurs frequently in the valley of the Guadalquivir, Southern Spain. In spite of their low organic C contents (< 2 %), these soils appear rather dark. Being fertile, they have been cultivated since millennia. Analysis of their soil organic matter (SOM) by solid-state ¹³C NMR spectroscopy revealed high aromatic C contents (up to 35% of total organic C). Preliminary ¹⁴C dating indicated a mean age of the SOM of approximately 5000 years. Chemical oxidation with acid potassium dichromate confirmed considerable contributions of pyrogenic organic material (PyOM), possibly incorporated into the soils as a consequence of early-time slash and burn practice. Alternatively, it may have been added stepwise by continuing after-harvest-burning of crop residues, which since ancient times was and still is a common agricultural managing form in this area. The effect of PyOM and its aging on SOM turnover in these soils is presently explored in more detail with further respiration experiments. First results confirmed slightly slower turnover rates of charcoal than of SOM. Thus, the observed high PyOM contents of the “Tierra negra” are best explained by a selective preservation of PyOM and scarce fresh litter input due to crop removal and burning of the remains. Employing our observation for an evaluation of the impact of modern biochar amendment to soil, a major concern may be a considerable aromatization of the SOM. To which extend this may alter other soil properties, however, has still to be investigated.



S05.03a -2

A META-ANALYSIS OF THE EFFECTS OF BIOCHAR APPLICATION TO SOILS ON CROP PRODUCTIVITY

Jeffery Simon^{*[1]}, Verheijen Frank^[5], Van Der Velde Marijn^[3], Bastos Ana^[4]

^[1]none ~ none ~ Laveno ~ Italy ^[2]Department of Environment and Planning ~ Centre for Environmental and Marine Studies ~ Aveiro ~ Portugal ^[3]International Institute for Applied Systems Analysis ~ One of them ~ Laxenburg ~ Austria

^[4]Centre for Environmental and Marine Studies ~ Department of Biology ~ Aveiro ~ Portugal ^[5]Centre for Environmental and Marine Studies ~ Department of Environment and Planning ~ Aveiro ~ Portugal

One of the most commonly reported agronomic benefit of adding biochar to soils is increased crop yields. However, causative mechanisms are yet to be fully elucidated and can be obscured owing to variations in experimental set-up, soil properties and conditions. Therefore, a meta-analysis was undertaken with the aim of evaluating the relationship between biochar and crop productivity (either yield or above-ground biomass). Results showed statistically significant benefit of biochar application to soils on crop productivity, with a “grand mean” calculated from the data from all of the studies included found to be an increase of 10% in crop productivity/yield. However, the mean results for each analysis performed were variable (from -28% to 39%). The largest (positive) effects with regard to soil analyses occurred in acidic (14%) and neutral soils (13%), and in soils with a coarse (10%) or medium textures (13%). It seems probable, therefore, that the main mechanisms for yield increase include improved water holding capacity of the soils, concurrent with along with improved crop nutrient availability as well as liming effects. Of the biochar feedstocks considered and in relation to crop productivity, poultry litter showed the strongest (significant) positive effect (28%), in contrast to biosolids, which were the only feedstock showing a statistically significant negative effect (-28%). However, information concerning co-variables reported in the literature were often incomplete. Furthermore, the full range environmental and management conditions in relevant soil types and over longer timeframes are yet to be investigated.



S05.03a -3

THE BIOCHAR EFFECT: PLANT GROWTH PROMOTION AND RESISTANCE TO BIOTIC STRESSES

Graber Ellen R.^{*[1]}, Elad Yigal^[2]

^[1]The Volcani Center ~ Institute of Soil, Water and Environmental Sciences ~ Bet Dagan ~ Israel ^[2]The Volcani Center ~ Institute of Phytopathology ~ Bet Dagan ~ Israel

The positive impacts of biochar on crop productivity are frequently attributed to different direct and indirect effects (e.g., biochar-supplied nutrients, increased water and nutrient retention, improvements in soil pH and CEC, promotion of mycorrhizal associations). Yet, improved crop performance is also evident under conditions of intensive production where many of these soil functions are neither limited nor relevant. Moreover, biochar has been found to induce plant systemic resistance responses against disease-causing fungi. The severity of diseases caused by Botrytis cinerea (gray mold) and Oidiopsis sicula (powdery mildew) foliar pathogens in pepper and tomato was significantly reduced in biochar-amended treatments. Reduced damage by broad mite (Polyphagotarsonemus latus) in biochar-amended pepper plants was also observed. In addition, biochar amendment resulted in suppression of Podosphaera aphanis (powdery mildew), B. cinerea and Colletotrichum acutatum (anthracnose) in strawberry. How does biochar promote plant growth and induce system-wide resistance? Biochar addition to soil alters microbial populations in the rhizosphere, and may cause a shift towards beneficial microorganism populations that promote plant growth and resistance to biotic stresses. Moreover, systemic resistance may be induced by various chemical components of the residual tars in biochars. Molecular studies in strawberry indicate that biochar induces responses along both systemic acquired resistance and induced systemic resistance pathways, resulting in a broad spectrum controlling capacity. Improvement of plant responses to disease can be one of the benefits gained from applying biochar to soil.



S05.03a -4

BIOCHAR EFFECTS ON ARID AND SEMI-ARID SOIL CHEMICAL AND MICROBIAL PROCESSES

Ippolito Jim*^[1]

^[1]USDA-Agricultural Research Service ~ Northwest Irrigation and Soils Research Laboratory ~ Kimberly, Idaho ~ United States

Most of the recent biochar research has focused on improving the physico-chemical properties of tropical and highly weathered soils, while few studies have investigated effects in arid or semi-arid soils. Results presented will specifically target biochar use in calcareous systems, addressing challenges such as, can biochar: 1) improve the soil fertility status; 2) supply critical plant nutrients; 3) improve soil physical properties; 4) alter microorganism populations and respiration rates; and 5) increase soil C storage? To address these issues, four separate studies (in field, greenhouse, and laboratory) were conducted in calcareous soils. Results were variable and at times dependent on biochar application rate. In general, biochar application caused a short-term decrease in soil NO₃-N content but increased micronutrient (Fe, Mn, Zn, Ni) availability, an important finding in plant-available micronutrient-poor calcareous systems. In some instances, such as when biochar and manure were co-applied, a synergistic effect was observed with respect to nutrient availability. A 2% biochar application improved soil moisture content by 3-7%, and based on regional evapotranspiration rates, could possibly extend crop water availability from 0.4 to 2.5 days; biochar may play an important role under future water-use limits. Increasing biochar application rates increased overall bacterial populations and microbial respiration rates, yet total soil C concentrations were also maintained at greater levels. Overall, our findings suggest that biochar could play a role in improving the environmental quality of calcareous soil systems.



S05.03a -5

“OVERVIEW OF USDA-ARS BIOCHAR RESEARCH: IMPACTS ON SOIL QUALITY, CONTAMINANT BINDING, AND REDUCTIONS IN GREENHOUSE GASES EMISSIONS”

Novak Jeff^[1]

^[1]USDA-ARS-CPRC ~ Coastal Plains Research Center ~ Florence, SC ~ United States

Biochar is under intensive evaluation by USDA-ARS scientists and cooperators for its many roles, such as an amendment to improve soil fertility, physical conditions, and sequester pollutants. In our evaluations, biochars can be effective sorbents for inorganic and organic compounds, can also sorbed volatile gasses which trigger various plant and microbial responses, and can influence greenhouse gas production/consumption. Biochar's ability to influence these reactions are dependent on pyrolysis conditions, feedstock selection, aging, and the presence of associated volatile components. Understanding how biochar quality is influenced by pyrolytic conditions and feedstock selection led to development of the 'designer biochar principal' where the biochar is engineered to possess chemical and physical features known to improve targeted soil characteristics. Recent laboratory experiments have shown that designer biochars in weathered and aridic soils can selectively improve C sequestration, reduce physical problems, and re-balance soil plant nutrient levels. This presentation will highlight USDA-ARS field and laboratory biochar research projects and will discuss results for the varied uses/applications of biochar.



S05.03a -6

THE EFFECTIVENESS OF USING BIOCHAR FOR PALM OIL ESTABLISHMENT IN DIFFERENT SOIL TYPES IN COSTA RICA

Benjamin Tamara^{*[1]}, Soto Gabriela^[2], Major Julie^[7], Lerner Robert^[6], Covell Phil^[8], Garro Francisco^[2], Muñoz Marianela^[2], Muñoz Leda^[2], Solorzano Alexander^[2], Joseph Stephen^[5]

^[1]Purdue University ~ Forestry and Natural Resources ~ West Lafayette ~ United States ^[2]CATIE ~ Agroecology ~ Turrialba ~ Costa Rica ^[3]McGill University ~ Soils ~ Montreal ~ Canada ^[4]Forest Trends ~ Agroecology ~ Washington, D.C. ~ United States ^[5]University of New South Wales ~ Electron Microscope Unit ~ Sydney ~ Australia ^[6]Independent Consultant ~ Biochar ~ Oakland ~ United States ^[7]McGill University ~ Faculty of Agricultural and Environmental Sciences ~ Montreal ~ Canada ^[8]Forest Trends ~ Katoomba Incubator ~ Washington, D.C. ~ United States

In the Osa Peninsula in Costa Rica, during 2009 and 2010, four oil palm plantations were established with biochar, from melina (Gmelina melina) timber waste, which was added to the soil. Additional biochar was incorporated into the soil in 2011 at a 1-meter radius around the palms. Five treatments were established in each site (unamended control, urea fertilizer, NPK:10-30-10 fertilizer, biochar + urea, and activated biochar using H₂O₂ or with phosphoric acid+ urea). Additionally in one site we added a partial biochar mineral complex. Growth data, such as height, diameter, number of new leaves, and leaf measurements to determine leaf biomass, have been collected over the past two years. Additionally, production parameters (flower and fruit quantity) were measured for the plants established in 2009. Significant differences were found in the growth parameters for the partial biochar mineral complex in the site that had lower soil fertility (San Juan de Sierpe). The three treatments with biochar additions had higher quantities of flowers and fruit, but only the biochar mineral complex was significantly higher than the NPK, urea, and control treatments. Biochar improves establishment of oil palm plantations and can reduce the time of when fruit production can initiate. Longer term studies on different soils and with more individuals are needed to understand the mechanisms for this improvement.



S05.03b - BIOCHAR EFFECTS ON SOIL PROPERTIES, PROCESSES AND FUNCTIONS

Chair Person:

Heike Knicker, Sevilla - Spain

Thursday 05 July 2012 from 13:30 to 15:00. Room Acero

S05.03b -1

ROOT AND RHIZOSPHERE RESPONSES TO BIOCHAR ADDITION

Miranda Prendergast-Miller, Edinburgh - United Kingdom

S05.03b -2

BIOCHAR (IN)STABILITY IN SOILS: THE ROLE OF SOIL ORGANISMS

Nele Ameloot, Gent - Belgium

S05.03b -3

BIOCHAR: ITS BIOAVAILABILITY AND UTILISATION BY SOIL MICROORGANISMS

Mark Farrell, Adelaide - Australia

S05.03b -4

BIOCHAR AS CARRIER FOR PLANT NUTRIENTS AND MICROORGANISMS – A FIRST APPROACH TO ACTIVATION TECHNIQUES

Hans-Peter Schmidt, Arbaz - Switzerland

S05.03b -5

BIOCHAR AMENDMENT AFFECTS METAL LEACHING FROM MULTI-CONTAMINATED SUBSTRATES: A MICROCOSM STUDY

Guido Fellet, Udine - Italy

S05.03b -6

THE ROLE OF BIOCHAR IN THE PHYTOREMEDIATION OF METAL/METALLOID CONTAMINATED SOILS.

Luke Beesley, Aberdeen - United Kingdom



S05.03b -1

ROOT AND RHIZOSPHERE RESPONSES TO BIOCHAR ADDITION

Prendergast-Miller Miranda^{*[1]}, Duvall Michael^[1], Sohi Saran^[1]

^[1]University of Edinburgh ~ UK Biochar Research Centre ~ Edinburgh ~ United Kingdom

*Biochar has been proposed as a climate change mitigation option, however, the potential and risks when applied to temperate soils must be evaluated. Biochar is created through the thermal conversion of organic matter through a process known as pyrolysis: the solid char residue is highly recalcitrant, and thus has the potential for long-term carbon storage. Additionally, biochar used as a soil amendment could help reduce the environmental impact of agriculture by localising soil processes within the root zone, thus providing a 'rhizosphere management' approach to managing agricultural soils. To gain understanding of biochar impacts in the rhizosphere, wheat seedlings were grown in rhizoboxes which allowed direct observation of root-biochar interactions, as well as sampling of rhizosphere and bulk soil zones. Our research indicated a localisation effect of nitrogen within the rhizosphere when nitrate was applied to biochar-amended soils (Prendergast-Miller et al 2011). Additional rhizosphere responses are presented following the application of fresh and manipulated chars. Further research is required into biochar-rhizosphere interactions and the potential for localised nutrient management around the root zone. Reference Prendergast-Miller, MT., Duvall, M. and Sohi, SP. 2011 Localisation of nitrate in the rhizosphere of biochar-amended soils. *Soil Biology and Biochemistry* 43:2243-2246.*



S05.03b -2

BIOCHAR (IN)STABILITY IN SOILS: THE ROLE OF SOIL ORGANISMS

Ameloot Nele^{*[1]}, Graber Ellen^[2], Verheijen Frank^[3], De Neve Stefaan^[1]

^[1]Ghent University ~ Department of Soil Management ~ Gent ~ Belgium ^[2]The Volcani Center ~ Institute of Soil, Water and Environmental Sciences ~ Bet Dagan ~ Israel ^[3]Centre for Environmental and Marine Studies ~ Department of Environment and Planning ~ Aveiro ~ Portugal

In recent years there has been an increasing number of studies concerning the stability of biochar and its interactions with soil organisms. While it has been suggested that biochar is a nearly inert material in soil, there is a substantial number of studies that reports important C mineralization after the addition of biochars to soils, indicating that soil organisms are stimulated by the addition of biochar as a preferential habitat, or/and that (parts) of the material in biochar may serve as a substrate for soil biota or/and that biochar interacts with soil organic carbon pools. We hypothesize that in order to better understand the mechanisms involved in biochar turnover, we need a thorough mechanistic insight into the interactions between biochar additions and soil biota. Observed biphasic mineralization rates suggest rapid mineralization of labile biochar compounds by microorganisms, with more stable aromatic compounds decomposed at a slower rate. A meta-analysis of data in the literature showed that C-mineralization rates decreased with increasing time, pyrolysis temperature and OC content of the biochars, while a positive correlation was found between the SOC content and C mineralization rates. Soil faunal associations may be altered directly by the addition of biochar or indirectly through the effects of biochar on soil structure and other physicochemical properties and as well as soil microbial communities on which the fauna depend. However, only a few studies on earthworms have been published, whereas other crucial ecosystem engineers such as termites, nematodes, and protozoa have not been reported at all.



S05.03b -3

BIOCHAR: ITS BIOAVAILABILITY AND UTILISATION BY SOIL MICROORGANISMS

Farrell Mark^[1], Kuhn Thomas^[1], Macdonald Lynne^[1], Maddern Todd^[1], Singh Bhupinder Pal^[2], Clode Peta^[3], Murphy Daniel^[4], Baldock Jeff^[1], Krull Evelyn^[1]

^[1]CSIRO ~ Land & Water ~ Adelaide ~ Australia ^[2]NSW Department of Primary Industries ~ . ~ Beecroft ~ Australia

^[3]The University of Western Australia ~ Centre for Microscopy, Characterisation and Analysis ~ Perth ~ Australia ^[4]The University of Western Australia ~ School of Earth and Environment ~ Perth ~ Australia

The addition of biochar to soil has been shown to have both positive and negative impacts on crop productivity, carbon (C) dynamics and ecosystem services. Many aspects of biochars and their behaviour in soils are not yet fully understood. This includes the crucial question of how stable biochars remain within the soil environment when exposed to soil microorganisms, and what causes observed agronomic benefits of biochar amendment. We hypothesised that biochars contain compounds which are labile and bioavailable to soil microorganisms within their predominantly recalcitrant, condensed polyaromatic structure. We used ¹³C-labeled biochars in conjunction with isotopic analysis of the respired CO₂ and phospholipid fatty acids (PLFAs) to quantify the amount of biochar that was being utilised, and also to identify which groups of microorganisms were responsible for this during the incubation experiment. Nano-scale Secondary Ion Mass Spectrometry (NanoSIMS) was utilised to visually identify C flows within the soil-biochar matrix. We present data that demonstrate the presence of labile compounds in both incubated biochars, their utilisation by soil microorganisms and the effect this has on community structure. Our data also allowed us to estimate the short- and medium-term stability of the added biochars, and to demonstrate and quantify the utilisation and turnover of the bioavailable biochar-C and its partitioning into different groups of microorganisms during their metabolism.



S05.03b -4

BIOCHAR AS CARRIER FOR PLANT NUTRIENTS AND MICROORGANISMS – A FIRST APPROACH TO ACTIVATION TECHNIQUES

Schmidt Hans-Peter*^[1]

^[1]Delinat Institute for Ecology and Climate Farming ~ Climate Farming ~ Arbaz ~ Switzerland

The soil ameliorating potential of biochar is strongly linked to its impact on nutrient cycling dynamics, sorption capacity and to its ability to change the habitat function for the soil fauna. However, as shown in multiple studies, the addition of pure biochar to agricultural soils will not always have benefits; rather it may even reduce plant growth caused by the (initial) immobilisation of plant nutrients. This capacity may be used to our advantage: The very potent sorption dynamics of biochar could potentially make it an effective carrier for plant nutrients and plant-root symbiotic microorganisms. At the Delinat-Institute, we tried a variety of methods of charging biochars with organic and mineral plant nutrients as well as with potentially beneficial microorganisms. This includes the use of biochar as bulk agent in aerobic composting, in malolactic fermentation and as pre-treatment for liquid manure, but also formulations of mineral carbon-fertilizers. The biochar products were tested in pot trials and also in larger-scale field trials. Results and experiences of these trials as well as different activation methods will be explained. A short overview of the potential of industrial designing of potential biochar-based products will be given.



S05.03b -5

BIOCHAR AMENDMENT AFFECTS METAL LEACHING FROM MULTI-CONTAMINATED SUBSTRATES: A MICROCOSM STUDY

Fellet Guido^{*[1]}, Contin Marco^[1], Marchiol Luca^[1], Guarino Carmine^[2]

^[1]University of Udine ~ Agriculture and Environmental Sciences ~ Udine ~ Italy ^[2]University of Sannio ~ Biological and Environmental Science ~ Benevento ~ Italy

The application of biochar to soils have been proven to be effective in changing their physical and chemical characteristics (e.g. water holding capacity, nutrient retention, pH and EC). Moreover, its influence on the soil properties extends to the mobility of pollutants. For its intrinsically high resistance to degradation, long term effects are expected. The application of biochar to industrial and mine wastes may be a solution to reduce environmental risks posed by the pollutants release because of leaching into the groundwater. Besides, the reduction in terms of bioavailability of toxic elements and other physical and nutritional modifications to the substrate may be of help to plant growth and therefore to establish a green cover on top of the wastes for a long term stabilization. Wastes from the formerly Pertusola Sud zinc smelter (Crotone, Italy) and the Cave del Predil mining site (Udine, Italy) rich in As, Cd, Pb, Tl and Zn, were mixed with biochars from three different feedstocks at the dose of 3% (DW/DW). Column leach tests were set up to evaluate the effects of the biochars on the mobility of the toxic elements. Soil water was sampled at three depths with Rhyzon® and the leachate at the bottom was collected by gravity. The results on the mobility behavior of the toxic elements as consequence of the type of biochar will be presented. The use of biochar to improve plant growth and reduce metals leaching may be a viable technique.



S05.03b -6

THE ROLE OF BIOCHAR IN THE PHYTOREMEDIATION OF METAL/METALLOID CONTAMINATED SOILS.

Beesley Luke^[1], Marmiroli Marta^[2], Moreno-Jimenez Eduardo^[3]

^[1]The James Hutton Institute ~ Soils ~ Aberdeen ~ United Kingdom ^[2]University of Parma ~ Environmental Sciences ~ Parma ~ Italy ^[3]Katholieke Universiteit Leuven ~ Environmental Sciences ~ Leuven ~ Belgium

Biochar has been evaluated for its role in improving soil quality and sequestering carbon, with much less attention paid to soil clean-up and remediation. In the following study a hardwood biochar and greenwaste compost alone and in combination were mixed with two contaminated soils (As, Cd, Cu, Pb and Zn) from former industrial sites and, following environmental exposure, pore water was collected and ryegrass (L. perenne L. var. Cadix) germinated to determine the amendments affects on i) solubility/mobility of the elements and ii) uptake and phytotoxicity to ryegrass. Biochar was most efficient at reducing Cd and Zn in pore water, decreasing phytotoxicity to ryegrass, but mobilized small concentrations of As. Copper in pore water was also reduced by a decrease in dissolved organic carbon (DOC) and co-mobility. Greenwaste compost was more efficient for immobilizing Pb than biochar alone but combining greenwaste compost and biochar provided the best conditions for ryegrass growth and yield because of the immobilization of metals and the input of N and P from compost. Despite some reductions in ryegrass shoot concentrations of metals after amendment, the large biomass increase raised harvestable amounts of the metals, increasing food chain transfer potential. An assessment should therefore be made as to whether maximum reductions in plant concentrations or maximum reduction in harvestable amounts of metals are required to ensure amendments may be suitably deployed to maximize their effects.



S05.03c - BIOCHAR EFFECTS ON SOIL PROPERTIES, PROCESSES AND FUNCTIONS

Chair Person:

Ellen Graber, Bet Dagan - Israel

Thursday 05 July 2012 from 15:30 to 17:15. Room Acero

S05.03c -1

STABILITY AND BIOLOGICAL EFFECTS OF PYROGENIC AND HTC-BIOCHARS IN TWO SOILS

Bernd Marschner, Bochum - Germany

S05.03c -2

EARLY MINERALIZATION OF BIOCHAR: IMPORTANCE OF ABIOTIC AND BIOTIC PROCESSES

Sander Bruun, Frederiksberg C - Denmark

S05.03c -3

SOIL PRIMING EFFECTS AND THE MINERALISATION OF BIOCHAR FOLLOWING ITS INCORPORATION TO SOILS OF DIFFERENT PH

Yu Luo, Beijing - China

S05.03c -4

BIOCHAR AND SOIL SURFACE ALBEDO

Frank Verheijen, Aveiro - Portugal

S05.03c -5

WILL AGED BIOCHARS CONTINUE TO REDUCE N₂O EMISSIONS?

Claudia Kammann, Gießen - Germany

S05.03c -6

BIOCHAR SUPPRESSION OF N₂O EMISSIONS FROM AN AGRICULTURAL SOIL

Sean Case, Lancaster - United Kingdom

S05.03c -7

BIOCHAR CARBON STABILITY AND PRIMING EFFECT IN CONTRASTING SOILS OF AUSTRALIA

Balwant Singh, Sydney - Australia



S05.03c -1

STABILITY AND BIOLOGICAL EFFECTS OF PYROGENIC AND HTC-BIOCHARS IN TWO SOILS

Marschner Bernd^[1], Bamminger Chris^[1], Heitkoetter Julian^[1], Jueschke Elisabeth^[2]

^[1]Ruhr-University Bochum ~ Soil Science/Soil Ecology ~ Bochum ~ Germany ^[2]Max-Planck Institute for Biogeochemistry ~ Biogeochemical processes ~ Jena ~ Germany

The feasibility of the currently discussed option of CO₂-sequestration through incorporation of biochars into soils strongly depends on the long-term stability of the biochars and on the lack of negative effects on soil properties. While much is already known about changes in chemical and physical soil properties after biochar incorporation, effects on microbial and enzyme activities have been rarely studied. In this study the stability of maize derived biochar in two soils was examined in a 59 day long incubation with additions of different biochar qualities and amounts. The fresh biochar additions were carried out with a biochar produced by slow pyrolysis of corn silage, one produced by hydrothermal carbonization of corn silage (HTC-biochar) and a commercial mixture of compost and pyrogenic biochar (Palaterra®). Selected treatments received substrate additions of glucose at day 50 of incubation. Respiration was monitored continuously and microbial biomass and enzyme activities were determined at day eight and at the end of the incubation. Through analysis of d13C contents before and after incubation the C-balance is calculated separately for SOM and the added chars. Also, the composition and biological stability of DOC was determined. The results show that the samples with added young HTC-biochar have a higher respiratory loss of carbon dioxide until reaching the basal respiration than the other treatments. Moreover the microbial biomass after the incubation of the samples with HTC-biochar is higher. Enzyme activity patterns are also distinctly affected by the different biochars, but effects generally subside during the course of incubation.



S05.03c -2

EARLY MINERALIZATION OF BIOCHAR: IMPORTANCE OF ABIOTIC AND BIOTIC PROCESSES

Bruun Sander*^[1]

^[1]University of Copenhagen ~ Department of Agriculture and Ecology ~ Frederiksberg C ~ Denmark

The stability of biochar in soil is of importance for the prospect of using biochar application for soil carbon sequestration and for long-term soil improvement. It is well known that a significant fraction of biochar is highly stable in soil but also that CO₂ is released immediately after biochar has been applied to soil. However, not very much is known about the sources and nature of the processes leading to this CO₂ evolution. The purpose of this paper was to investigate the nature of the initial flush of CO₂ evolution. To do this, we made incubations of ¹⁴C labelled biochar produced at different temperatures in soils with different pH and clay contents and in sterilized and non-sterilized soil. To elucidate the role of carbonates, the carbonate content of the biochars was determined. The results showed that carbonate concentrate during or from after biochar production, resulting in significant carbonate contents in the biochar. If carbonate released CO₂ is misinterpreted as mineralization of biochar, mineralization in short-term incubations may be significantly overestimated. In addition to the CO₂ released from carbonates however, there is a small labile fraction of biochar which is mineralized quickly during the first days of incubation by some abiotic process. This is likely to be CO₂ evolved during the oxidation of the surfaces of biochar.



S05.03c -3

SOIL PRIMING EFFECTS AND THE MINERALISATION OF BIOCHAR FOLLOWING ITS INCORPORATION TO SOILS OF DIFFERENT PH

Luo Yu*^[1], Durenkamp Mark^[2], Lin Qimei^[3], De Nobili Maria^[4]

^[1]China Agriculture University & Rothamsted Research ~ Soil department ~ Beijing ~ China ^[2]Rothamsted Research ~ Sustainable Soils and Grassland Systems Department ~ Harpenden ~ United Kingdom ^[3]China Agriculture university ~ soil department ~ Beijing ~ China ^[4]Udine University ~ soil ~ Udine ~ Italy

We determined the magnitude of the priming effect (PE), i.e. short-term changes in rate (negative or positive) of mineralisation of native soil organic C, following biochar addition, made from *Miscanthus giganteus*, a C4 plant, naturally ¹³C enriched. The biochars were produced at 350 °C (biochar350) and 700 °C (biochar700) and applied \pm ryegrass to a clay-loam soil at pH 3.7 and 7.6. After 87d, biochar350 addition caused PEs equivalent to 250 and 319 μ g CO₂-C g⁻¹ soil, or % positive priming effects of 514 % and 272 %, in the low and high pH soil (based on CO₂-C evolved from the respective control soils), respectively. Biochar700 addition led to much smaller priming effects. The largest PEs occurred at the start of the incubations. By 87d incubation, 0.14 % and 0.18 % of biochar700 and 0.61 % and 0.84 % of biochar350 were mineralized in the low and high pH soil respectively. Ryegrass addition increased biochar mineralisation in all treatments. Our results show that if biochar is used to sequester carbon, PEs may occur, increasing CO₂-C evolved from soil and decreasing soil organic C. A similar conclusion holds for accelerated mineralisation of biochar due to incorporation of fresh labile substrates. We consider that our results are the first to unequivocally demonstrate the initiation and progress of a true PE by biochar on native soil organic C.



S05.03c -4

BIOCHAR AND SOIL SURFACE ALBEDO

Verheijen Frank^[1], Jeffery Simon^[2], Van Der Velde Marijn^[3], Bastos Ana Catarina^[4], Penizek Vit^[5], Beland Martin^[6], Mehl Wolfgang^[7]

^[1]CESAM, University of Aveiro ~ Department of Environment and Planning ~ Aveiro ~ Portugal ^[2]Self-employed ~ Himself ~ Laveno-Mombello ~ Italy ^[3]IIASA ~ Ecosystem Services and Management ~ Vienna ~ Austria ^[4]CESAM, University of Aveiro ~ Department of Biology ~ Aveiro ~ Portugal ^[5]Faculty of Agrobiological Sciences ~ Department of Soil Science and Soil Protection ~ Prague ~ Czech Republic ^[6]University of Sherbrooke ~ CARTEL ~ Sherbrooke ~ Canada ^[7]European Commission Joint Research centre ~ Land Management and Natural Hazards ~ Ispra ~ Italy

Applying biochar to soils is considered to be geoengineering because it has the potential to help mitigate global climate change, although the potential for long-lived changes to fundamental soil properties, processes and functions also warrants the label ‘geoengineering’. Surface albedo is known to be a sensitive parameter in surface-atmosphere energy exchange and in planetary radiative forcing (RF). Considering the potential for changes in soil albedo to influence both global RF as well as local soil processes, through altering soil energy balance dynamics, a detailed knowledge of quantitative relationships between albedo and biochar applications, and resulting topsoil concentrations, for a range of soil types and climates is paramount. Therefore, we developed an experimental dataset of soil surface albedo estimates from spectroscopic measurements on a representative set of soils mixed with increasing amounts of biochar (and soil moisture contents). From this dataset we will estimate the planetary RF under a global biochar application scenario and compare this value to RF values from studies that omitted albedo effects. This work describes a robust first approximation of the effect of changes in soil surface albedo resulting from biochar application and subsequent implications for RF, and discusses important directions for future research.



S05.03c -5

WILL AGED BIOCHARS CONTINUE TO REDUCE N₂O EMISSIONS?

Kammann Claudia^[1], Christoph Finke^[1], Philipp Trulley^[1], Christoph Müller^[1]

^[1]Justus-Liebig-University Gießen ~ Department of Plant Ecology ~ Gießen ~ Germany

It is now well established that many freshly produced biochars (BCs) can significantly reduce N₂O emissions from BC-amended soils. The mechanisms under discussion include NH₃/NH₄⁺ adsorption by the biochar (as documented for acidic BCs), pH or other N-cycling changes, or soil aeration. However, we observed repeatedly that N₂O emissions were even reduced when the increased water-holding capacity had been accounted for. It is unclear to date if the N₂O-emission reducing effect will continue over time, or if, rather, the BC-amended soils will produce larger N₂O emissions in the long run e.g. if the microbial activity and organic carbon besides BC increases. Thus, we investigated (i) compost versus BC-compost (i.e. where BC was co-composted) and (ii) very old BC-soils such as two terra preta, or soil from old German charcoal-making sites, compared to the respective adjacent soils. So far, without further N amendment, no increase in the N₂O emissions from the BC-containing soils and substrates has been observed, although the BC-soils usually had the higher microbial activity and microbial biomass. In the presentation, further N₂O-emission results following NH₄⁺ or NO₃⁻ application to the old-BC soils and substrates will be presented.



S05.03c -6

BIOCHAR SUPPRESSION OF N₂O EMISSIONS FROM AN AGRICULTURAL SOIL

Case Sean^{*[1]}, Whitaker Jeanette^[1], Mcnamara Niall^[1], Reay David^[2]

^[1]Centre for Ecology and Hydrology ~ Biogeochemistry ~ Lancaster ~ United Kingdom ^[2]University of Edinburgh ~ School of Geosciences ~ Edinburgh ~ United Kingdom

Biochar is biomass that has been partially combusted at a temperature of between 350 and 800°C that is subsequently used as a soil amendment to increase agricultural productivity/efficiency or for carbon sequestration. Previous studies have also shown that adding biochar to soil suppresses soil N₂O emissions under certain conditions. During our experiments, addition of hardwood biochar to soil suppressed N₂O emissions following simulated rainfall events in a low-N (72 % suppression) and high-N agricultural soil (83% suppression). This result was replicated with soil from the same site incubated in-situ with biochar for 10 months (at least a 40 % suppression). We hypothesised that biochar may suppress N₂O emissions by increasing the water holding capacity (WHC) of the soil. Water was added to raise soil to the same WHC (87%) with biochar at a range of amendment rates. Biochar (5% addition) suppressed N₂O emissions by 67%, even when WHC was accounted for. We concluded that the increased WHC of biochar-amended soil cannot explain the suppression of N₂O emissions. Our second hypothesis was that biochar may immobilise inorganic-N in the soil by physical or biological mechanisms, reducing the availability of inorganic-N to N₂O-producing microbes. In this presentation, we discuss our use of stable isotope techniques, adding ¹⁵N-labelled ammonium and nitrate to soil, in order to determine the fate of inorganic-N within biochar-amended soil. We also present results showing the effect of biochar on the abundance of microbial functional groups of soil nitrifiers and denitrifiers.



S05.03c -7

BIOCHAR CARBON STABILITY AND PRIMING EFFECT IN CONTRASTING SOILS OF AUSTRALIA

Fang Yunying^[1], Singh Balwant^{*[1]}, Singh Bhupinder Pal^[2], Krull Evelyn^[3]

^[1]University of Sydney ~ Faculty of Agriculture, Food and Natural Resources ~ Sydney ~ Australia ^[2]NSW Department of Primary Industries ~ Forestry Research ~ Beecroft ~ Australia ^[3]CSIRO ~ Division of Land and Water ~ Adelaide ~ Australia

There has been growing interest in the application of biochar to soil for agronomic benefits and mitigation of greenhouse gas emissions. However, the stability of biochars in different soil types has not been comprehensively evaluated based on the soil-biochar interactions. Furthermore, there are conflicting observations about the priming effect of biochar on soil carbon (C), which have implications on the net C sequestration potential of biochar in soils. We assessed the stability of two wood biochars (450 and 550°C; Eucalyptus saligna; $\delta^{13}\text{C}$ ~-36‰) and their priming effect on soil organic C mineralisation at three incubation temperatures (20, 40 and 60°C). The biochars (2% w/w) were incubated for one year at 70% WHC with four soils of contrasting mineralogical composition and other properties (Inceptisol, Vertisol, Oxisol, Entisol). The results show that between 0.3 and 7% of added biochar C was mineralised during one year. The lowest mineralization of biochar occurred in the Vertisol amended with 550°C biochar incubated at 20°C, while the highest values was observed in the same soil amended with 450°C biochar incubated at 60°C. Biochar C mineralization rate increased with increasing incubation temperature, and the mineralisation rate of 450°C biochar was consistently higher than the 550°C biochar in all soils. Biochar C stability was also influenced by soil types especially at 40 and 60°C. The biochar application in the Inceptisol caused positive priming of soil-C at all incubation temperatures; whereas in other soils with higher clay content, biochar suppressed the mineralisation of soil-C over time.

W05.01 - RECYCLING OF URBAN WASTE RESOURCES – POSITIVE AND NEGATIVE IMPACTS ON SOIL QUALITY AND THE ENVIRONMENT

Chair Persons:

Jacob Magid, Copenhagen - Denmark

Sabine Houot, Thiverval-Grignon - France

Wednesday 04 July 2012 from 15:30 to 17:45. Room Alloro

W05.01 -1

LONG-TERM FIELD EXPERIMENTS EXAMINING SOIL AND CROP QUALITY AFTER SEWAGE SLUDGE APPLICATIONS

Steve Mcgrath, Harpenden - United Kingdom

W05.01 -2

CRUCIAL: A LONG-TERM FIELD TRIAL TO ASSESS WASTE RECYCLING IMPACTS ON ENVIRONMENT AND PRODUCTIONS SYSTEM INTEGRITY

Jakob Magid, Copenhagen - Denmark

W05.01 -3

FATE OF TRACE ELEMENTS IN ARABLE CROP SYSTEMS AMENDED WITH URBAN COMPOSTS DURING 10 YEARS

Aurélia Michaud, Thiverval - Grignon - France

W05.01 -4

FATE OF HUMAN ENTERIC VIRUSES SUPPLIED WITH WASTEWATER IRRIGATION: A REVIEW

Pierre Renault, Avignon - France

W05.01 -5

CHALLENGING AREAS FOR LIFE CYCLE ASSESSMENTS OF WASTE APPLICATION TO AGRICULTURAL LAND

Sander Bruun, Frederiksberg C - Denmark

W05.01 -6

CARBON CAPTURE BY CALCITE PRECIPITATION ON 'WASTES' IN URBAN SOILS

David Manning, Newcastle upon Tyne - United Kingdom



W05.01 -7

COMPLETE MATERIAL CYCLES BY MATERIAL FLOW MANAGEMENT USING THE TERRA-PRETA-TECHNOLOGY IN THE BOTANIC GARDEN BERLIN IN TERMS OF RESOURCE EFFICIENCY AND CLIMATE PROTECTION (TERRABOGA)

Robert Wagner, Berlin - Germany

W05.01 -8

EMERGENT POLLUTANT REMOVAL FROM SOIL AMENDMENTS

Isil Akmehmet Balcioglu, Istanbul - Turkey

W05.01 -9

PREDICTING CONSTRUCTED URBAN SOIL SUSTAINABILITY: IMPACT OF WASTE ORGANIC MATTER ON SOIL PHYSICAL PROPERTIES

Patrice Cannavo, Angers - France



W05.01 -1

LONG-TERM FIELD EXPERIMENTS EXAMINING SOIL AND CROP QUALITY AFTER SEWAGE SLUDGE APPLICATIONS

Mcgrath Steve*^[1]

^[1]Rothamsted Research ~ SSGS ~ Harpenden ~ United Kingdom

Due to environmental and resource use concerns, there is now increased urgency to improve the recycling of N and P. Treated sewage sludges (biosolids) are a useful source of nutrients including N and P, and organic matter. Sewage sludge also contains a number of metals at varying concentrations, depending on the source. Inventories of metal inputs to land in the UK show that although metal concentrations in sludges have decreased, the increase of metal concentration in soils where they are applied is more rapid than with animal manures and certain industrial wastes. Nine field experiments were originally set up to examine the effects of Zn, Cu and Cd on soil microbial activity and long-term soil fertility in 1994-7. This paper highlights results from these experiments from between 1999 and 2005. The concept was to test the additions of metals via sludge up to and slightly beyond the maximum values for soil concentrations of Zn, Cu and Cd (300, 140 and 3 mg/kg respectively) given in the EU Sludge Directive (86/278/EEC). No consistent effects were found on crop yields (herbage and wheat), but some were detected on the abundance of microbes in soils. However, Zn and Cu are biologically essential micronutrients. For example, there is a need to improve the Zn status of staple cereal grains for human health reasons. Sewage sludge can increase Zn concentrations in wheat grain for at least 2-8 years after application to soil. Positive effects are needed, and adverse effects are to be avoided.



W05.01 -2

CRUCIAL: A LONG-TERM FIELD TRIAL TO ASSESS WASTE RECYCLING IMPACTS ON ENVIRONMENT AND PRODUCTIONS SYSTEM INTEGRITY

Magid Jakob^[1], Poulsen Pernille Hasse Busk^[1], Lekkfeldt Jonas Duus Stevens^[1], Brandt Kristian Kofoed^[1], Nybroe Ole^[1], Holm Peter^[2], Kjaergaard Charlotte^[3], Jensen Lars Stoumann^[1]

^[1]Copenhagen University ~ Agriculture and Ecology ~ Copenhagen ~ Denmark ^[2]Copenhagen University ~ Basic Sciences and the Environment ~ Copenhagen ~ Denmark ^[3]Aarhus University ~ Department of Agroecology ~ Tjele ~ Denmark

We established the 'CRUCIAL' long-term field trial in 2003, in order to meet the societal demands for assuring that recycling of waste can be done without compromising environmental quality and production system integrity. The facility was established based on the rationale that by approaching the known limits for a number of heavy metals below which no profound disturbance should be observed on key soil ecological functions, it should be possible to discern if some of the many unknown components in the composite urban waste as well as agriculturally based fertilizers have measurable impacts. The following treatments were established: human urine, sewage sludge, degassed and subsequently composted organic municipal waste, deep litter, cattle slurry, cattle manure, NPK fertilizer, unfertilized but with clover undersown and an unfertilized control. Presently we have a factor 2 difference in soil organic matter level between the accelerated rate of municipal waste compost amendment and the unfertilized control. Similarly we have large differences in soil fertility and crop yield. Results obtained from a mid-term baseline soil biological characterization indicate no negative effects on soil biological function by use of urban waste products, and high throughput pyrosequencing of bacterial DNA indicates only very minor changes of microbial diversity across treatments. Antibiotic multiresistant pseudomonads increased after treatment with both animal and urban waste, but after 9 weeks the numbers were no different from the control treatment. Ongoing work on leaching of metals and bacteria will be briefly described, and potentials for future collaboration highlighted.



W05.01 -3

FATE OF TRACE ELEMENTS IN ARABLE CROP SYSTEMS AMENDED WITH URBAN COMPOSTS DURING 10 YEARS

Michaud Aurélia^[1], Cambier Philippe^[1], Mercier Vincent^[1], Bodineau Guillaume^[2], Doublet Jérémy^[3], Houot Sabine^[1]

^[1]INRA ~ UMR INRA - AGROPARISTECH EGC ~ Thiverval - Grignon ~ France ^[2]INRA ~ GBFOR ~ Orléans ~ France

^[3]VEOLIA Environnement ~ Recherche et Innovation ~ Limay ~ France

A field experiment upon long-term effects of using different organic waste products (OWP), including three urban originated composts, has been monitored during more than 10 years. It concerns arable crop systems representative of the central Paris Basin, and involves OWP and techniques close to French regulations and farmer practices. The synthesis of all results upon trace element contents and fluxes aimed to answer the following questions: what are the chemical impacts on the surface soil layer and the crop quality (wheat, maize, barley)? Does the balance between OWP and atmospheric inputs and the crop and leaching outputs match the stock variation of trace elements in the plough layer? The Cu and Zn stocks of all amended plough layers increased after several applications, in close relationship with the cumulated metal balance. The variations concerning Cr, Ni and Pb were not significant, due to relatively low inputs, and for Pb to data dispersion. Cd and Hg did not significantly vary in amended plots, but Cd progressively appeared lower in the control compared to all OWP treatments; and Hg after 10 years became significantly lower in the control compared to two treatments (municipal solid waste and sewage sludge composts). Indeed, Cd and Hg stocks decreased in the control plough layers between 1998 and 2009. The study also pointed out a progressive decrease of most analysed trace metals in most used OWP. The contents of the 7 trace metals in grains and crop residues were overall not changed by OWP applications.



W05.01 -4

FATE OF HUMAN ENTERIC VIRUSES SUPPLIED WITH WASTEWATER IRRIGATION: A REVIEW

Renault Pierre*^[1], Bon Fabienne^[2]

^[1]INRA ~ EMMAH ~ Avignon ~ France ^[2]Université de Bourgogne ~ LIMA ~ Dijon ~ France

Wastewater reuse in irrigation may partly meet the increasing water requirement that results from climate change, population growth and diversification of water uses. However, wastewaters may contain human enteric viruses, and their transmission through foods and drinks after environmental transport has become an emerging topic with the development of new molecular detection methods. Norovirus, hepatitis A viruses, Enterovirus (especially Coxsackievirus and Echovirus) and Rotavirus are sometimes considered in the prioritizing pathogens for future regulations in drinking water. They have been detected at the entrance and exit of wastewater treatment plants, in soils and in aquifers. Enteric viruses may be rejected in the environment at high concentrations, whereas infectious levels are very low. They are extremely resistant. During irrigation, they may be dispersed as aerosols or move at the surface or within the soil, and either reach the aquifer or be internalized in some crops after root absorption. In soils, virus behaviour varies with species, strain and virus conformation. Their transport, immobilisation on solids and inactivation are coupled with each other: virus may move sorbed or not on colloids, and their inactivation may be accelerated or slowed down by their adsorption on minerals. Virus immobilization depends on the virus, the solid phases, and the physical-chemical characteristics of the soil solution (pH, ionic strength, mineral cations and anions, organic compounds). Immobilization is controlled by various forces (electrical, van der Waals, hydrophilic/hydrophobic ...) and sometimes may explain virus inactivation due the mechanical effect of the adsorption on the stability of the viral capsid.



W05.01 -5

CHALLENGING AREAS FOR LIFE CYCLE ASSESSMENTS OF WASTE APPLICATION TO AGRICULTURAL LAND

Bruun Sander*^[1], Birkved Morten^[2], Magid Jakob^[1], Ten Hoeve Marieke^[1], Stoumann Jensen Lars^[1], Hauschild Michael^[2]

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The purpose of this presentation is to review the LCA approaches that have been used to quantify the potential impacts of waste application to arable land with special focus on challenging areas to LCA modelling. Recycling nutrients to agriculture most frequently requires waste application to arable land. A range of environmental impacts is associated with this type of nutrient recycling, including eutrophication, odour, global warming, acidification and toxicity. One of the broader methodological approaches which has been applied to assess the potential environmental impacts related with nutrient recycling via arable land is life cycle assessment. The identified challenging areas for LCA modelling of application of waste to agricultural land are: 1) Odour emissions, which consists of compounds that are rarely measured and for which no generally accepted impact assessment method currently exists 2) Carbon sequestration associated with organic wastes for which the time boundary is arbitrarily defined 3) Assessing the relative fertilizer value and environmental impact of P added with the waste, which strongly depends on the chemical form in which it exists 4) Definition of spatial boundaries and estimation of emissions of heavy metals and organic pollutants from arable land used for waste application.



W05.01 -6

CARBON CAPTURE BY CALCITE PRECIPITATION ON 'WASTES' IN URBAN SOILS

Manning David*^[1], Washbourne Carla-Leanne^[1], Renforth Phil^[2]

^[1]Newcastle University ~ Civil Engineering & Geosciences ~ Newcastle upon Tyne ~ United Kingdom ^[2]Oxford University ~ Earth Sciences ~ Oxford ~ United Kingdom

Urban soils commonly contain wastes derived from demolition of pre-existing buildings, and also clinker and other artificial materials. We have shown that urban soils from a number of locations contain pedogenic calcite (CaCO_3), with carbon contents over 3 m soil depth typically averaging 300 T C/ha (Renforth et al., Applied Geochemistry 2009). Carbon isotope studies show that 50% or more of the carbon in the calcite is derived from the atmosphere, primarily through high-pH driven hydroxylation of CO_2 within the soil solution, which is promoted by biologically mediated rapid dissolution of the waste material in the soil. This leads to a conceptual model in which plant growth provides a source of CO_2 within the root zone as a consequence of root respiration and microbial degradation of plant root acid exudates. Corrosion of artificial calcium silicate minerals by plant root exudates releases Ca, which combines with carbonate in solution to produce calcite. The amounts of waste arising from demolition activity are substantial. Typically, demolition involves the use of crushers on site so that secondary aggregates can be recovered and sold. This process inherently produces a fine fraction, and that is often retained on site, forming part of the subsoil. We estimate that sufficient demolition waste is produced globally to provide a carbon capture potential of 24-100 MtC/year if incorporated into soils as part of an urban development (Renforth et al., Environmental Science & Technology 2011). This is a consequence of natural soil-forming processes, adding value to other ecosystem services.



W05.01 -7

COMPLETE MATERIAL CYCLES BY MATERIAL FLOW MANAGEMENT USING THE TERRA-PRETA-TECHNOLOGY IN THE BOTANIC GARDEN BERLIN IN TERMS OF RESOURCE EFFICIENCY AND CLIMATE PROTECTION (TERRABOGA)

Wagner Robert^[1], Terytze Konstantin^[1], Schatten Rene^[1], König Nadine^[1], Vogel Ines^[1], Friede Karin^[1], Worzyk Florian^[1]

^[1]Freie Universität Berlin ~ Earth Sciences, Geoecology ~ Berlin ~ Germany

The main focus of this project is the efficient utilization of biogenic waste and residual materials like green waste and faeces of employees and visitors. The research and development project intends to complete the internal, small scale material cycles in the Botanic Garden Berlin. The aim is to make a contribution to sustainable soil management within Urban Farming in terms of carbon reduction and the impacts of climate change processes. The Berlin Botanic Garden produces around 1500 m³ of green waste, pruning waste, grass cuttings and wood. Much of this is still unused and is disposed of in a way that is both energy and cost intensive, as well as the sewage from employees and the annual 260.000 visitors of the Botanic Garden Berlin. In contrast, around 350 m³ of compost and fertilizer has had to be bought in each year. The total biomass is planned to be turned into nutrient-rich black earth substrates (premium potting soil) by using the "Terra Preta-Technology". Due to its high stability and functionality biochar provides long-term storage for nutrients and water for plants as well as the possibility for long-term carbon storage. The environmental relief potential of the closed material cycle and the plant growth effectiveness of biochar substrates will be determined by means of tests in laboratories and field studies taking into account chemical and physical as well as biological parameters. Currently diverse chemical, physical and biological examinations are performed. First results will be presented.



W05.01 -8

EMERGENT POLLUTANT REMOVAL FROM SOIL AMENDMENTS

Akmehmet Balcioglu Isil^[1], Bilgin Öncü Nalan^[1], Ötker Uslu Merih^[2], Cengiz Murat^[3]

^[1]BOGAZICI UNIVERSITY ~ INSTITUTE OF ENVIRONMENTAL SCIENCES ~ Istanbul ~ Turkey ^[2]University of Windsor ~ Civil and Environmental Engineering ~ Ontario ~ Canada ^[3]Uludag University ~ Department of Pharmacology and Toxicology, Faculty of Veterinary Medicine ~ Bursa ~ Turkey

Soil amendments, sewage sludge and manure, are important sources of soil contamination with emergent pollutants as they may contain considerable amount of antibiotics. Appropriate treatment technologies are required to overcome antibiotic pollution in soil amendments for the prevention of the transfer of antibiotics and antibiotic resistant bacteria to soil. In the present study sewage sludge and manure that were synthetically contaminated with antibiotics (tetracyclines, sulfonamides and quinolones) were subjected to an integrated treatment process consisting of extraction pretreatment and chemical oxidation at various experimental conditions. Additionally, the destruction of antibiotic-resistant microorganisms in manure was investigated. In separate experiments, the removal the *tetM* gene and its host, *Escherichia coli* HB101 by chemical oxidation processes was examined. Although ozonation, Fenton oxidation, and persulphate treatment processes provided high removal performance for antibiotics from the manure only thermally activated persulfate treatment was able to complete destruction of antibiotics. On the other hand, for the sludge up to 98% of antibiotic removal was achieved by integrated ozonation process. This process also provided significant metal solubilization and it increased the fertilizer value of the sludge due to probable complexation of magnesium with the nutrients, which was indicated by the decrease in the phosphate and ammonia concentrations. Despite the high organic content of manure, 99% bacterial inactivation was obtained by the ozonation process and the band intensity of the *tetM* gene gradually decreased by increasing the dose of oxidant. However, significantly high doses of oxidants would be required to completely eliminate bacterial pollution in manure.



W05.01 -9

PREDICTING CONSTRUCTED URBAN SOIL SUSTAINABILITY: IMPACT OF WASTE ORGANIC MATTER ON SOIL PHYSICAL PROPERTIES

Cannavo Patrice*^[1], Vidal-Beaudet Laure^[1], Grosbellet Claire^[2], Forget-Caubel Virginie^[1]

^[1]UPSP Ephor ~ AGROCAMPUS OUEST Centre d'Angers ~ Angers ~ France ^[2]Union Nationale des Entreprises du Paysage ~ UNEP ~ Paris ~ France

Exogenous organic matter has a positive impact on agricultural soil physical properties. In some urban situations, the wide availability of waste organic matter and the necessity of restructured the soils, lead to the addition of large quantities of organic matter. Our objectives were to measure in soil reconstituted with high levels of OM: (1) the effects of OM decomposition on the evolution of physical properties, (2) to evaluate the sustainability of the soil system by modelling some soil physical properties at a long-term period (i.e 20 years). We monitored throughout a 5-yr experimental study, physical properties of urban soils placed in 600 L containers. The top layer was a sandy loam amended with 40% by volume of organic compost – a sewage sludge and wood chip compost or a green waste compost – laying on a layer of sandy loam. Organic matter had significant effects on the soil physical properties compared to the control with a significant decrease of the soil bulk density and a significant increase of the structural stability. Organic matter modified the aggregate organisation and the pore distribution which contributed to a better infiltration rate. These good properties induced by organic matter were still maintained 5-yr after placement. Using our results and correlation equations between organic matter and soil physical properties, it was possible to determine by extrapolation soil physical properties 20 years after placement. Then, we used HYDRUS model to estimate soil water fluxes. We observed that urban soil sustainability depended on the waste organic matter nature.

S06.01a - GREENHOUSE GAS EMISSIONS FROM SOIL UNDER CHANGING ENVIRONMENTAL CONDITIONS: CONCEPTS, MODELING AND OBSERVATIONS

Chair Person:

Marc Lamers, Hohenheim - Germany

Wednesday 04 July 2012 from 08:30 to 10:00. Room Olmo

S06.01a -1

EFFECT OF SOIL PORE STRUCTURE ON CO₂ FLUX IN SOILS UNDER NO-TILL AND CONVENTIONAL TILL

Shamsudheen Mangalassery, Loughborough - United Kingdom

S06.01a -2

EFFECTS OF AGRICULTURAL TILLAGE PRACTISE ON GREEN HOUSE GAS BALANCE AND DYNAMICS OF AN ARABLE SOIL IN A LONG TERM FIELD EXPERIMENT

Jean Charles Munch, Neuherberg - Germany

S06.01a -3

GREENHOUSE GAS MITIGATION OPTIONS FOR CALIFORNIA AGRICULTURE

Johan Six, Davis - United States

S06.01a -4

ORGANIC AGRICULTURE – GHG SAVINGS THROUGH SOIL CARBON SEQUESTRATION?

Jens Leifeld, Zurich - Switzerland

S06.01a -5

SIMULATING SOIL ORGANIC CARBON STOCK CHANGE IN JAPANESE AGRICULTURAL LAND WITH THE ROTH C MODEL

Yasuhito Shirato, Tsukuba - Japan

S06.01a -6

USING SOIL ORGANIC MATTER TO INITIALIZE THE ROTH C CARBON TURNOVER MODEL: A PEDOTRANSFER FUNCTION

Lutz Weihermueller, Juelich - Germany



S06.01a -1

EFFECT OF SOIL PORE STRUCTURE ON CO₂ FLUX IN SOILS UNDER NO-TILL AND CONVENTIONAL TILL

Mangalassery Shamsudheen^{*[4]}, Sjogersten Turner Sofie^[4], Sparkes Debbie^[3], Sturrock Craig^[4], Mooney Sacha^[4]

^[1]University of Nottingham ~ Agriculture and Environmental Sciences, School of Biosciences, Sutton Bonington Campus ~ Sutton Bonington, LE12 5RD ~ United Kingdom ^[2]University of Nottingham ~ Division of Plant and Crop Sciences, Sutton Bonington Campus ~ Loughborough ~ United Kingdom ^[3]University of Nottingham ~ Division of Plant and Crop Sciences, Sutton Bonington Campus ~ Loughborough ~ United Kingdom ^[4]University of Nottingham ~ Division of Agricultural and Environmental Sciences, Sutton Bonington Campus ~ Loughborough ~ United Kingdom

Reduced tillage practices have received considerable attention due to many projected benefits. However the literature hosts many arguments of contradiction on soil physical properties and gas fluxes on adoption of reduced tillage. The objective of this study was to assess the effect of conventional and no-till practices on pore dynamics and release of CO₂ in soils of contrasting textures (clay and sand) and different traffic regimes. Intact soil cores were subjected to X-ray Computed Tomographic scanning and analysed to reveal their undisturbed 3-D pore structure. The different tillage, traffic and soil textures created contrasting soil structures with a strong variation in porosity. A significant positive linear relationship was found between mean CO₂ flux and total soil porosity ($R^2 = 0.62$, $P < 0.001$) and between surface area of pores ($R^2 = 0.3247$, $P < 0.05$). The multiple regression analysis of CO₂ emission with soil organic carbon, loss on ignition, microbial biomass carbon, soil organic carbon stock and porosity showed the significant effect of porosity on CO₂ emission over other parameters. The fitting of soil microbial biomass carbon, loss on ignition, bulk density, soil organic carbon did not explain additional variation in the CO₂ fluxes over and above porosity. This data highlights that management practices that impacts on soil porosity may have large impacts on soil C dynamics. However, the net impact of porosity on soil C storage and net green house gas fluxes in relation to different tillage practices and soils types is yet not understood and needs further investigation.



S06.01a -2

EFFECTS OF AGRICULTURAL TILLAGE PRACTISE ON GREEN HOUSE GAS BALANCE AND DYNAMICS OF AN ARABLE SOIL IN A LONG TERM FIELD EXPERIMENT

Munch Jean Charles^[1], Rolf Schilling^[1], Bernard Ruth^[1], Roland Fuss^[2]

^[1]Helmholtzzentrum Muenchen ~ Soil Ecology ~ Neuherberg ~ Germany ^[2]Johann Heinrich von Thünen Institute ~ Institute of Agricultural Climate Research ~ Braunschweig ~ Germany

Although it is desirable to minimize esp. N₂O emissions while maintaining high crop yields it is still poorly understood how green house gas emissions may be steered by agricultural management practise, i.e. tillage and fertilization systems. In an ongoing long term field experiment at the research farm Scheyern, Bavaria, an arable field with one homogenous soil formation was transformed into plots in a randomized design 16 years ago. Since then, they are managed using conventional tillage (CT) and no tillage (NT) as well as low and high fertilization. A conventional crop rotation is maintained on the field. Starting 2007, CO₂ and N₂O emissions were monitored continuously for 3 years. Furthermore water content, temperature and redox potential were measured in-situ as they are major factors on microbial activity and denitrification. Soil was sampled from the Ap horizons of the plots about twice a month and extracts from these soil samples were analyzed for dissolved organic carbon (DOC), ammonium, nitrate/nitrite, and dissolved organic nitrogen (DON). According to the results soil density and hydrology are clearly affected by tillage practise. DOC is more affected by tillage while concentration of nitrogen species is controlled mainly by fertilization. There are distinct differences in redox potential between CT and NT plots with CT plots having more anaerobic periods. CO₂ and N₂O emissions exhibit a clear seasonal pattern and are affected by both tillage system and fertilization.



S06.01a -3

GREENHOUSE GAS MITIGATION OPTIONS FOR CALIFORNIA AGRICULTURE

Six Johan*^[1]

^[1]University of California - Davis ~ Department of Plant Sciences ~ Davis ~ United States

In California, agriculture is responsible for 8% of the total GHG emissions, with 12.5% emitted as CO₂, 37.5% as CH₄, and 50% as N₂O. Over the past several years, however, growers and researchers have teamed up to develop economically feasible practices to mitigate GHG emissions within California agriculture. One of the main challenges before effective mitigation practices can be developed, is obtaining accurate estimates of current GHG emissions due to the high temporal and spatial variation, especially of N₂O, across crop types, soil types, and climates. We measured background N₂O emissions from perennial cropping systems (vineyards and almond orchards); compared conventional versus integrated management in tomato crops; and tested the effect of biochar amendments on N₂O emissions within vegetable crops and walnut orchards. Vineyard N₂O emissions without and with a leguminous cover crop ranged from 0.2 to 2.0 kg N₂O-N ha⁻¹ yr⁻¹, respectively, while the almond orchard averaged 0.4 kg N₂O-N ha⁻¹ yr⁻¹. The conventional tomato cropping system yielded 2.1 kg N₂O-N ha⁻¹ yr⁻¹ while the integrated system less than half that, with only 0.9 kg N₂O-N ha⁻¹ yr⁻¹. Results from a walnut biochar study show slight increases in N₂O emissions compared to the untreated control, however, reduced emissions were found when the same biochar was applied to lettuce crops. These results indicate the need for further research in this area, coupled with more accurate field measurements in order to foster adoption of these practices among farmers as well as policy makers.



S06.01a -4

ORGANIC AGRICULTURE – GHG SAVINGS THROUGH SOIL CARBON SEQUESTRATION?

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^[1]Agroscope Research Station ART ~ Air Pollution / Climate Group ~ Zurich ~ Switzerland ^[2]Agroscope Research Station ART ~ Air Pollution / Climate Group ~ Zurich ~ Switzerland

Agriculture directly contributes around ten percent to the global anthropogenic greenhouse gas emissions with an even higher share when CO₂ from land converted for agriculture is included. Amongst options to reduce agriculture-related emissions management-induced change in soil organic matter (SOM) content, termed soil carbon sequestration, is thought to provide significant relief as it may offset most of the agricultural CH₄ and N₂O emissions. Organic farming is considered particularly beneficial because of supposedly high sequestration rates and reduced N₂O emissions. Agricultural management controls SOM content in two ways, residue input and rate and efficiency of SOM turnover. Organic farming yields are often much below that of conventional farming making less plant residue available for soil carbon built-up. Only under non-sustainably high inputs of external organic matter (e.g. additional manure) organic farms sequester more or loose less soil carbon than conventional ones, making it very unlikely that higher inputs are a powerful driver for the hypothesized potential in organic agriculture. The second control, changes in rates and efficiencies of SOM turnover requires that microorganisms in organically managed soils have lower specific activities or use their substrate more efficiently. Data from field experiments and farm comparisons suggest no systematic difference in rates or efficiencies between conventional and organic farming. Under very limiting nutrient conditions soils may even loose organic matter. Based on these results the claim for GHG savings through organic farming is, at least at the sequestration side, premature at best and longer-term impairment of soil fertility cannot be excluded.



S06.01a -5

SIMULATING SOIL ORGANIC CARBON STOCK CHANGE IN JAPANESE AGRICULTURAL LAND WITH THE ROTHC MODEL

Shirato Yasuhito^{*[1]}, Yagasaki Yasumi^[1]

^[1]National Institute for Agro-Environmental Sciences ~ Natural Resources Inventory Center ~ Tsukuba ~ Japan

We calculated the carbon sequestration potential of Japanese agricultural soils. At first step, the Rothamsted carbon model (RothC) was tested using long-term experimental data sets in Japan. The model needed to be modified for Andosols and for paddy soils concerning unique mechanisms of soil carbon (C) dynamics of these soils while the model adequately simulated changes in the soil C content with time in non-volcanic ash upland soils. After the validation and modification of the model at plot scale, we estimated the C sequestration potential by organic matter application at country scale by applying the model at 100 m resolution from 1970 to 2020. We constructed a simulation system which linked the RothC model with spatial data such as weather, soils, land use, and activity data (the amount of C input to soils by crop residue or manure) including two different scenarios in future; 1) BAU: business as usual and 2) C sequestration scenario which increase C input to soils. The results of simulation showed that SOC in Japanese agricultural lands tended to decrease over time in most combination of soil types and land use. In addition, area of agricultural land decreased largely during 1970-2020. As a result, accounting of the amount of changes in SOC by the net-net accounting method following Kyoto protocol resulted in net sink of CO₂ because the rate of SOC decline was greater in 1990 (base year) than recent years (assumed commitment period).



S06.01a -6

USING SOIL ORGANIC MATTER TO INITIALIZE THE ROTHC CARBON TURNOVER MODEL: A PEDOTRANSFER FUNCTION

Weiermueller Lutz^[1], Graf Alexander^[1], Herbst Michael^[1], Vereecken Harry^[1]

^[1]Forschungszentrum Juelich GmbH ~ IBG-3 Agrosphere Institute ~ Juelich ~ Germany

Modelling of carbon turnover is an appropriate tool to estimate changes in soil carbon stocks as a response to modifications in land use or climate change. In general, carbon turnover models are nowadays used not even at the point scale but also on regional and continental scales. Hereby, the Rothamstadt Carbon Model (RothC) seems to be well suited due to its simplicity and easy implementation. For the initialization of the RothC model knowledge about the carbon pool sizes is essential which can be drawn either from physical fractionation or equilibrium model runs, but both approaches are time consuming and tedious. In the study presented two different pedotransfer functions (PTF) were developed to estimate the resistant plant material (RPM) pool based either on fractionated or simulated RPM data. As an independent variable only Corg data are necessary, which are easily available at most scales. The results showed that there is a linear relation between Corg and RPM. To estimate the associated error induced by the use of the PTF simulation runs were performed for a 100 year time period and crop rotation as well as manure application and different clay contents. The results indicate that the maximum relative errors are small (< 10 %) and decline to be less than 5 % after 100 years. Additionally, absolute errors are in the range of the measurement error for soil organic carbon measurements. Therefore, we propose to use the PTF directly to initialize the RothC model.



S06.01b - GREENHOUSE GAS EMISSIONS FROM SOIL UNDER CHANGING ENVIRONMENTAL CONDITIONS: CONCEPTS, MODELING AND OBSERVATIONS

Chair Person:

Michael Herbst, Jülich - Germany

Wednesday 04 July 2012 from 10:30 to 12:00. Room Olmo

S06.01b -1

DIRECT AND INDIRECT N₂O EMISSIONS FROM AGRICULTURAL SOILS IN A CHANGING CLIMATE

Michael Dannenmann, Freiburg - Germany

S06.01b -2

IMPACT OF TWO DIFFERENT TYPES OF GRASSLAND-TO-FIELD-CONVERSION ON GREENHOUSE GAS EMISSIONS AND SOIL MICROBIAL BIOMASS

Greta Roth, Braunschweig - Germany

S06.01b -3

POSITIVE FEEDBACK OF LONG-TERM CO₂ ENRICHMENT ON N₂O EMISSIONS, CH₄ FLUXES AND A LACK OF SOIL C SEQUESTRATION IN OLD TEMPERATE GRASSLAND

Claudia Kammann, Gießen - Germany

S06.01b -4

TOWARDS A UNIFIED FRAMEWORK FOR MEASURING AND MONITORING SOIL ORGANIC C STOCKS IN AGRICULTURAL SOILS

Mike Beare, Christchurch - New Zealand

S06.01b -5

SEASONAL METHANE DYNAMICS IN THREE TEMPERATE GRASSLANDS ON PEAT

Carolyn-Monika Schäfer, Tjele - Denmark

S06.01b -6

ARE SHIFTS IN SPATIAL NICHE OF METHANOTROPHS REGULATING SOIL METHANE UPTAKE?

Pascal Niklaus, Zürich - Switzerland



S06.01b -1

DIRECT AND INDIRECT N₂O EMISSIONS FROM AGRICULTURAL SOILS IN A CHANGING CLIMATE

Dannenmann Michael^[1], Klaus Butterbach-Bahl^[2]

^[1]University of Freiburg ~ Forest Botany and Tree Physiology, Chair of Tree Physiology ~ Freiburg ~ Germany

^[2]Karlsruhe Institute of Technology KIT ~ IMK-IFU Biogeochemical Processes ~ Garmisch-Partenkirchen ~ Germany

Also under future environmental conditions, agricultural nitrogen use is expected to remain the leading cause of reactive nitrogen (Nr) release to the environment. Here we summarize potential mechanisms which may affect denitrification and associated nitrous oxide (N₂O) emissions in/ from agricultural systems under future environmental conditions. Though changes in climate, specifically in temperature and precipitation, are likely to directly affect denitrification rates and N₂O emissions, we identified several indirect mechanisms of global change which may potentially override direct effects. Among these are a) landscape scale changes of hotspots of denitrification: while the importance of upland soils for denitrification may decrease due to limitations in soil moisture the importance of riparian areas as denitrification hotspots may further increase due to the increased likeliness of flooding events leading to more frequent occurrences of aerobic-anaerobic cycles in riparian areas and, thus, increased denitrification, b) increased provision of labile carbon substrates via plant root exudation in the rhizosphere under elevated atmospheric carbon dioxide concentrations, leading to increased microbial activity and higher denitrification rates in agricultural subsoils, thereby potentially reducing rates of nitrate leaching from agricultural soils and c) increased ammonia (NH₃) volatilization from agricultural systems leading to increased denitrification rates and N₂O emissions downwind from ammonia emission sources. Obviously, under future environmental conditions the mentioned mechanisms would further strengthen the regional disjunction of areas of Nr application from those of Nr removal by denitrification, thereby calling for a reappraisal of the importance of indirect emissions of N₂O from agricultural Nr use.



S06.01b -2

IMPACT OF TWO DIFFERENT TYPES OF GRASSLAND-TO-FIELD-CONVERSION ON GREENHOUSE GAS EMISSIONS AND SOIL MICROBIAL BIOMASS

Roth Greta^[1], Heinz Flessa^[1], Reinhard Well^[1], Mirjam Helfrich^[1], Andreas Gensior^[1]

^[1]Johann Heinrich von Thünen Institute ~ Institut for Agricultural Climate Research ~ Braunschweig ~ Germany

Conversion of grassland to arable land often causes enhanced greenhouse gas emissions (CO₂, N₂O, CH₄) to the atmosphere. However, prediction of such effects is uncertain so far because emissions may differ depending on site and soil conditions. We aim to evaluate the impact of grassland-to-arable-conversion on N₂O fluxes, CO₂ source processes as well as to total microbial and fungal biomass. A four times replicated randomized plot experiment with (i) mechanical conversion (ploughing, maize), (ii) chemical conversion (broadband herbicide, maize per direct seed) and (iii) continuous grassland as reference was started in April 2010. Gas fluxes were measured weekly, soil microbial biomass three times a year. The development of N₂O emissions is affected by soil moisture and application of fertilizers, as well as cultivation dates. Microbial biomass before conversion shows a typical spatial distribution with decreasing biomass with increasing soil depth. Chemical conversion did not affect the depth distribution of the microbial biomass, but slightly decreased its overall amount in all soil depths. Mechanical conversion caused a shift in the depth distribution of the microbial biomass (highest amount in 15 – 20 cm). Annual N₂O emissions were three to four times higher within the first year after both, chemical and mechanical conversion in comparison to continuous grassland. We will report ¹³C/¹²C ratios of CO₂ fluxes to elucidate the contribution of different organic C-pools to the total CO₂ flux.



S06.01b -3

POSITIVE FEEDBACK OF LONG-TERM CO₂ ENRICHMENT ON N₂O EMISSIONS, CH₄ FLUXES AND A LACK OF SOIL C SEQUESTRATION IN OLD TEMPERATE GRASSLAND

Kammann Claudia^[1], Katharina Lenhart^[2], Ludger Grünhage^[1], Lisa Schottler^[1], Christoph Müller^[1]

^[1]Justus-Liebig University Gießen ~ Department of Plant Ecology ~ Gießen ~ Germany ^[2]Max-Planck-Institute for Chemistry ~ Atmospheric Biogeochemistry ~ Mainz ~ Germany

Atmospheric CO₂ concentrations are rising with accelerating speed, soon crossing the 400 ppm concentration benchmark. Although CO₂ is a primary plant nutrient, the beneficial effects of this "CO₂ fertilization" on plant growth are often reduced or absent factors such as drought or nutrient deficiency limiting. It is well known that warming accelerates decomposition of soil C, i.e. poses a positive feedback loop danger to the earths' climate system. However, much less is known on the dangers of rising CO₂ concentrations on positive feedback dangers. We investigated continuously over 12 years now the ecosystem respiration, N₂O emission and CH₄ fluxes in an continuously running free-air CO₂ enrichment study in temperate grassland near Gießen, Germany. The ecosystem lost any additionally fixed CO₂ under elevated CO₂ quickly back to the atmosphere via ecosystem respiration which was predominantly stimulated during autumn-winter. The N₂O emissions more than doubled under elevated CO₂ over the entire FACE time, while methanotrophic CH₄ uptake was reduced. At the same time, the soil-C content or aggregation did not increase; rather, the entire site lost soil organic carbon over the years which was not prevented by the CO₂ enrichment. In balance, almost all of the roughly +10% increase in plant yield must be charred into stable biochar and added to the soil, to compensate for the CO₂-equivalents that were released under elevated CO₂ due to stimulated N₂O emissions. Thus, rising atmospheric CO₂ might have a "take two for the price of one" effect on other soil-GHG releasing processes.



S06.01b -4

TOWARDS A UNIFIED FRAMEWORK FOR MEASURING AND MONITORING SOIL ORGANIC C STOCKS IN AGRICULTURAL SOILS

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^[2]Agriculture & Agri-Food Canada ~ Soil Science ~ Quebec City ~ Canada

The development of robust protocols for soil carbon (C) measurement are important to quantifying soil C stocks and rates of change over time. These measurements are essential to developing and verifying national greenhouse gas emission inventories and emission trading schemes as well as identifying management practices that mitigate soil C losses or enhance soil C sequestration. Procedures for measuring C concentrations in soil samples are well established, though some notes of caution are warranted when comparing results obtained with different technologies. In contrast, there are few widely agreed protocols for sampling and calculating soil C stocks and these remain a potentially significant source of error. Accurate estimates of soil C stocks require the collection of samples that adequately represent the land units of interest (e.g. field, slope position, experimental plot) to a depth that reflects any potential changes imposed by management or environmental (e.g. climate, erosion) factors. The size, number and depth of samples taken depend on the vertical stratification and heterogeneity of soil C across the land unit. Factors such as tillage depth, rooting depth, row width, crop residue placement, bed height and wheel tracks are important considerations. Accounting for known differences in soil mineralogy, texture, drainage and slope position is also important. We will present several case studies to outline the key assumptions and critical differences between different sampling and calculation procedures and propose steps toward a unified framework for measuring soil C stocks.

S06.01b -5

SEASONAL METHANE DYNAMICS IN THREE TEMPERATE GRASSLANDS ON PEAT

Schäfer Carolyn-Monika*^[1], Elsgaard Lars^[1], Conrad Ralf^[3], Petersen Søren O.^[1]

^[1]University of Aarhus ~ Department of Agroecology ~ Tjele ~ Denmark ^[2]Max Planck Institute for Terrestrial Microbiology ~ Department of Biogeochemistry ~ Marburg ~ Germany ^[3]Max Planck Institute for Terrestrial Microbiology ~ Department of Biogeochemistry ~ Marburg ~ Germany

*Drained peatlands are considered to be insignificant CH₄ sources, but the effect of drainage on CH₄ cycling has not been extensively studied. We investigated seasonal dynamics of CH₄ in two fen peat soils and one bog peat soil under permanent grassland in Denmark. Soil CH₄ concentrations were measured several times throughout the year in parallel to a one year CH₄ flux monitoring campaign with static chambers. In addition, archaeal communities at different depths were assessed via molecular fingerprint (T-RFLP) analysis. Methane fluxes were negligible even though soil CH₄ concentrations of up to 155 and 1000 $\mu\text{mol CH}_4 \text{ dm}^{-3}$ were measured in one of the fen peats and in the bog peat, respectively. Significant CH₄ concentrations were observed above the water table and methanogens were detected throughout the soil profile at these two sites. Methane production potentials determined in a laboratory incubation assay confirmed the presence of viable methanogens in the upper parts of the bog peat soil. Methane was liberated from the peat at rates of up to 3.3 mg CH₄ m⁻² h⁻¹ via the aerenchymous plant *Juncus effusus* L. No methanogens were detected in the second fen peat which, in contrast to the other two sites, had high sulfate concentrations. Peat type and the distribution of aerenchymous plants should be considered before dismissing temperate grasslands on peat as CH₄ sources. Also, data on the distribution of methanogens should be further pursued to allow interpretations regarding their influence on soil CH₄ concentrations in comparison to environmental factors.*



S06.01b -6

ARE SHIFTS IN SPATIAL NICHE OF METHANOTROPHS REGULATING SOIL METHANE UPTAKE?

Niklaus Pascal^[1], Stiehl-Braun Petra^[2], Rime Thomas^[1], Ellen Kandeler^[3], Hartmann Adrian^[2]

^[1]University of Zürich ~ Institute of Evolutionary Biology and Environmental Studies ~ Zürich ~ Switzerland ^[2]ETH Zürich ~ AGRL ~ Zürich ~ Switzerland ^[3]University of Hohenheim ~ Soil Science ~ Hohenheim ~ Germany

The oxidation of methane by soil methanotrophic bacteria is the only globally relevant biological sink for atmospheric methane (CH₄). The activity of these bacteria is affected by many factors, both natural and anthropogenic. Of particular importance are effects of nitrogen fertilizers, which often reduce the sink activity of the respective soils. Interestingly, N-fertilizer effects are only found in some soils, whereas the soil methane sink is not inhibited in others. We have studied N fertilizer effects in several natural and agricultural soils, testing the hypothesis that spatial shifts in the niche of soil methanotrophs under N fertilization and climate change are a mechanism modulating the soil-atmosphere exchange of methane. The spatial distribution of CH₄ assimilation and its response to fertilizer application and climate change were studied in several field experiments in grassland, using a novel isotopic technique allowing the mapping of methanotrophic activity at a resolution of approximately 100 micrometers. Here, we present a synthesis of results from these studies. Our data indicates that even relatively pronounced effects on methanotrophic activity in the top soil can be alleviated by increased methane oxidation in deeper soil layers (i.e. by a shift in activity down the soil profile). Overall, our results demonstrate that an understanding of the spatial dimension of the interactions between the involved processes needs to be developed in order to infer the ecosystem-level methane sink under disturbance.

S06.01c - GREENHOUSE GAS EMISSIONS FROM SOIL UNDER CHANGING ENVIRONMENTAL CONDITIONS: CONCEPTS, MODELING AND OBSERVATIONS

Chair Person:

Jens-Arne Subke, Stirling - United Kingdom

Wednesday 04 July 2012 from 13:30 to 15:00. Room Olmo

S06.01c -1

SENSITIVITY OF SOIL RESPIRATION WITH RESPECT TO MULTIPLE ENVIRONMENTAL FACTORS

Carlos Sierra, Jena - Germany

S06.01c -2

SOIL ORGANIC CARBON SEQUESTRATION IN GRAZING SYSTEMS OF THE SOUTHEASTERN USA

Alan Franzluebbers, Watkinsville Georgia - United States

S06.01c -3

SPATIAL AND TEMPORAL VARIABILITY OF CO₂ FLUXES IN TEMPERATE PERMANENT GRASSLANDS ON PEAT SOILS

Carolyn-Monika Schäfer, Tjele - Denmark

S06.01c -4

DUAL-CHAMBER MEASUREMENTS OF $\Delta^{13}\text{C}$ OF SOIL-RESPIRED CO₂ PARTITIONED USING A FIELD-BASED THREE END-MEMBER MODEL

Fabrizio Albanito, Aberdeen - United Kingdom

S06.01c -5

INCREASED CO₂ FLUXES UNDER WARMING TESTS IN HISTIC AND TURBIC CRYOSOLS FROM SALLUIT, NUNAVIK (QC, CANADA)

Julien Fouché, Aix en Provence - France

S06.01c -6

THE PERMAFROST TRANSECT - EFFECTS OF CLIMATE CHANGE AND LAND USE ON PERMAFROST AND CARBON DYNAMICS IN SOILS ALONG A CLIMATE GRADIENT ACROSS THE TIBETAN PLATEAU

Thomas Scholten, Tübingen - Germany



S06.01c -1

SENSITIVITY OF SOIL RESPIRATION WITH RESPECT TO MULTIPLE ENVIRONMENTAL FACTORS

Sierra Carlos*^[1]

^[1]Max Planck Institute for Biogeochemistry ~ Biogeochemical Process ~ Jena ~ Germany

The sensitivity of soil respiration to global environmental change is a topic of prominent relevance for the global carbon cycle. Much attention has been given to the temperature sensitivity of soil respiration, a topic still controversial in which consensus has been elusive. Respiration however, depends on multiple factors that are being altered simultaneously as a result of global environmental change. For this reason it is important to study the overall sensitivity of respiration with respect to multiple and interacting drivers. I present here a theoretical framework for the development of experimental and modeling studies that allows a comprehensive understanding of the response of respiration in the context of global change. This framework is based on simple concepts from multivariate vector analysis. To demonstrate its usefulness I present some examples on how these basic concepts can be applied to resolve some controversies in the 'temperature-quality' debate. In addition, I present some hypotheses about the absolute sensitivity of respiration with respect to simultaneous changes in temperature and moisture. At the global level, tropical peatlands appear to be more sensitive than any other ecosystem including boreal and arctic peats.



S06.01c -2

SOIL ORGANIC CARBON SEQUESTRATION IN GRAZING SYSTEMS OF THE SOUTHEASTERN USA

Franzluebbers Alan*^[1]

^[1]USDA ~ Agricultural Research Service ~ Watkinsville Georgia ~ United States

Improved pasture management systems are needed to restore soil quality, sequester soil organic C, and build the productive capacity of soils in grassland environments so that (1) precipitation can be effectively utilized by plants, (2) water runoff and contaminant transport can be minimized, (3) natural nutrient cycling processes can be restored to rejuvenate long-term fertility, and (4) productive capacity of soils can be fully realized to produce the food, feed, fiber, and fuel needs of the future. Grazing lands in the eastern USA are managed primarily for introduced plant species that have high forage production potential or that fit a niche with a farming system. Moderate grazing of pastures may be the most effective strategy for storing soil organic C, because return of dung to the soil surface has positive effects on soil surface properties, including soil microbial biomass and mineralizable C and N. Grazing land managed with moderate grazing pressure, i.e., utilizing forage to an optimum level without compromising regrowth potential, can (1) provide economic opportunities with low risk for landowners, (2) improve degraded land by building soil fertility, (3) improve water utilization and quality within the landscape, and (4) help mitigate the greenhouse effect by storing C in soil as organic matter. Literature in the southeastern USA was reviewed to illustrate the effect of improved pasture management on soil quality and soil organic C sequestration. Implications of soil organic C sequestration for provision of ecosystem services are discussed.



S06.01c -3

SPATIAL AND TEMPORAL VARIABILITY OF CO₂ FLUXES IN TEMPERATE PERMANENT GRASSLANDS ON PEAT SOILS

Schäfer Carolyn-Monika^{*[1]}, Elsgaard Lars^[1], Kutzbach Lars^[2], Petersen Søren O.^[1]

^[1]University of Aarhus ~ Department of Agroecology ~ Tjele ~ Denmark ^[2]University of Hamburg ~ Institute of Soil Science ~ Hamburg ~ Germany

Permanent grasslands constitute the most widespread land use type for agriculturally managed peatlands in Europe. They are typically significant sources of CO₂ to the atmosphere as a result of drainage-induced peat decomposition, but quantitative data are still scarce. This study presents the first in-depth analysis of CO₂ flux variability at the field and plot scale for different Danish grasslands on peat. Net ecosystem exchange (NEE) of CO₂ and ecosystem respiration were monitored over one year with temperature-controlled static chambers at a former bog with partly well preserved Sphagnum peat and at two fens with highly decomposed peat. The amplitudes of annual groundwater fluctuations were less than 40 cm at one of the fens and ~ 90 cm at the other two sites. The first part of the analysis consisted of a detailed evaluation of the flux dataset to gain insight into the effect of fast fluctuations (seconds to minutes) in the wind and light intensity on the plot scale CO₂ flux. In the second part of the analysis, gross photosynthesis and ecosystem respiration were modeled on the field and plot scale with candidate sets of simple light and temperature response models commonly found in the literature. The results of this analysis will be used to assess the influence of peat type, management intensity, vegetation cover and weather conditions on the spatial and temporal variability of CO₂ fluxes.



S06.01c -4

DUAL-CHAMBER MEASUREMENTS OF $\Delta^{13}\text{C}$ OF SOIL-RESPIRED CO_2 PARTITIONED USING A FIELD-BASED THREE END-MEMBER MODEL

Albanito Fabrizio*^[1], Mcallister Jonathan^[1], Robinson David^[1], Smith Pete^[1]

^[1]University of Aberdeen ~ Institute of Biological & Environmental Sciences, School of Biological Sciences ~ Aberdeen ~ United Kingdom

Reliably estimating the heterotrophic component of RS is crucial for the characterisation of an ecosystem's net C balance. However, the contribution of 'historical' soil C (SOM) to total soil respiration (RS) in forest remains still uncertain. One of the contributing factors of this uncertainty is the difficulty to reliably measure and partition key carbon-cycle processes. Isotopic methods, such as natural variations in carbon isotope composition ($\delta^{13}\text{C}$) of soil respiration, are more frequently being applied, and show promise in separating heterotrophic and autotrophic contributions to RS. In this study we report the partitioning of soil-surface CO_2 effluxes, measured in forests in Italy and in Germany, using a new field-based $\delta^{13}\text{C}$ method and a three end-member mixing model. Soil-surface CO_2 flux was partitioned into components derived from root, litter/humus and SOM sources, and compared this with the conventional partitioning into autotrophic and heterotrophic components (two end-member mixing model). In addition, we used a novel dual-chamber technique to ensure that measurements of $\delta^{13}\text{C}$ Rs were subjected to minimal artefacts during measurement. Our results provide new information about the contributions of belowground components to the CO_2 flux at the soil surface, and show an alternative approach to the partitioning of RS components using their ^{13}C signatures.



S06.01c -5

INCREASED CO₂ FLUXES UNDER WARMING TESTS IN HISTIC AND TURBIC CRYOSOLS FROM SALLUIT, NUNAVIK (QC, CANADA)

Fouché Julien^{*[1]}, Keller Catherine^[1], Ambrosi Jean Paul^[1], Allard Michel^[2]

^[1]Aix Marseille Université, CNRS, CEREGE ~ Département Sol, Eau, Déchets ~ Aix en Provence ~ France ^[2]CEN, Université Laval ~ Département de géographie ~ Quebec ~ Canada

Cryosols in tundra ecosystems contain large stocks of organic carbon. Global warming could induce an Arctic ecosystems positive feedback on global C release. Instrumentation was installed in Salluit (Nunavik; 62°14'N, 75°38'W) to monitor respiration of Cryosols under current and warmer conditions. Two experimental sites under tussock tundra vegetation were set up: one is a Histic Cryosol (organic soil, H site) in a polygonal peatland; the other is a Turbic Cryosol reductaquic (mineral soil, M site) on post-glacial marine clays. On each site an open top chamber was installed to modify thermal conditions in the active layer. All measurements were performed in both normal (N) and transformed (T) conditions from mid July to end of August 2010. At each site, surface temperature was monitored hourly and soil respiration (SR) was measured at 10:00 AM, 3:00 and 8:00 PM every second day with a respiration chamber linked to a portable IRGA. In natural conditions, average SR in H (0.96 $\mu\text{molCO}_2\cdot\text{m}^{-2}\cdot\text{s}^{-1}$) was lower than in M (1.67 $\mu\text{molCO}_2\cdot\text{m}^{-2}\cdot\text{s}^{-1}$). An increase of the surface temperature of 2.5°C was observed and led to an 80% enhancement of SR at HT station. At MT station a 1.5°C increase induced an average SR increase of 40%. The induced warming increased CO₂ fluxes in both soils; this impact appears to be more striking in Histic Cryosols even if they have lower SR than Turbic Cryosols. SR variations at H and M sites follow the same seasonal trend, highly correlated with the surface temperature variations.



S06.01c -6

THE PERMAFROST TRANSECT - EFFECTS OF CLIMATE CHANGE AND LAND USE ON PERMAFROST AND CARBON DYNAMICS IN SOILS ALONG A CLIMATE GRADIENT ACROSS THE TIBETAN PLATEAU

Scholten Thomas*^[1], Wagner Dirk^[2], Schlöter Michael^[3], Kühn Peter^[1], Dörfer Corina^[1], Ollivier Julien^[3], Yang Sizhong^[2]

^[1]University of Tübingen ~ Department of Geosciences ~ Tübingen ~ Germany ^[2]Alfred Wegner Institute ~ Geosciences Division ~ Potsdam ~ Germany ^[3]Helmholtz Zentrum München ~ Department for Environmental Genomics ~ München ~ Germany

Our work focuses on the impact of climate change and human activities on the sensitive permafrost-affected geoecosystems on the Tibetan Plateau. We assume that permafrost dynamics are largely controlled by precipitation and temperature as well as land use changes and have a central impact on soil degradation, soil microbial activities and consequently on carbon sequestration, and greenhouse gas emissions. Our geoecosystem-based approach will determine carbon dynamics and greenhouse gas fluxes on three different spatial scales, namely landscape, plot and pedon. Soil temperature, soil moisture, and soil redox potential) are main drivers along the 1,500 km transect at altitudes between 4,600 and 5,100 m ASL. The allocation of 10 study sites along the permafrost transect includes different monsoon dynamics and thus, distinct temperature and moisture regimes. Our research is divided into (i) permafrost dynamics, pedogenesis and soil organic carbon stocks, variability and turnover, and (ii) formation of methane and carbon dioxide (methanogenesis and methane oxidation). The presentation will show results from the 2009 and 2011 expeditions integrating an indicator-based interpretation across scales from molecular biology to plot and landscape scale. Feedback mechanisms and the resultant risk potential related to material fluxes and greenhouse gas emission are of particular interest in the scope of a warming Earth.

S06.02 - SUSTAINABLE AGROECOSYSTEMS IN CLIMATE CHANGE MITIGATION

Chair Person:

Maren Oelbermann, Waterloo - Canada

Monday 02 July 2012 from 13:30 to 15:00. Room Mirto

S06.02 -1

*CHANGES IN AGROECOSYSTEM NUTRIENT STOCKS FOLLOWING AFFORESTATION OF
DEGRADED IRRIGATED CROPLAND IN CENTRAL ASIA*

Asia Khamzina, Bonn - Germany

S06.02 -2

*THE INFLUENCE OF ELEVATED AIR OZONE CONCENTRATION ON THE ENVIRONMENTAL
BEHAVIOR AND ECOLOGICAL EFFECTS OF PYRENE IN SOIL*

Hongyan Guo, Nanjing - China

S06.02 -3

*EFFECT OF MULCH QUALITY AND SOIL TYPE ON C AND N BIOTRANSFORMATION AND
TRANSPORT IN SOIL*

Akhtar Iqbal, Reims - France

S06.02 -4

*INTERACTION OF MITIGATION AND ADAPTATION STRATEGIES TO REDUCE GREENHOUSE
GAS EMISSIONS FROM AGRICULTURE*

Lorenzo Brilli, Firenze - Italy

S06.02 -5

*FARMYARD MANURE APPLICATION MITIGATES GREENHOUSE GASES EMISSIONS FROM
MANAGED GRASSLANDS IN JAPAN*

Ryusuke Hatano, Sapporo - Japan

S06.02 -6

*CARBON SEQUESTRATION AND GHG EMISSIONS ANALYSIS IN TROPICAL AREAS WITH
USE OF NEW ANALYTICAL TOOLS*

Ladislau Martin-Neto, Sao Carlos - Brazil



S06.02 -1

**CHANGES IN AGROECOSYSTEM NUTRIENT STOCKS FOLLOWING AFFORESTATION OF
DEGRADED IRRIGATED CROPLAND IN CENTRAL ASIA**

Khamzina Asia^[1], Dubovyk Olena^[1], Lamers John P.a.^[1], Vlek Paul L.g.^[1]

^[1]University of Bonn ~ Center for Development Research (ZEF) ~ Bonn ~ Germany

Cropland degradation jeopardizes agro-ecosystem services in irrigated drylands of Central Asia, threatening economic development in the region. Climate change is likely to exacerbate the adverse effects via reducing water supplies for land reclamation and irrigation of water-intensive crops. This study in the downstream area of the Amudarya River addressed an adaptive option of setting aside degraded cropland for afforestation, to increase the land productivity and to mitigate climate change effects via creating carbon sinks. A spatio-temporal analysis based on MODIS NDVI images revealed that 36% of croplands (161,000 ha) in the area have experienced a vegetation decline, often associated with land abandonment. Carbon sequestration in small-scale, mixed-species tree plantations was monitored during seven consecutive years following afforestation. Depending on species potential, between 64 and 70 tC ha⁻¹yr⁻¹ was sequestered in woody biomass, of which roots accumulated 15-20 tC ha⁻¹. The increase in soil organic carbon (SOC) was most pronounced in the topsoil, ranging 7-12 t ha⁻¹. Without the forestry intervention, the abandoned cropland experienced a 30% SOC loss. Soil available N and P showed similar trends, with the fallow land measuring 1.5-2.5 times as little stock as the afforested plots. N₂-fixing species contributed the most to soil N, P, and SOC replenishment whereas exchangeable K increased regardless the species choice. The delineation of cropland parcels in need of rehabilitation, combined with field-observed nutrient accrual rates, indicate significant potential of afforestation as carbon sink in degraded cropping areas. Hydrological aspects are being analyzed to determine an appropriate scale of forestry decisions.



S06.02 -2

THE INFLUENCE OF ELEVATED AIR OZONE CONCENTRATION ON THE ENVIRONMENTAL BEHAVIOR AND ECOLOGICAL EFFECTS OF PYRENE IN SOIL

Guo Hongyan*^[1]

^[1]Nanjing University ~ School of the Environment ~ Nanjing ~ China

Pollution of the environment with both ozone and organic pollutants has been steadily increasing. Field studies on the synergic effect of these pollutants are limited. We studied the effects of elevated ozone on pyrene degradation in soil, bioaccumulation and oxidative stress on wheat using a free-air concentration enrichment (FACE) system. In this field experiment in Jiangdu (Jiangsu Province, China), wheat plants were grown in pots containing soil with various concentrations of pyrene (0, 100, and 200 mg kg⁻¹ pyrene was added to the soil) under ambient conditions and under elevated O₃ levels (50% higher than the ambient O₃) throughout the growth season. From 2008 to 2010, the concentration of pyrene in the soils decreased over time, and the concentration in ambient conditions were higher than that under FACE conditions. The concentration of pyrene in wheat tissues (shoots, seeds) exposed to elevated O₃ were higher than that in ambient conditions. With the concentration of pyrene increasing, the activities of APX, CAT, POD and SOD isoenzymes increased, and their activity in ambient conditions were higher than in FACE conditions, except in 200 mg kg⁻¹ treatment. In the future, pyrene will become easier to degrade with increased O₃ levels, but pyrene accumulation in wheat will still increase although the reason(s) for this increase remain uncertain. Thus, the synergic effect of these pollutants on the soil system may be more harmful to food safety in the future.



S06.02 -3

EFFECT OF MULCH QUALITY AND SOIL TYPE ON C AND N BIOTRANSFORMATION AND TRANSPORT IN SOIL

Iqbal Akhtar^{*[1]}, Sohaib Aslam^[2], Gonzague Alavoine^[1], Pierre Benoit^[2], Patricia Garnier^[2], Sylvie Recous^[1]

^[1]INRA ~ UMR FARE ~ Reims ~ France ^[2]INRA ~ UMR EGC ~ Grignon ~ France

Improving crop rotations, reducing or suppressing soil tillage, and maintaining a mulch of crop residues at the soil surface are gaining popularity throughout the world. But the impacts of these practices and of their combination on soil processes are not fully well understood. The objective of the work was to study, for different crop associations and pedo-climatic conditions met in temperate (France) and tropical (Madagascar and Brazil) agrosystems under conservation agriculture, the effects of residue mulch characteristics on their decomposition and subsequent fate of C and N in soil. An experiment was performed in controlled conditions with 10 cm wide x 25 cm depth soil columns. The treatments varied either by the type of residue mulch (mixture of Zea mais & Doliquos lablab or Triticum aestivum & Medicago sativa), or by the type of soil (sandy or loamy soil) and by the water regime (manipulated through the intensity and frequency of rain applied with a rain simulator to the columns). The incubation was performed at 20°C during 3 months with continuous measurements of CO₂, N₂O emissions and water dynamics, and with measurements of mulch, soil and microbial biomass C and N, by destructive samplings at 0, 14, 41 and 84 days. A C&N biotransformation and transport model coupled to a mulch module (Findeling et al., 2007) was tested and used to calculate fluxes that are not measureable (gross mineralization and immobilization, nitrate and soluble C leaching), and to extrapolate the fate of C on a longer term.



S06.02 -4

INTERACTION OF MITIGATION AND ADAPTATION STRATEGIES TO REDUCE GREENHOUSE GAS EMISSIONS FROM AGRICULTURE

Brilli Lorenzo^{*[1]}, Lugato Emanuele^[2], Moriondo Marco^[2], Ferrise Roberto^[1], Bindi Marco^[1]

^[1]Università degli studi di Firenze ~ DiPSA (Department of Plant, Soil and Environmental Science Section of Agronomy and Land Management) ~ Firenze ~ Italy ^[2]CNR ~ IBIMET ~ Firenze ~ Italy

In Italy, total greenhouse gas emissions (GHGs) from agriculture amounted to 34.5 Mt of CO₂ equivalent in 2009 (Romano et al., 2011), almost coming from N₂O emission from agricultural soils (15.5 Mt CO₂ eq.), manure management and enteric fermentation (6.6 and 10.7 Mt CO₂ eq.). In order to reduce these emissions and consequently impact on climate change, several mitigation strategies (MS), such as the use of less intensive or organic production systems, minimum tillage techniques and lower use of inorganic fertilizers, have been proposed (Lugato et al., 2010). However, these practices are generally not evaluated in combination with some adaptation strategies (AS) that farmers may adopt independently to offset climate change. In this work, a biogeochemical model (DNDC) was run to assess GHGs emissions in an intensive agricultural area of Tuscany region (Italy), for the present period (1976-2005) and in a projected warmer climate. A number of alternative MS with respect to conventional farming system have been compared, also in combination with potential farmer AS, in order to find the best combination of AS and MS for future periods. Model projections suggested that crop yield will increase under intensive management (on average 8% than present), as well as N₂O (+70%) and CO₂ (+35%) emissions. Simulation of MS resulted in a slightly reduced crop yield (-4%) and consistent lower N₂O emissions and N leaching (-70% and -67%, respectively) than intensive production system. The best combination of AS and MS was obtained using late cultivar and high rate of crop residue incorporation.



S06.02 -5

FARMYARD MANURE APPLICATION MITIGATES GREENHOUSE GASES EMISSIONS FROM MANAGED GRASSLANDS IN JAPAN

Hatano Ryusuke^[1], Shimizu Mariko^[1], Arita Takatoshi^[2], Kouda Yasuyuki^[2], Mori Akinori^[3], Matsuura Shoji^[3], Niimi Mitsuhiro^[4], Mano Masayoshi^[5], Hirata Ryuichi^[1], Limin Atfritedy^[1], Jin Tao^[1], Kawamura Osamu^[4], Hojito Masayuki^[6], Miyata Akira^[5]

^[1]Hokkaido University ~ Research Faculty of Agriculture ~ Sapporo ~ Japan ^[2]Hokkaido Research Organization ~ Konsen Agricultural Experiment Station ~ Nakashibetsu ~ Japan ^[3]National Agriculture and Food Research Organization ~ National Institute of Livestock and Grassland Science ~ Nasushiobara ~ Japan ^[4]Miyazaki University ~ Faculty of Agriculture ~ Miyazaki ~ Japan ^[5]National Institute for Agro-Environmental Sciences ~ Agro-Meteorology Division ~ Tsukuba ~ Japan ^[6]Kitasato University ~ School of Veterinary Medicine ~ Towada ~ Japan

Applying manure leads to reduce chemical N fertilizer and to sequester carbon in soils. This study was conducted to quantify the effect of manure application on the CO₂, CH₄ and N₂O emission at five managed grasslands in four climatic regions in Japan. Net ecosystem exchange (NEE) by eddy covariance method, CH₄ and N₂O emissions by chamber method were measured at the plots of manure (M) and chemical N fertilizer (F) from 2004 to 2010. Manure application rate was decided based on the potassium demand of grasses. CO₂ emission was estimated as NEE – manure + harvest. Global warming potential (GWP) was calculated using conversion factors of 1 for CO₂, 25 for CH₄ and 298 for N₂O. CO₂ emission in F and M plots was 1.3±1.5 and -1.1±2.4 Mg C ha⁻¹ yr⁻¹, respectively, indicating that M plot gained carbon. Harvests in F and M plots were not different. NEE showed more CO₂ uptake in the F plot (-3.0±1.7 Mg C ha⁻¹ yr⁻¹) than in the M plot (-1.8±1.8 Mg C ha⁻¹ yr⁻¹), but manure carbon recovered the shortage. The small CH₄ uptake was found in the F and M plots (-0.03±1.2 and -0.15±0.4 kg C ha⁻¹ yr⁻¹, respectively). The significant N₂O emission was found in the F and M plots (4.2±3.6 and 4.9±3.7 kg N ha⁻¹ yr⁻¹, respectively). The GWP was significantly higher in the F plot than in the M plot. Harvest and N₂O emission increased GWP significantly, and NEE and manure carbon reduced GWP significantly.



S06.02 -6

CARBON SEQUESTRATION AND GHG EMISSIONS ANALYSIS IN TROPICAL AREAS WITH USE OF NEW ANALYTICAL TOOLS

Martin-Neto Ladislau^[1], Marcondes Bastos Pereira Milori Debora^[1], La Scala-Junior Newton^[2], Ferreira Edilene Cristina^[1], Leme De Almeida Tania^[1], Segnini Aline^[1], Gaiad Sérgio^[3], Miranda Carvalho Camila^[4], Ribeiro Villas-Boas Paulino^[1], Ferreira Ednaldo José^[1]

^[1]Brazilian Agricultural Research Corporation (EMBRAPA) ~ Research and Development ~ Sao Carlos ~ Brazil

^[2]Universidade Estadual Paulista ~ Soil Science ~ Jaboticabal ~ Brazil ^[3]Brazilian Agricultural Research Corporation (EMBRAPA) ~ Research and Development ~ Colombo ~ Brazil ^[4]University of Sao Paulo ~ Physics Institute of Sao Carlos ~ Sao Carlos ~ Brazil

Currently Brazil has in use to crops around 60 millions of hectares. Other 100 millions have potential to be increased from pastureland conversion or in combined use of crop and livestock productions, and yet some addition of new agricultural land in Savanna region, without any increase in deforestation of Amazon rainforest (around 85% preserved or 400 million of hectares). Conservative systems, as no-till, crop-livestock and crop-livestock-forest systems, have a growth adoption in Brazil with important potential of carbon sequestration. In all these systems spatial and temporal variabilities of soil carbon are crucial aspects so development of analytical tools to facilitate carbon content analysis is very important. Some laser-base methodologies, as laser-induced fluorescence spectroscopy (LIFS) and laser-induced breakdown spectroscopy (LIBS) are powerful alternatives for several quantitative and qualitative analysis of soil carbon. Results about carbon dynamics (soil carbon measurements with laser-based techniques and greenhouse gas emissions) in areas under sugar-cane cultivation, integration crop-pastureland and sewage sludge amendment in afforested areas will be presented showing complexity associated with these systems in different soils. For studied soils, preliminary results for integration crop-pastureland and sewage sludge addition systems promoted an increasing of soil carbon and a decreasing of humification degree of organic matter. This behavior is probably due to recent input of fresh organic matter. However, the continuous monitoring should provide more precise information about the dynamics of this soil carbon.



S06.03 - SOIL FUNCTIONS IN A CHANGING CLIMATE - RECENT INSIGHTS FROM FIELD EXPERIMENTS

Chair Persons:

Sven Marhan, Hohenheim - Germany

Pascal Niklaus, Zurich - Switzerland

Christian Poll, Hohenheim - Germany

Tuesday 03 July 2012 from 10:30 to 12:00. Room Mirto

S06.03 -1

IMPACT OF CLIMATE CHANGE ON SOIL MICROORGANISMS AND CARBON CYCLING IN AN ARABLE ECOSYSTEM

Christian Poll, Stuttgart - Germany

S06.03 -2

NUTRIENT AVAILABILITY AND UPTAKE UNDER DROUGHT CONDITIONS IN OAK MODEL ECOSYSTEMS WITH TWO DIFFERENT FOREST SOILS

Thomas M. Kuster, Birmensdorf - Switzerland

S06.03 -3

RESPONSE OF SOIL PROPERTIES TO A LONG TERM FACTORIAL SNOW AND N-FERTILIZATION EXPERIMENT, COLORADO FRONT RANGE, USA

Michele Freppaz, Grugliasco - Italy

S06.03 -4

EFFECTS OF LONG-TERM TEMPERATURE AND NUTRIENT MANIPULATION ON NORWAY SPRUCE FINE ROOTS, MYCORRHIZAL ROOT TIPS AND MYCELIA PRODUCTION

Jaana Leppälammi-Kujansuu, Helsinki - Finland

S06.03 -5

IMPACTS OF EXTREME EVENTS ON CO₂ SOIL EFFLUX IN GRASSLAND IN A CONTEXT OF FUTURE CLIMATE CHANGE

Angela Augusti, Porano (TR) - Italy



S06.03 -6

CARBON AND NITROGEN DECOUPLING UNDER AN 11-YEAR DROUGHT IN THE SHORTGRASS STEPPE: IMPLICATIONS FOR INCREASED NUTRIENT LOSS AND PROLONGED ECOSYSTEM RECOVERY

Sarah Evans, Fort Collins - United States



S06.03 -1

IMPACT OF CLIMATE CHANGE ON SOIL MICROORGANISMS AND CARBON CYCLING IN AN ARABLE ECOSYSTEM

Poll Christian^[1], Marhan Sven^[1], Niklaus Pascal^[2], Kandeler Ellen^[1]

^[1]University of Hohenheim ~ Institute of Soil Science, Soil Biology ~ Stuttgart ~ Germany ^[2]University of Zurich ~ Institute of Evolutionary Biology and Environmental Studies ~ Zurich ~ Switzerland

*Carbon cycling in terrestrial ecosystems provides a feedback mechanism to climate change by releasing or sequestering additional atmospheric CO₂. However, the role of soil microorganisms as key players in this feedback mechanism is still unclear. The Hohenheim Climate Change (HoCC) experiment was established in summer 2008 to manipulate soil temperature and precipitation on an arable field. Soil temperature is increased by 2.5°C in 4 cm and is combined in a factorial design with the following precipitation manipulation treatments: a) ambient, b) precipitation amount decreased by 25% during summer and increased by 25% during winter, c) drought periods increased by 50% during summer, d) combination of b and c. The experimental plots were planted with spring wheat (*Triticum aestivum*, 2009), spring barley (*Hordeum vulgare*, 2010) and oilseed rape (*Brassica napus*, 2011). Soil samples were taken at four occasions each year (March, June, August, November/December) in 0-5 cm, 5-15 cm and 15-30 cm depth. Data of aboveground biomass, soil organic carbon, soil microbial biomass and CO₂ fluxes (weekly measurements) will be presented. First results indicate that changes in soil temperature and precipitation differently affected aboveground biomass and that these effects depended on the crop. Effects of elevated soil temperature on microbial biomass and CO₂ fluxes were related to moisture conditions during the different seasons of the year. Overall, the presentation will give insight into the complex interactions between climate change, soil moisture and soil microorganisms as key players of carbon cycling in the investigated arable ecosystem.*



S06.03 -2

NUTRIENT AVAILABILITY AND UPTAKE UNDER DROUGHT CONDITIONS IN OAK MODEL ECOSYSTEMS WITH TWO DIFFERENT FOREST SOILS

Kuster Thomas M.*^[1], Patrick Schleppi^[2], Madeleine S. Günthardt-Goerg^[1], Rainer Schulin^[3]

^[1]Swiss Federal Research Institute WSL ~ Forest Dynamics ~ Birmensdorf ~ Switzerland ^[2]Swiss Federal Research Institute WSL ~ Forest Soils and Biogeochemistry ~ Birmensdorf ~ Switzerland ^[3]ETH Zurich ~ Institute of Terrestrial Ecosystems (ITES) ~ Zurich ~ Switzerland

Global climate change is expected to increase annual temperature and to decrease summer precipitation in Central Europe. Little is known on how drought, air-warming and their interaction affect forest soil fertility and nutrient uptake of trees. Therefore, we investigated the response in fertility of two forests soils, acidic and calcareous, stocked with young oak stands, to air-warming (+1-2 °C) and drought (-43% irrigation). Air-warming did neither change the nutrient availability nor their uptake. Possibly, soil temperature increase was too weak (+1 °C). Drought treatment increased the availability of Mg and P in the acidic soil, whereas no changes in NO₃⁻/NH₄⁺, K, Ca and Mn availabilities were recorded. Under drought, the concentrations of N and P in oaks growing on the calcareous soil increased whereas the concentrations of Mg and Ca decreased. Expectedly, soil reaction in well-watered calcareous (vs. acidic) soils resulted in lower P and Mn availabilities which consequently reduced the biomass of oak stands. However, under drought conditions there was no difference in biomass between the two soils, indicating that nutrient limitation was governed by water availability. In the acidic soil, oaks invested relatively more roots in the nutrient rich top layer than in deeper layers, whereas the root distribution in the non-layered calcareous soil was more uniform. Although drought effects on soil fertility and nutrient uptake were significant in this oak ecosystem study, the effects of water limitation on the oak stand performance were much more pronounced than the drought effects on soil fertility.



S06.03 -3

RESPONSE OF SOIL PROPERTIES TO A LONG TERM FACTORIAL SNOW AND N-FERTILIZATION EXPERIMENT, COLORADO FRONT RANGE, USA

Freppaz Michele^{*[1]}, Williams Mark W.^[2], Seastedt Timothy^[2], Filippa Gianluca^[1]

^[1]Università degli Studi di Torino ~ DIVAPRA - Laboratorio Neve e Suoli Alpini ~ Grugliasco ~ Italy ^[2]University of Colorado at Boulder ~ Institute of Arctic and Alpine Research and Department of Geography ~ Boulder ~ United States

Alpine ecosystems are thought to be particularly sensitive to small environmental changes in climate and other parameters due to the plants and soil organisms being on the edge of environmental tolerances. Snow distribution is critical to microclimate in the alpine, affecting soil temperature, growing season duration, and nutrient cycling. Moreover anthropogenic nitrogen deposition over the past half century has had a detrimental impact on temperate ecosystems, resulting in soil acidification and a reduction in plant biodiversity. Here we build on a snowfence experiment, combined with N-fertilization experiment, at the Niwot Ridge LTER site, to increase our understanding of how changes in snow properties and N deposition may affect soil processes. The snowfence used in this manipulation results in a pattern of snow accumulation, from deep snowpacks near the fence to moderate and shallow snowpacks away from the snowfence. Over the 16 years of the experiment, the amount, timing, and duration of snow cover appears to affect soil properties. Under the moderate snow cover, without N addition, a greater content of total organic carbon (TOC) and total nitrogen (TN) than either under deep or shallow snow was observed. Nitrogen amendments in general worked in the opposite direction of snowpack controls on soil processes. The N addition caused a significant increase under the shallow snow for TOC, and TN, while there was a significant decrease of these values under the moderate snow treatment. Our results clearly demonstrate how long-term changes in snow properties and N deposition may significantly affect soil properties.



S06.03 -4

EFFECTS OF LONG-TERM TEMPERATURE AND NUTRIENT MANIPULATION ON NORWAY SPRUCE FINE ROOTS, MYCORRHIZAL ROOT TIPS AND MYCELIA PRODUCTION

Leppälammi-Kujansuu Jaana*^[1], Ostonen Ivika^[2], Nilsson Lars Ola^[3], Berggren Dan Kleja^[4], Strömgren Monika^[4], Sah Shambhu^[1], Helmisaari Heljä-Sisko^[1]

^[1]University of Helsinki ~ Department of Forest Sciences ~ Helsinki ~ Finland ^[2]University of Tartu ~ Institute of Botany and Ecology ~ Tartu ~ Estonia ^[3]Norwegian University of Life Sciences ~ . ~ Ås ~ Norway ^[4]Swedish University of Agricultural Sciences ~ Department of Soil and Environment ~ Uppsala ~ Sweden

As fine roots are the main contributors in sequestering carbon into boreal forest soils, their responses to environmental changes, such as soil warming, are of great importance. We examined the responses of fine roots and mycelia production in a boreal Norway spruce (Picea abies (L.) Karst.) forest in northern Sweden after 14 years of soil warming and/or 22 years of liquid fertilization. The fine root biomass and necromass, ectomycorrhizal (EcM) root tip biomass, morphology and number, as well as mycelia production were determined. Total fine root biomass and necromass were the highest in fertilized plots, similar to the above-ground biomass, whereas warming increased the amount of fine root biomass and live/dead ratios deeper in the soil. Warming had a positive effect on the amount of EcM root tips in the mineral soil and tended to increase fungal mycelia production. Significantly higher specific root length of EcM tips revealed a possible stress reaction caused by warming, but in general fertilization affected the EcM root morphology the strongest. Consequently, changes in EcM root morphological traits reflected differences in foraging strategies of fine roots related to environmental conditions. Overall, through better nutrient supply and warmer soil temperature there is a potential to increase the flow of carbon to the soil via increased fine root biomass, but the carbon balance depends also on production and decomposition.



S06.03 -5

IMPACTS OF EXTREME EVENTS ON CO₂ SOIL EFFLUX IN GRASSLAND IN A CONTEXT OF FUTURE CLIMATE CHANGE

Augusti Angela^[5], Gazon Pablo^[6], Landais Damien^[7], Hasibeder Roland^[4], Bahn Michael^[4], Roumet Catherine^[8], Ravel Olivier^[7], Roy Jacques^[3], Picon-cochard Catherine^[6]

^[1]Grassland Ecosystem Research Team ~ INRA ~ Clermont Ferrand ~ France ^[2]Institute of Agro-environment and Forest Biology ~ CNR ~ Porano (Tr) ~ Italy ^[3]Ecotron ~ CNRS ~ Montferrier sur Lez ~ France ^[4]University of Innsbruck ~ Institute of Ecology ~ Innsbruck ~ Austria ^[5]CNR ~ Institute of Agro-environment and Forest Biology ~ Porano (Tr) ~ Italy ^[6]INRA ~ Grassland Ecosystem Research Team ~ Clermont Ferrand ~ France ^[7]CNRS ~ Ecotron ~ Montferrier sur Lez ~ France ^[8]CNRS ~ Center for Evolutionary and Functional Ecology ~ Montpellier ~ France

Future scenarios foresee more frequent and severe extreme events, such as heat wave and drought. Soil CO₂ efflux constitutes the second largest carbon flux between terrestrial ecosystems and atmosphere and derives from two main components, autotrophic respiration (Ra) being associated with root and rhizosphere respiration and heterotrophic respiration (Rh) associated with the turnover of soil organic matter by microorganisms. The aim of this work was to study how increased atmospheric CO₂ can mediate the effects of extreme events on grassland soil respiration and to analyze its components Ra and Rh. Grassland monoliths were exposed, from May 2010, to air temperature and precipitation expected for the period 2040-2060. Since March 2011 a CO₂ enrichment was applied and during summer a heat wave and drought stress was applied too. Soil respiration and its components were not significantly affected by elevated CO₂ until 4 months after the start of the CO₂ fumigation, but it increased under elevated CO₂ by about 20% during August and September. The extremes treatment decreased drastically soil respiration both at ambient (59%) and at elevated CO₂ (67%). Soil respiration recovered from extremes events, even if Ra and Rh showed different recovery times. This was associated to a recover of root growth and to an increase in root decomposition. This behavior agrees with preliminary data on daily ecosystem carbon uptake showing a stronger recovery after rewetting and under elevated CO₂ compared to ambient CO₂. In view of these results, the interactions between elevated CO₂ and extreme events will be discussed



S06.03 -6

CARBON AND NITROGEN DECOUPLING UNDER AN 11-YEAR DROUGHT IN THE SHORTGRASS STEPPE: IMPLICATIONS FOR INCREASED NUTRIENT LOSS AND PROLONGED ECOSYSTEM RECOVERY

Evans Sarah^{*[1]}, Burke Ingrid^[2]

^[1]Colorado State University ~ Graduate Degree Program in Ecology ~ Fort Collins ~ United States ^[2]University of Wyoming ~ Environment and Natural Resources Program, Dept. of Botany, Dept of Renewable Resources, and Program in Ecology ~ Laramie ~ United States

The frequency and magnitude of drought is expected to increase in the US Great Plains under future climate regimes. Although semiarid systems are often considered highly resistant to drought, novel drought events could alter linkages among biogeochemical processes, and result in new feedbacks that influence the timescale of ecosystem recovery. We examined changes in carbon and nitrogen cycling in the last two years of an 11-year drought manipulation in the shortgrass steppe, and under the first two years of drought recovery. We measured plant production, plant tissue chemistry, soil trace gas flux, and soil inorganic nitrogen pools to test whether drought decreased the nitrogen conservation in this ecosystem. We found soil inorganic nitrogen increased up to 4-fold under our most severe drought manipulation, but that this nitrogen may not have been accessible to plants and microbial communities under drought due to diffusion limitations. When plots received ambient rainfall under recovery, we observed higher plant tissue nitrogen and N₂O flux in drought plots, suggesting nitrogen use efficiency decreases and gaseous N-loss increases in the years following long-term drought. These changes in plant production and nitrogen cycling persisted up to 2 years after this 11-year drought. Our results suggest that an 11-year drought drastically alters biogeochemical and ecosystem dynamics in the highly drought-resistant shortgrass steppe. In semiarid systems, the more “open” nitrogen cycling we observed following severe drought could alter fundamental ecosystem properties and prolong, or prevent, recovery.



S06.04 - LYSIMETER RESEARCH AND CLIMATE CHANGE

Chair Person:

Peter Cepuder, Vienna - Austria

Tuesday 03 July 2012 from 08:30 to 10:00. Room Leccio

S06.04 -1

LYSIMETER NETWORKS: DATA MANAGEMENT, QUALITY CONTROL AND MAINTENANCE

Georg Unold Von, Munich - Germany

S06.04 -2

TERENO – SOILCAN A LYSIMETER-NETWORK IN GERMANY TO STUDY THE EFFECT OF LAND USE AND CLIMATE CHANGE

Thomas Pütz, Jülich - Germany

S06.04 -3

LYSIMETER INVESTIGATIONS TO EVALUATE DROUGHT EFFECTS ON THE GROWTH REACTION OF TREES

Jürgen Müller, Eberswalde - Germany

S06.04 -4

IMPACT OF CLIMATE CHANGE SCENARIOS ON CROP YIELD, SOIL WATER AND NITROGEN BALANCE AT THE LYSIMETER SITE WAGNA, AUSTRIA

Gernot Klammler, Graz - Austria

S06.04 -5

CONSEQUENCES OF CLIMATE CHANGE ON ECOSYSTEM FUNCTIONS, WATER BALANCE, PRODUCTIVITY AND BIODIVERSITY OF AGRICULTURAL SOILS IN THE PANNONIAN AREA

Andreas Baumgarten, Vienna - Austria

S06.04 -6

DO 59 YEARS OF HYDROLOGICAL AND HYDROCHEMICAL OBSERVATIONS ON THE 4 MEGALYSIMETERS NEAR CASTRICUM (NETHERLANDS) REVEAL EFFECTS OF CLIMATE CHANGE?

Pieter Jan Stuyfzand, Nieuwegein - Netherlands



S06.04 -1

LYSIMETER NETWORKS: DATA MANAGEMENT, QUALITY CONTROL AND MAINTENANCE

Thomas Puetz^[1], Unold Von Georg^[2], Herndl Markus^[3], Ralf Kiese^[4], Georg Leitinger^[5], Nikolaus Obojes^[6]

^[1]Forschungszentrum Juelich ~ Agrosphaere ~ Juelich ~ Germany ^[2]UMS GmbH ~ R&D ~ Munich ~ Germany ^[3]LFZ Raumberg Gumpenstein ~ Pflanzenbau und Kulturlandschaft ~ Irdning ~ Austria ^[4]Karlsruhe Institute of Technology ~ Institute for Meteorology and Climate Research ~ Garmisch-Partenkirchen ~ Germany ^[5]University Innsbruck ~ Institute for Ecology ~ Innsbruck ~ Austria ^[6]EURAC ~ Institute for Alpine Environment ~ Bozen ~ Italy

In 2010/2011 we installed a Network of Lysimeters in Germany & Austria. An amount of 142 "third generation lysimeters" delivers now up to 3800 Sensor signals continuously. Those are combined with fix and variable background information as well as with Meta data arriving from cameras, alarm systems, station management & maintenance inputs. They arrive at a database containing proofed, comparable & reliable long time measurements produced with standardized routines. In addition, modelled data as in situ retention curves or in situ evapotranspiration rates are available. Therefore, an automatized procedure for data upload, visualization, filter levels & backup's works in combination with comparable, modular & online accessible sensors, controllers and data loggers are in operation. The maintenance works at the field stations are based on the results of the data base. Beneath the site management the technical data management requires modern data acquisition and communication tools to ensure high quality, comparable and reliable long term data.



S06.04 -2

TERENO – SOILCAN A LYSIMETER-NETWORK IN GERMANY TO STUDY THE EFFECT OF LAND USE AND CLIMATE CHANGE

Pütz Thomas^[1], Ralf Kiese^[2], Steffen Zacharias^[3], Eckart Priesack^[4], Ute Wollschläger^[3], Mike Schwank^[5], Horst Gerke^[6], Hans Papen^[2], Erik Borg^[7], Harry Vereecken^[1]

^[1]Forschungszentrum Jülich ~ Institute of Bio- and Geoscience IBG-3: Agrosphere ~ Jülich ~ Germany ^[2]Karlsruhe Institute of Technology ~ Institute of Meteorology and Climate Research Atmospheric Environmental Research ~ Garmisch-Partenkirchen ~ Germany ^[3]Helmholtz Centre for Environmental Research- UFZ ~ Department Monitoring- und Exploration Technologies ~ Leipzig ~ Germany ^[4]Helmholtz Center München ~ Institute of Soil Ecology ~ München ~ Germany ^[5]Helmholtz Centre Potsdam GFZ German Research Centre for Geosciences ~ Geoecology and Geomorphology ~ Potsdam ~ Germany ^[6]Leibniz-Zentrum für Agrarlandschaftsforschung e.V. ~ Institut für Bodenlandschaftsforschung ~ Müncheberg ~ Germany ^[7]German Aerospace Center (DLR) ~ German Remote Sensing Data Center ~ Neustrelitz ~ Germany

TERENO (TERrestrial ENvironmental Observatories) aims to collect and provide long-term observation data of the hydrosphere, biosphere, pedosphere, lower atmosphere, and anthroposphere across multiple spatial and temporal gradients. Based on the TERENO infrastructure, the lysimeter-network SoilCan a long-term large-scale experiment to study the effects of land use changes of terrestrial systems caused by Global Change, has been implemented and represents one of the key research infrastructures for pedological research in TERENO. Main objectives are the terrestrial hydrology, the N-/C-cycle and the biodiversity. In particular, the analysis of changes in water and matter fluxes in the soil-plant-atmosphere system is in the focus of SoilCan. The gained high-quality data will be used for the development and calibration of computer models in combination with remote sensing. The SoilCan network consists of 126 fully automated lysimeter systems that were installed at 13 highly equipped experimental field sites within the TERENO-observatories and the relevant status variables of each ecosystem are monitored (e.g. climate, hydrology, biosphere-atmosphere exchange, biodiversity, etc.). Lysimeters were either left at their sampling site, transplanted inside the observatory of origin, or moved within or between the four different observatories. The translocation of lysimeters was performed along existing temperature and rainfall gradients in order to simulate climate change. The lysimeters are currently cultivated as grassland or arable land with a standardized crop rotation of winter wheat – pea - winter barley - winter canola. The presentation will comprise the results and experience of 18 months of lysimeter networking and will give an outlook on future work.



S06.04 -3

LYSIMETER INVESTIGATIONS TO EVALUATE DROUGHT EFFECTS ON THE GROWTH REACTION OF TREES

Müller Jürgen^{*[1]}

^[1] Johann Heinrich von Thünen-Institute, Institute for Forest Ecology and Forest Inventories ~ Forest Ecology ~ Eberswalde ~ Germany

Broad areas of the northeast German lowlands are characterised by low precipitation and periods of summer drought. Scenarios of the climatic development for the next decades indicate an increase in weather extremes threatening the current ecosystems in their existence. In this region, forest hydrology research looks into the influence of differently structured forest on the landscape water balance. The use of different types of lysimeters in this region has a tradition of more than 100 years. A main topic of the research is to investigate the water consumption and the growth of the trees at decreasing water resources. To investigate the impact of intensified drought on forest regeneration field experiments were carried out with different types of lysimeters. This field laboratory enables investigations of the effects of drought on the growth and vitality of forest trees in the open under largely controlled conditions. Lysimeters with a surface area between 1m² and 100m² were installed in the open at ground level in isolation from the surrounding soil. Special lysimeters were fitted with an automatic retractable roof to eliminate precipitation from the site. The focus of the research is the investigation of growth reaction of trees and fine root development as a function of the soil water availability. The Forest structures with their special hydrological properties have a substantial influence on the water budget, water supply and water distribution. New technical developments as well as strategies for the lysimeter investigations will be presented and discussed.



S06.04 -4

IMPACT OF CLIMATE CHANGE SCENARIOS ON CROP YIELD, SOIL WATER AND NITROGEN BALANCE AT THE LYSIMETER SITE WAGNA, AUSTRIA

Klammler Gernot^[1], Fank Johann^[1], Kupfersberger Hans^[1], Draxler Johannes C.^[1]

^[1] JOANNEUM RESEARCH Graz ~ RESOURCES - Institute of Water, Energy and Sustainability; Water Resources Management ~ Graz ~ Austria

According to the IPCC (2007) future climate change scenarios suggest that global average temperature increases by 1.8 °C from 1980-2000 to 2100. This will result in increases in temperature, shifts in precipitation patterns, an increase in the frequency of flooding and droughts, and also water quality will be affected. Effects and implications on groundwater will depend on the groundwater system, and its geographical location. The goal of this work is to quantify the influence of climate change on groundwater recharge, nitrogen leaching and crop yields for the lysimeter site Wagna, Austria, using the unsaturated flow and transport model STOTRASIM. At this research station, the water movement and nitrate leaching below two lots have been monitored by two lysimeters over more than seven years. Lysimeter data have been used to calibrate STOTRASIM, which is applied for two future temperature and precipitation scenarios. These climate change scenarios rely on assumptions of certain economic and environmental future development and are gained by dynamical and statistical downscaling. On the one hand it is expected that a changing annual sum of precipitation does not influence the crop yield significantly, because the water storage capacity of the soil in Wagna is generally low, but will affect groundwater recharge and nitrogen leaching directly. On the other hand, higher future temperatures will probably increase crop yields and evapotranspiration in Wagna, which also influence groundwater recharge and nitrogen leaching. So the expected crop yield, groundwater recharge and nitrogen leaching will be affected by the combination of temperature and precipitation changes.



S06.04 -5

CONSEQUENCES OF CLIMATE CHANGE ON ECOSYSTEM FUNCTIONS, WATER BALANCE, PRODUCTIVITY AND BIODIVERSITY OF AGRICULTURAL SOILS IN THE PANNONIAN AREA

Baumgarten Andreas^[1], Helene Berthold^[1], Franz Hadacek^[2], Gert Bachmann^[2], Alexander Bruckner^[3], Janet Wissuwa^[3], Johann Zaller^[3], Erwin Murer^[4], Johannes Hoesch^[1], Barbara Kitzler^[5], Kerstin Michel^[5], Sophie Zechmeister-Boltenstern^[6]

^[1]AGES ~ Inst. for Soil Health and Plant Nutrition ~ Vienna ~ Austria ^[2]University of Vienna ~ Chemical Ecology and Ecosystem Research ~ Vienna ~ Austria ^[3]University of Natural Resources and Life Science ~ Inst. of Zoology ~ Vienna ~ Austria ^[4]Federal Agency for Water Management ~ Inst. for Land and Water Management Research ~ Petzenkirchen ~ Austria ^[5]Federal Research and Training Centre for Forests, Natural Hazards and Landscape ~ Soil Biology ~ Vienna ~ Austria ^[6]University of Natural Resources and Life Sciences ~ Institute for Soil Science ~ Vienna ~ Austria

Lysimeters have mainly been used to investigate processes regarding soil hydrology and mass transport, but have rarely been utilized to study climate change effects of multi-trophic ecosystem processes and functions. In a multidisciplinary study, we tested the impact of a climate change scenario (longer dry periods, increased rainfall events) predicted for one of the most productive agricultural areas of Austria. Using the AGES Lysimeter station comprising 18 3-m² lysimeters we tested the effects of this climate scenario for the three major soil types of the region: calcareous phaeozem, gleyic phaeozem and calcic chernozem. We monitored soil hydrological and mass transport processes, chemical soil properties, emissions of greenhouse gases (CO₂, CH₄ and N₂O), soil microbial activity and soil faunal diversity. Furthermore, the impact on crop production (peas), root growth, rhizodeposition, mycorrhization and the establishment and diversity of weeds was assessed. The results of the first year of investigations will be presented, highlighting especially the integrated view of physical, chemical and biological processes in the soil plant system and its relevance for the development of mitigation and/or adaptation strategies. The soil type specific identification of the major drivers of observed changes will contribute to proposals for an ecologically sound management of the soils investigated. Ideas to extend the risk assessment area in conjunction with related projects in the EU region will be presented.



S06.04 -6

DO 59 YEARS OF HYDROLOGICAL AND HYDROCHEMICAL OBSERVATIONS ON THE 4 MEGALYSIMETERS NEAR CASTRICUM (NETHERLANDS) REVEAL EFFECTS OF CLIMATE CHANGE?

Stuyfzand Pieter Jan*^[1]

^[1]KWR Watercycle Research Institute ~ Water Systems ~ Nieuwegein ~ Netherlands

Bulk precipitation in the open field and the drainage water from four 625 m², 2.5 meter deep lysimeters, in coastal dunes of the Western Netherlands near Castricum, have been studied regarding their quantity and chemical composition. Each lysimeter is not weighable, contains a dendritic drainage system with a groundwater reservoir of maximum 0.25 m, and is filled with calcareous dune sand. Lysimeter 1 is barren, lysimeter 2 covered with dune shrubs (mainly sea buck thorn), lysimeter 3 with oaks and lysimeter 4 with black pines. In this contribution observations in the period 1941-1999 (from the beginning till the close down), are presented and interpreted with a focus on detecting effects of climate change. Since 1948 the addition of fertilizers to stimulate growth on the vegetated lysimeters has ceased, while growth of vegetation and thinnings have been well documented. Meteorological data reveal that during the whole study period mean annual temperature increased by about 1 °C, gross precipitation increased by 10-15% and wind velocity decreased by 15-20%. The time series of the drainage waters clearly show effects of differences in vegetation, growth of vegetation, trends in atmospheric pollution, extremes in rainfall and in sea spray deposition. These effects are largely overprinting any potential effects of climate change on the drainage quantity and quality of the 4 lysimeters, the occurrence of extremes in drainage and dissolved ions possibly excluded. Effects of increased gross precipitation and decreased wind velocities can be noticed in the bare lysimeter.



W06.01a - FOREST BIOENERGY AND SOIL SUSTAINABILITY

Chair Person:

Heljä-Sisko Helmisaari, Helsinki - Finland

Tuesday 03 July 2012 from 13:30 to 15:00. Room Mirto

W06.01a -1

PRESENTATION OF OECD CO-OPERATIVE RESEARCH PROGRAMME

Leena Finér, Joensuu - Finland

W06.01a -2

ECONOMIC AND TECHNOLOGICAL POTENTIAL OF FOREST BIOENERGY, AND THE CONDITIONS FOR DEVELOPMENT

Rolf Bjorheden,- Invited

W06.01a -3

APPROACHES TO SOIL SUSTAINABILITY IN GUIDELINES FOR FOREST FUEL HARVESTING AND PRODUCTION IN FOREST AND PLANTATIONS

Inge Stupak, Copenhagen - Denmark

W06.01a -4

A REVIEW OF INTENSIVE HARVESTING GUIDELINES IN CANADA AND THE SCIENCE BEHIND THEM

Brian Titus, Victoria, BC - Canada

W06.01a -5

DEVELOPMENT OF FOREST BIOENERGY GUIDELINES FOR SOIL AND WATER PROTECTION-EXPERETISE FROM UK

Tom Nisbet, Alice Holt Lodge - Farnham, Surrey - United Kingdom



W06.01a -1

PRESENTATION OF OECD CO-OPERATIVE RESEARCH PROGRAMME

Finér Leena*^[1]

^[1]*Finnish Forest Research Institute ~ Joensuu Unit ~ Joensuu ~ Finland*



W06.01a -2

*ECONOMIC AND TECHNOLOGICAL POTENTIAL OF FOREST BIOENERGY, AND THE
CONDITIONS FOR DEVELOPMENT*

Bjorheden Rolf^{*¶}



W06.01a -3

APPROACHES TO SOIL SUSTAINABILITY IN GUIDELINES FOR FOREST FUEL HARVESTING AND PRODUCTION IN FOREST AND PLANTATIONS

Stupak Inge*^[1]

^[1]University of Copenhagen ~ Forest & Landscape ~ Copenhagen ~ Denmark

There are concerns that forest fuel harvesting and production may decrease soil sustainability, due to its effects of soil physical, chemical and biological factors. The main issues are increased removal of soil organic matter, carbon and nutrients, soil compaction, and impacts of compensation fertilisation, e.g. with wood ash. An increasing number of countries have developed guidelines for sustainable harvesting and production of forest fuels. This paper analyses the approaches taken to ensure soil sustainability by such guidelines. Recommendations usually classify sites and stands according to the sensitivity to forest fuel extraction, and different types of restrictions are then imposed for a range of specific site types, for example the number of extractions during the rotation, types of extractions, share of material left in the single harvesting operation, spatial distribution of the left residues, use of compensation fertilisation, time for the nutrient removal and fertiliser addition in relation to the season and stand development stage. Differences between different countries are discussed in relation to the natural conditions and type of forestry



W06.01a -4

A REVIEW OF INTENSIVE HARVESTING GUIDELINES IN CANADA AND THE SCIENCE BEHIND THEM

Titus Brian^{*[1]}, Thiffault Evelyne^[2], Paré David^[2], Berch Shannon^[3], Morris Dave^[4]

^[1]Natural Resources Canada ~ Canadian Forest Service, Pacific Forestry Centre, ~ Victoria, BC ~ Canada ^[2]Natural Resources Canada ~ Canadian Forest Service, Laurentian Forestry Centre ~ Sainte-Foy, Québec, QC ~ Canada ^[3]BC Ministry of Environment ~ ~ Victoria, BC ~ Canada ^[4]Centre for Northern Forest Ecosystem Research ~ Ontario Ministry of Natural Resources ~ Thunder Bay, ON ~ Canada

Canada's 10 provinces and three territories are responsible for forest management. Guidelines and regulations therefore differ across the country in response to local situations (site, land ownership, industry, regulatory history, politics). Intensive harvesting (whole-tree; WTH) began in the 1980s for economic reasons and usually predominates where it is applicable to local forest types and landscapes; resultant piles of harvesting residue (slash) at roadside can be of interest as a new source of biomass feedstock. In addition, previously non-merchantable trees are sometimes removed at final felling, which further reduces biomass previously left on-site; where trees are processed at stump, slash is sometimes (but not commonly) removed using second-entry systems. Governments developed sustainable forest management guidelines/regulations before the current interest in slash recovery, and there are a range of responses to new uses for biomass: some jurisdictions made no changes; some made no changes but summarized current practices in new explicit biomass policies; some instituted new biomass guidelines to enhance ecosystem protection; and one has (at least temporarily) banned whole-tree harvesting and residue removal for electricity generation from provincial land. The science that informs policy development has resulted in a range of policy responses, from new site-specific guidelines to use of spatially explicit nutrient cycling models for identifying sites that would be sensitive to intensive biomass removals. We will review the soil science that informs indicator development and the application of indicators in guidelines and regulations across Canada; we will also compare and contrast the situations in Canada and Europe.



W06.01a -5

**DEVELOPMENT OF FOREST BIOENERGY GUIDELINES FOR SOIL AND WATER
PROTECTION-EXPERETISE FROM UK**

Nisbet Tom*^[1]

^[1]Centre for Forestry and Climate Change ~ Forest Research ~ Alice Holt Lodge ~ Farnham, Surrey ~ United Kingdom

The development of forest bioenergy presents a number of risks to soil and water resources. Negative impacts include soil infertility, acidification, soil carbon loss, ground damage and diffuse water pollution. In addition, the potential high water use of Short Rotation Coppice and Short Rotation Forestry can reduce water resource availability and the maintenance of ecological flows in rivers. On the other hand, energy crops can provide a number of soil and water benefits, such as waste treatment, reduced nutrient and sediment delivery to watercourses, and the attenuation of flood flows. This presentation considers the development of guidelines to aid site selection and promote good practice for forest bioenergy in the UK. The principal policy instrument driving good forest practice is the UK Forestry Standard and supporting Forests and Soil and Forests and Water Guidelines. These define the standards and requirements for sustainable forest management and provide a basis for regulation and monitoring. The Guidelines include a number of measures designed to control risks and promote benefits associated with energy forestry. These will be described, along with separate guidance on site selection for harvesting residues and planting new energy crops.



W06.01b - FOREST BIOENERGY AND SOIL SUSTAINABILITY

Chair Person:

Elena Vanguelova, Farnham - United Kingdom

Tuesday 03 July 2012 from 15:30 to 17:00. Room Mirto

W06.01b -1

*FOREST BIOMASS FOR ENERGY AND SUSTAINABLE MANAGEMENT OF FOREST SOILS –
WHAT DO WE NEED TO KNOW TO KNOW?*

Gustaf Egnell, Umeå - Sweden

W06.01b -2

IMPACTS OF INCREASED BIOMASS USE ON SOIL SUSTAINABILITY IN AUSTRIA

Klaus Katzensteiner, Vienna - Austria

W06.01b -3

FOREST BIOENERGY AND SOIL SUSTAINABILITY IN THE UK

Elena Vanguelova, Farnham - United Kingdom

W06.01b -4

*ASSESSING HARVESTING POTENTIAL AND NUTRIENT SUSTAINABILITY IN TEMPERATE
FORESTS BASED ON MONITORING DATA*

Klaus V.wilpert, Freiburg - Germany

W06.01b -5

*IMPACT OF SHORT- AND VERY SHORT-ROTATION COPPICES OF POPULUS AND SALIX
SPECIES ON SOIL C, N AND P CYCLING*

René Guéron, Reims - France

W06.01b -6

*LOGGING RESIDUE AND STUMP HARVESTING AND FOREST SOIL SUSTAINABILITY IN
FINLAND*

Heljä-Sisko Helmisaari, Helsinki - Finland



W06.01b -1

**FOREST BIOMASS FOR ENERGY AND SUSTAINABLE MANAGEMENT OF FOREST SOILS –
WHAT DO WE NEED TO KNOW TO KNOW?**

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The set targets for renewable energy use in 2020 within the European union will inevitably put more pressure on forest biomass within the union. In countries like Sweden and Finland this has already resulted in an increased harvest of nutrient rich forest biomass that used to be left in the forest during silvicultural operations oriented toward round-wood production for the forest industry. This has raised concerns about the sustainability in these practices when it comes to long-term site- and stand-productivity as well as soil acidity and quality of run-off water. Modeling approaches have suggested that in many cases it will not be sustainable to harvest nutrient rich forest biomass like logging residues, small diameter trees, and stumps with roots. This suggests that long-term site and stand productivity, soil quality, and surface water quality may be threatened by the new demand for forest biomass. Here we scrutinize uncertainties in models suggesting that bioenergy is a major threat to long-term site- and stand-productivity from losses with harvested biomass and leaching, to nutrients gained through weathering and deposition. The link between topsoil chemistry and surface water quality is also weak and needs further research before forest biomass for energy is disqualified as a sustainable alternative to fossil fuels. Furthermore, if needed, recycling wood ash to the forest soil could counteract many of the drawbacks with nutrient rich forest biomass for energy.



W06.01b -2

IMPACTS OF INCREASED BIOMASS USE ON SOIL SUSTAINABILITY IN AUSTRIA

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Almost half of Austria is covered by forests. Incentives for the establishment of CHP plants have raised the demand for forest biomass dramatically during the last decade and lead to an increased utilization of small dimensions and forest residues. Opportunities and limitations for forest biomass utilization for Austria have been evaluated based upon data from the Austrian Forest Inventory, supporting soil information and nutrient balance modelling by the Research and Training Centre for Forests, Natural Hazards and Landscape. The application of the concepts at the scale of individual forest management units is however frequently restricted by missing site/soil information. Thus, guidelines are rarely applied due to a lack of data. To overcome these restrictions, novel methods for partly model based site classification are combined with forest growth and yield, carbon and nutrient balance models for test regions to estimate impacts of different utilization intensities on humus dynamics and nutrient budgets. The concepts will be presented, model results for contrasting site/soil situations (calcareous versus silicate parent material for soil formation) will be shown and possibilities for the application at regional scales will be discussed.



W06.01b -3

FOREST BIOENERGY AND SOIL SUSTAINABILITY IN THE UK

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^[1]Forest Research ~ Centre for Forestry and Climate Change ~ Farnham ~ United Kingdom

The ongoing drive to develop renewable energy is generating increasing interest in energy forestry in the UK. Woody biomass from both forest residues and short rotation forestry has the potential to make a significant contribution to climate change mitigation through fossil fuel substitution. However, there is a danger of practice running ahead of understanding of the environmental impacts and benefits. Consequently, there is an urgent requirement for scientifically underpinned guidance on best management practices to ensure soil protection, including sustaining forestry's key role in carbon capture. This presentation will address the main issues emerging from an expansion of energy forestry in the UK. It will focus on evaluating the impacts of forest bioenergy management practices on ground damage, soil fertility, acidification, carbon stocks and soil carbon sequestration potential. Impact of residue and stump removal on soil carbon and nutrient sustainability will be reviewed from long-term Whole Tree Harvesting (England) and Tree Stump Removal experiments in Scotland and Wales. Results from a review of the benefits and impacts of Short Rotation Forestry on ex-agricultural land to long term soil sustainability will also be presented. In addition, new bioenergy research studies and experimental monitoring networks in the UK will be described.



W06.01b -4

ASSESSING HARVESTING POTENTIAL AND NUTRIENT SUSTAINABILITY IN TEMPERATE FORESTS BASED ON MONITORING DATA

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Actually an increasing demand on biomass harvest exists for regenerative energy production. Nutrient export will be predominantly high for fuel-wood harvest. Thus sustainability gets a crucial question. However nutrient export with harvest is not the only and unambiguously dominant threat for nutrient sustainability, since soils in Central Europe are widely afflicted by acid deposition. Thus the biomass potential as well as nutrient budgets must be reliably, and at landscape level quantified, in order to direct increased harvesting intensity in a responsible way and maintain soil sustainability. We present results of a study a growth-region in SW-Germany with 140.000 ha forests. We derived from National Forest Inventory (NFI) the harvested biomass and from Forest Environmental Monitoring (FEM), input with deposition and weathering, as well as exports with seepage and harvest. FEM data had to be transferred to NFI sites by means of regionalized maps, based on multiple linear regression models which predicted soil properties with landscape-related predictors, explaining around 70% of their variance. Following results will be presented: the enduring fuel-wood-potential corresponds to a permanent wattage of ca. 200 MW. The mean base-cation balance (Ca+Mg+K) displays without technical compensation a deficit of 0.3-0.6 kmolcha-1a-1, depending on harvesting strategy. Element budgets are available also for micro-nutrients. If nutrients would be quantitatively brought back to forest sites through wood-ash recycling, nutrient balances can be balanced. We developed an organizational strategy and a standardized product of a mixture between dolomite rock powder and wood-ash to be used for soil protective liming.



W06.01b -5

IMPACT OF SHORT- AND VERY SHORT-ROTATION COPPICES OF POPULUS AND SALIX SPECIES ON SOIL C, N AND P CYCLING

Guénon René^[3], Bastien Jean-Charles^[2], Thiebeau Pascal^[3], Bodineau Guillaume^[2], Bertrand Isabelle^[3]

^[1]French National Institute (INRA) ~ FARE ~ Reims ~ France ^[2]French National Institute (INRA) ~ UR AGPF ~ Orléans ~ France ^[3]French National Institute (INRA) ~ UMR FARE ~ Reims ~ France

The use of plant biomass appears as an interesting alternative to fossil fuel. Thus, it is necessary to develop and validate a so-called "second-generation" bioprocess for ethanol production by using lignocellulose. Within this context, Populus and Salix which are genus of fast growing trees may be suitable as bioenergy crops grown in short rotation systems. However, the effects of these woodfuel-production systems on soil fertility, quality and microbial properties have not yet been fully evaluated. The aim of this study was to investigate the impact of short- and very short-rotation coppices (SRC=5-8 and VSRC=2-3 years of rotation) on soil organic matter dynamics through C, N and P cycling. We used a field experiment located in the center of France (Saint-Cyr-en-Val), in which both species (one for each genus) were planted in May 2010. SRC were planted at a density of 1400 stems.ha⁻¹ while it was of 8000 stems.ha⁻¹ for VSRC. Two soil horizons were characterized i.e. 0-20 cm (tillage horizon) and 20-45 cm (deep horizon) and C, N and P exportations through biomass cut were measured while the amount of these elements remaining or returning to soil (roots and leaves) were quantified to approach the elemental balance of these crops. Our results indicate that, after only 2 years, Populus culture could affect the soil microbial status and soil organic matter content, especially at low density plantation (SRC) that could lead to resource erosion and decrease soil fertility on long term.



W06.01b -6

LOGGING RESIDUE AND STUMP HARVESTING AND FOREST SOIL SUSTAINABILITY IN FINLAND

Helmisaari Heljä-Sisko^{*[1]}, Kukkola Mikko^[2], Luiro Jukka^[1], Saarsalmi Anna^[2], Tamminen Pekka^[2]

^[1]University of Helsinki ~ Dept. of Forest Sciences ~ Helsinki ~ Finland ^[2]Finnish Forest Research Institute ~ Vantaa Research Centre ~ Vantaa ~ Finland

Forest soil is the basis for renewable forest resources, but the soil itself is practically non-renewable - only organic matter from above- and belowground litter slowly accumulates in forest soil. While long-term experiments exist for studying the effects of logging residue harvesting for bioenergy (Helmisaari et al. 2011), the use of stumps is a relatively recent phenomenon, and therefore long-term studies are rare. We report recent results on changes in forest soil sustainability on long-term logging residue experiments as well as on sites where stump harvesting was made 5-10 years ago in Finland. While the major effect on soil sustainability from logging residue harvesting is in the nutrient loss, followed by a decrease in tree growth, stump harvesting poses a threat to soil physical structure. After stump removal and site preparation, the share of undisturbed soil may account only around 30% of soil surface while site preparation alone may leave twice as large area untouched. The results are discussed in relation to present guidelines.



S07.01a - SOIL ORGANIC MATTER FROM BULK TO MOLECULAR SCALE: INNOVATIVE METHODS AND APPLICATIONS

Chair Persons:

Guido Wiesenberger, Bayreuth - Germany

Jose A. Gonzalez-Perez, Sevilla - Spain

Thursday 05 July 2012 from 13:30 to 15:00. Room Leccio

S07.01a -1

SOIL CARBON STOCKS AND LOSSES IN A RECENTLY BURNT FOREST AREA IN NORTH-CENTRAL PORTUGAL

Sílvia Regina Faria, Aveiro - Portugal

S07.01a -2

CAN MOLECULAR MARKERS FOR PYROGENIC CARBON HELP TO RECONSTRUCT WILDFIRE TEMPERATURES?

Maximilian P.w. Schneider, Zurich - Switzerland

S07.01a -3

APPLICATION OF THERMAL AND SPECTROSCOPIC TECHNIQUES TO ASSESS THE STABILITY OF PYROGENIC ORGANIC MATTER IN A BURNT FOREST

Giovanni Mastrodonato, Firenze - Italy

S07.01a -4

MICROBIAL TRANSFORMATIONS OF ORGANIC ACIDS IN SOIL ASSESSED BY POSITION-SPECIFIC LABELLING OF PALMITATE AND ¹³C-PLFA ANALYSIS

Michaela Dippold, Bayreuth - Germany

S07.01a -5

DEVELOPMENT OF A NOVEL TOOL FOR SOIL SCIENCE BASED ON COMPOUND-SPECIFIC DELTA18O ANALYSES OF (HEMI-)CELLULOSE-DERIVED MONOSACCHARIDES

Mario Tuthorn, Bayreuth - Germany

S07.01a -6

HYDRATION OF SUPRAMOLECULAR SOM STRUCTURE: THE COOPERATIVE RESPONSE OF SORBATE-SOM INTERACTIONS AND THE POSSIBLE ROLE OF ORGANIC SORBATE SIZE

Mikhail Borisover, Bet Dagan - Israel



S07.01a -1

SOIL CARBON STOCKS AND LOSSES IN A RECENTLY BURNT FOREST AREA IN NORTH-CENTRAL PORTUGAL

Faria Sílvia Regina*^[1], Varela María Eufemia^[1], Pinto Renata^[1], Caria Margarida^[1], Skulska Iryna^[1], Pratts Sérgio^[1], Ferreira Raquel^[1], Esteves Valdemar^[2], Keizer Jan Jacob^[1]

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*Wildfire may cause significant changes to organic carbon stocks on the forest floor and in the topsoil. This may have important implications for the export of particulate and dissolved organic carbon from recently burnt forest areas, especially when considering the often-observed increases in runoff and erosion following fire and leaching from the ash/soil. Carbon losses by post-fire runoff, however, have been poorly studied in Mediterranean regions. The FIRECNUTS project (PTDC/AGR-CFL/104559/2008) aims to investigate, among others, the losses of organic matter and (in-)organic carbon by runoff in recently burnt areas, also in relation to topsoil stocks. The study area is located in north-central Portugal. It was burnt by a wildfire in the summer of 2010, affecting some 250 ha of forest plantations of Maritime Pine (*Pinus pinaster*) and especially eucalypt (*Eucalyptus globulus*). Monitoring began before the occurrence of significant rainfall and has since been carried out at regular intervals (at 1- to 2-weekly intervals), both in microplots (0.28 m²) and at the slope scale (83-170 m²). (In-)organic carbon was analyzed using a Shimadzu TOC Analyser. This presentation will focus on the results for dissolved (in-)organic carbon content of the runoff generated during the first year following the wildfire. Higher concentrations were found in burnt pine stands when compared with burnt eucalypt stands, which is possibly due to differences in post-fire litter cover from scorched leave/needles and/or to differences in runoff rates. Concentrations decreased with time at all study sites, pointing to the exhaustion of the carbon stock available for export.*



S07.01a -2

CAN MOLECULAR MARKERS FOR PYROGENIC CARBON HELP TO RECONSTRUCT WILDFIRE TEMPERATURES?

Schneider Maximilian P.w.^{*[1]}, Hockaday William C.^[2], Masiello Caroline A.^[3], Schmidt Michael W.i.^[1]

^[1]University of Zurich ~ Department of Geography ~ Zurich ~ Switzerland ^[2]Baylor University ~ Department of Geology ~ Waco, Texas ~ United States ^[3]Rice University ~ Department of Earth Sciences ~ Houston, Texas ~ United States

The maximum temperature experienced by charcoals strongly influences relevant properties, such as sorption capacity and degradability. Yet information about the formation temperature of natural charcoal is difficult to obtain. Benzenepolycarboxylic acids (BPCA) are molecular markers specific for pyrogenic carbon (PyC) and are used to quantify PyC in soils, sediments and oceans. Additionally to quantitative information, BPCA provide information on the degree of aromatic condensation in charcoals. We calibrated this “molecular thermometer” by using a thermosequence of charcoals produced at temperatures from 200 to 1000°C under controlled laboratory conditions. So far it is not clear how other factors during pyrolysis, such as availability of oxygen, moisture and exposition time, influence the resulting molecular marker pattern. Here we apply the molecular marker method to a set of 10 charcoals produced during a controlled burn experiment, which was conducted at the US Forest Service Silas Little Experimental Forest, located near New Lisbon, New Jersey. The charred samples were derived from litter and bark of pitch pine and inkberry plants. Thermo-sensitive paints were used to keep record of the maximum temperature that a sample experienced during the fire event. Maximum temperatures of 260 to 650°C were monitored, which are typical temperatures for wildfires and which is well within the calibrated temperature range of the thermosequence charcoals. We compare the estimated formation temperatures derived from molecular marker patterns with those measured by the thermo-sensitive paints. Our results show if the “molecular thermometer” can be used to estimate the formation temperature of natural charcoals.



S07.01a -3

APPLICATION OF THERMAL AND SPECTROSCOPIC TECHNIQUES TO ASSESS THE STABILITY OF PYROGENIC ORGANIC MATTER IN A BURNT FOREST

Mastrolonardo Giovanni^[1], Francioso Ornella^[2], Di Foggia Michele^[3], Bonora Sergio^[3], Certini Giacomo^[1]

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Fire events generally are considered as a major disturbance factor in forest ecosystems. The high temperatures may irreversibly alter physical, chemical, and biological soil properties. Fire can totally oxidise soil organic matter (SOM), however, under environmental conditions, the combustion is often incomplete, leading to formation of rearranged macromolecules, with prevailing aromatic nature and characterised by marked recalcitrance to degradation. In a burnt pine forest in Tuscany, Central Italy, we sampled the charcoal layer formed onto the ground and the top ten cm of mineral soil. The latter and the litter layer were sampled in an adjacent unburnt area similar to the burnt one prior to the wildfire occurrence. The aim of our work was to evaluate, combining thermal and spectroscopic analyses, how much fire may influence the biogeochemical stability of SOM. The composition of the intact litter, the charcoal on the ground and the SOM from the mineral soil were analysed by attenuated total reflectance/Fourier transform infrared (ATR/FT-IR), solid-state ¹³C nuclear magnetic resonance (NMR) spectroscopy, thermogravimetric (TG-DTG), and differential scanning calorimetry (DSC) analysis. Such analytical techniques were used to assess the effect of fire at molecular level, so as to infer the thermal and biochemical stability of the investigated organic pools. Overall, our findings showed that the wildfire, although of moderate intensity, had modified tremendously the chemical structure of the residual SOM, making it little appetizing to the heterotrophic organisms and, hence, able to stay for a long time in soil.



S07.01a -4

MICROBIAL TRANSFORMATIONS OF ORGANIC ACIDS IN SOIL ASSESSED BY POSITION-SPECIFIC LABELLING OF PALMITATE AND ¹³C-PLFA ANALYSIS

Dippold Michaela^{*[4]}, Glaser Bruno^[2], Kuzyakov Yakov^[3]

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^[3]Georg-August-University of Göttingen ~ Soil Science of Temperate Ecosystems ~ Göttingen ~ Germany ^[4]University of Bayreuth ~ Departement of Agroecosystem Research ~ Bayreuth ~ Germany

Transformation of monomeric organic substances in soil is an important process in soil, as all high molecular substances pass this stage during decomposition. Using organic monomers as biomarkers requires their unmodified stabilization, but microbial transformation of lipid biomarkers is hardly investigated. We assessed transformations of palmitic acid by injecting position-specifically labeled ¹³C-palmitate into soil. Microbial utilization was quantified by chloroform-fumigation-extraction. ¹³C-PLFA revealed utilization and transformation of palmitic acid by microbial groups. After ten days, the maximum of palmitic acid incorporation into microbial biomass (<10% of added label) and PLFA (<0.1%) was not reached, yet. The C1-group was preferentially decarboxylated. Incorporation was highest in 16:0-PLFA, as 16:0-fatty acid is a lipid precursor in metabolism, but transformation to a broad range of microbial fatty acids was detected. Position-specific labeling and its coupling with compound-specific analyses allow conclusions about the mechanisms and kinetics of microbial utilization and reveals transformation of biomarkers in soils.



S07.01a -5

DEVELOPMENT OF A NOVEL TOOL FOR SOIL SCIENCE BASED ON COMPOUND-SPECIFIC DELTA18O ANALYSES OF (HEMI-)CELLULOSE-DERIVED MONOSACCHARIDES

Tuthorn Mario^{*[1]}, Bruno Glaser^[2], Michael Zech^[4]

^[1]University of Bayreuth ~ Department of Soil Physics and Chair of Geomorphology ~ Bayreuth ~ Germany ^[2]Martin-Luther University Halle-Wittenberg ~ Department of Soil Biogeochemistry ~ Halle ~ Germany ^[3]Martin-Luther University Halle-Wittenberg and University of Bayreuth ~ Department of Soil Biogeochemistry ~ Bayreuth ~ Germany ^[4]Martin-Luther University Halle-Wittenberg and University of Bayreuth ~ Department of Soil Biogeochemistry, Department of Soil Physics and Chair of Geomorphology ~ Halle and Bayreuth ~ Germany

Compound-specific stable carbon, nitrogen and hydrogen analyses of molecules extracted from soil organic matter have become invaluable tools in soil science and paleoclimate research, respectively, during the last approximately 15 years. By contrast, although technical improvements allow the coupling of gas chromatographs with isotope ratio mass spectrometers via online pyrolysis reactors (GC-Py-IRMS) also for 18O analyses this technique is hardly applied by researchers, so far. We see large potential for this method in soil science, especially when combined with palaeoclimate research, because it is well known that not only deltaD, but also delta18O of precipitation and of certain chemical compounds of plants (e.g. cellulose) depend on climate parameters. In a first analytical step, we extract hydrolytically from soil, sediment or plant samples the monosaccharides such as arabinose, fucose, xylose and rhamnose. In a second analytical step, we derivatise the monosaccharides, thus making them GC-amenable. Compound-specific delta18O measurements are finally carried out using GC-Py-IRMS (Zech, M. and Glaser, B., 2009, RCMS 23, 3522-3532). Theoretical considerations and experimental results demonstrate that oxygen exchange reactions do neither occur to (hemi-)cellulose monosaccharides in natural archives nor during our analytical workup (Zech et al., 2011, OrgGeochem, in press). First results from applications of the novel method are presented for a 240 ka paleosol sequence in NE-Siberia and for Late Glacial and Holocene high mountain lake sediment cores from Helambu Himal, Nepal. Accordingly, delta18O variations of hemicellulose sugars reflect the two last glacial-interglacial cycles and record the variability of the Indian Summer Monsoon, respectively.



S07.01a -6

HYDRATION OF SUPRAMOLECULAR SOM STRUCTURE: THE COOPERATIVE RESPONSE OF SORBATE-SOM INTERACTIONS AND THE POSSIBLE ROLE OF ORGANIC SORBATE SIZE

Borisover Mikhail^[1], Sela Maggie^[1], Chefetz Benny^[2]

^[1]The Volcani Center, Agricultural Research Organization ~ Institute of Soil, Water and Environmental Sciences ~ Bet Dagan ~ Israel ^[2]The Hebrew University of Jerusalem ~ The Department of Soil and Water Sciences, the Faculty of Agriculture, Food and Environment ~ Rehovot ~ Israel

Soil organic matter (SOM) controls distributions of multiple organic compounds between different environmental compartments. The role of SOM-associated water in sorbate-SOM interactions is not well understood, in contrast to the role of solute-bulk water interactions. Supramolecular SOM structure presumes a complexed response of organic sorbate-SOM interactions to the SOM hydration. Therefore, the SOM-associated water may affect organic compound – SOM interactions in a cooperative manner. This becomes evident as the power function increase in organic compound sorption with increasing water activity. Such a cooperativity reflects a participation of several solvent molecules in disruption of multiple interactions in the supramolecular SOM structure. Using the data on sorption of organic compounds on the differently hydrated organic matter-rich peat chosen as a model SOM sorbent, this paper examines the cooperative involvement of water in interactions between SOM and one probe organic sorbate, carbamazepine (CBZ), and compares it with the earlier studied phenol-SOM interactions. In comparison with a smaller-size organic sorbate, CBZ needs more SOM-associated water in order to demonstrate the strengthening of interactions with SOM, and, when started, this strengthening rises more steeply with water activity. Therefore, for penetration of the larger sorbate molecules into the SOM interior, a greater number of water molecules are needed to compensate for the local SOM disintegration thus suggesting the greater extent of the cooperativity in the involvement of water molecules in the organic compound-SOM interactions. This comparison provides an insight into the significance of the structural organization of SOM for its potential to sequester organic molecules.



S07.01b - SOIL ORGANIC MATTER FROM BULK TO MOLECULAR SCALE: INNOVATIVE METHODS AND APPLICATIONS

Chair Persons:

Eileen Eckmeier, Bonn - Germany

Francisco J. Gonzalez-Vila, Sevilla - Spain

Thursday 05 July 2012 from 15:30 to 17:15. Room Leccio

S07.01b -1

MICROBIAL DEGRADATION OF ORGANIC COMPOUNDS (NATURAL COMPOUNDS, XENOBIOTICS, AND PESTICIDES) AND THE FORMATION OF SOIL ORGANIC MATTER OR BIOGENIC NON-EXTRACTABLE RESIDUES

Matthias Kaestner, Leipzig - Germany

S07.01b -2

QUANTITATIVE AND QUALITATIVE CHARACTERISTICS OF SOM-FRACTIONS OBTAINED FROM CHEMICAL AND DENSITY FRACTIONATION

Marie I. Ludwig, Trier - Germany

S07.01b -3

USEFULNESS OF ³¹P NMR TO ELUCIDATE PHOSPHATE-METAL-HUMIC COMPLEXES IN COMPLICATED MINERAL AND ORGANO-MINERAL MATRIXES

Roberto Baigorri, Orkoien - Spain

S07.01b -4

NEW SYNTHETIC AND SEMISYNTHETIC APPLICATIONS TO MODIFY STRUCTURE OF SOIL HUMIC MATTER

Antonio Nebbioso, Portici - Italy

S07.01b -5

EFFECT OF TEMPERATE ALLEY CROPPING SYSTEM ON SOME SOIL PROPERTIES IN SOUTH EASTERN TURKEY

Recep Gundogan, Kahramanmaras - Turkey

S07.01b -6

METABOLIC PROCESSING OF N AND C FROM INDIVIDUAL AMINO ACIDS AND WHOLE DUNG: A COMPOUND-SPECIFIC DUAL STABLE ISOTOPE PROBING APPROACH.

Timothy Knowles, Bristol - United Kingdom



S07.01b -7

COMBINING ANALYTICAL TECHNIQUES FOR SOIL ORGANIC MATTER CHARACTERIZATION IN THE FRENCH PREALPS: PARTICLE-SIZE FRACTIONATION, ROCK-EVAL PYROLYSIS AND MID-INFRARED SPECTROSCOPY

Anais Saenger, Grenoble - France



S07.01b -1

MICROBIAL DEGRADATION OF ORGANIC COMPOUNDS (NATURAL COMPOUNDS, XENOBIOTICS, AND PESTICIDES) AND THE FORMATION OF SOIL ORGANIC MATTER OR BIOGENIC NON-EXTRACTABLE RESIDUES

Kaestner Matthias^[1], Anja Miltner^[1]

^[1]Helmholtz-Centre for Environmental Research ~ Environmental Biotechnology ~ Leipzig ~ Germany

Carbon from biodegradable organic compounds in soil divides into parent compound, metabolites, non-extractable residues (NER), CO₂, and microbial biomass. This distribution must be considered for assessing the compound fate in soil. The formation and composition of soil organic matter (SOM) or humic compounds is a long lasting topic in soil science but the processes are still not yet understood. For decades, humic substances were considered as a novel category of cross-linked organic materials. However, recent results identified microbial biomass as a significant source for SOM. Using ¹³C-labelled bacterial cells incubated in agricultural soils and tracing the fate of the label of bacterial biomass components in soil, a high percentage of the biomass carbon remains in the non-living SOM. These residues could be visualised by scanning electron microscopy (SEM) as fragmented bacterial cell walls debris of 200-500 nm size in various stages of decay and fragmentation. The results provide a simple explanation for the development of nano-scale patchy organic materials observed in soil SEM/TEMs. In addition to small plant debris, microstructures of microbial cell wall debris and thus provide the molecular architecture of SOM. This origin and macromolecular architecture of SOM is consistent with most observations on SOM, e.g. the abundance of biomarkers, the low C/N ratio, the water repellency, the stabilisation of biomolecules, and the formation of some NER from pesticides. This was confirmed by analyzing the NER from several labeled pesticides in soil, which indicates that virtually all of the NER of the compounds are derived from microbial biomass.



S07.01b -2

QUANTITATIVE AND QUALITATIVE CHARACTERISTICS OF SOM-FRACTIONS OBTAINED FROM CHEMICAL AND DENSITY FRACTIONATION

Ludwig Marie I.^{*[1]}, Hens Sabina^[1], Bierl Reinhard^[2], Leinweber Peter^[3], Thiele-Bruhn Sören^[1]

^[1]Trier University ~ Soil Science ~ Trier ~ Germany ^[2]Trier University ~ Hydrology ~ Trier ~ Germany ^[3]Rostock University ~ Soil Science ~ Rostock ~ Germany

Various fractionation schemes and chemical extraction methods have been developed to quantify and qualify soil organic matter (SOM) and are reported in the literature. Hence, various procedures exist to isolate e.g. labile and recalcitrant fractions of SOM. However, only few studies explored the properties and the comparability of fractions obtained by different methods. This study compares two fractionation methods, i.e. density fractionation by sodium polytungstate SPT (Na₆(H₂W₁₂O₄₀)) and chemical fractionation by sodium hypochlorite (NaOCl). In particular, the focus is on the comparison of the mineral fraction (>2.0 g/cm³) gained from density fractionation with the respective NaOCl fraction. To investigate this even further, density fractions >2.0 g/cm³ were additionally treated with NaOCl. It is hypothesised that both methods identify the same recalcitrant fraction of SOM in different soil samples. Furthermore, quantitative parameters such as total carbon (C_t) and total nitrogen (N_t) have been determined. Spectra of Fourier-Transform-Infrared-Spectrometry (DRIFT-FTIR) and of pyrolysis-field ionisation mass spectrometry (Py-FIMS) of all fractions have been recorded. Results show that the chemical characteristics of fractions, although conformally defined as the stable, recalcitrant fraction, differ widely depending on the fractionation method used. Other than SPT density fractionation, NaOCl as a highly oxidative agent tends to eliminate specific chemical components of SOM. The combination of data from FTIR and Py-FIMS analyses provides detailed information on these changes.



S07.01b -3

USEFULNESS OF ^{31}P NMR TO ELUCIDATE PHOSPHATE-METAL-HUMIC COMPLEXES IN COMPLICATED MINERAL AND ORGANO-MINERAL MATRIXES

Baigorri Roberto^{*[1]}, Urrutia Oscar^[1], Erro Javier^[1], Mandado Marcos^[2], García-Mina José María^[1]

^[1]Timac Agro Int-Roullier Group ~ R&D Department (CIPAV) ~ Orkoien ~ Spain ^[2]University of Vigo ~ Physical-Chemistry Department ~ Vigo ~ Spain

Phosphate-Metal-Humic complexes play an important role in the interaction between soil solution and root system in the rhizosphere. Thus, the characterization of these complexes in complicated matrixes is very important and some authors have applied ^{31}P NMR to characterize Phosphate-Metal-Humic (PMH) complexes. They observed that the complexation process was related to significant changes in the width of phosphate-related peak. These authors associated this broadening with distortion effects on the coordination sphere of phosphate by humic-binding sites through metal bridges. In this work, we have applied ^{31}P NMR to study the formation of PMH complexes in two closely-related, but different fertilizer matrixes: Single super-phosphate (SSP) and Triple super-phosphate (TSP). Before carrying out these studies, we confirmed both the theoretical chemical viability and the complexing binding process by using Molecular Modelling and Fluorescence Spectroscopy. The ^{31}P NMR revealed that this technique may be useful to characterize PMH complexes. However, the data interpretation is not as clear as it was proposed in previous works. Our experiments showed that complex formation has different effects on phosphorus-related peak distribution and features, depending on the mineral matrix (SSP or TSP). We observed that complex formation causes an increase in the width of the peak associated with monocalcium phosphate in SSP matrix whereas in TSP matrix the effect was just the opposite, a decrease in the width of this peak. We discuss these results and propose a hypothesis to explain these differences in ^{31}P NMR spectra associated with PMH complex formation in SSP and TSP fertilizer matrixes.



S07.01b -4

NEW SYNTHETIC AND SEMISYNTHETIC APPLICATIONS TO MODIFY STRUCTURE OF SOIL HUMIC MATTER

Nebbioso Antonio^[5], Piccolo Alessandro^[6], Spiteller Michael^[3], Lamshöft Marc^[3]

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Macromolecules are synthesized by Biota for structural scaffolding, metabolic reservoir, catalytic activity or conservation and expression of genetic information. It is significant that Biochemistry prefers formation of reversible bonds between small building blocks in synthetic pathways of biomacromolecules. Chemical compliance to this approach is nowadays desirable, in order to moderate environmental impacts. The research of such a synthetic strategy has brought a new concept in chemical synthesis: "Click Chemistry". For a reaction to comply with Click approach it is required: i. high yields ; ii. favourable kinetics; iii. mild reaction conditions; iv. absence of toxic byproducts; v. cost efficiency of reagents and vi. compatibility with water solutions. In an attempt to modify soil humic substances with a "Click Chemistry" approach, an alkynyl alcohol was esterified with carboxyl groups of an organosoluble fraction from peat humic acid through ester formation. The freshly introduced triple bonding was then conjugated with a hydrophilic azidoamine via 1,3 dipolar cycloaddition. The result was a humic molecule with improved hydrophilicity and positive ionizability. The adducts were characterized via HPSEC hyphenated to Electrospray-Orbitrap Mass Spectrometry. Several formulae were found attributable to Click products from short (C8) and long chained (C>20) carboxylic acids, albeit with low yields. Surprisingly, humic molecules conjugates of average length (C16-18) were not observed. Tandem MS was also used for structural clarification and rule out amine-ester transposition. We showed a Click chemistry application for cheap, easy, and flexible modification of humic substances and may represent an advanced supramolecular engineering for soil humic matter.



S07.01b -5

EFFECT OF TEMPERATE ALLEY CROPPING SYSTEM ON SOME SOIL PROPERTIES IN SOUTH EASTERN TURKEY

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Intensive tillage and erosion lead to soil degradation in Pistachio orchard on slopping area in South east Turkey. Although it is not widespread practice because of concern of severe competition for water and nutrients, barley and legumes are grown for grain and forage production between pistachio and olive orchard in southeast Turkey. The study was carried out in an alley cropping system with forage crops (vetch, barley and vetch barley mixture) and Pistachio in 2008 to 2011 at South East. Soil properties includes soil organic matters, particle size, agregat stability, pH, CEC, total nitrogen are sampled at 0-15 cm depth and prior to seedling and after harvesting every year. The results show that there were no statistical differences between control and forage crops treatments. This study suggests that alley cropping effect on soil properties do not reveals in through three-year treatments. So these works should be extend much more year in order to reveal the plants effect on soil properties.



S07.01b -6

METABOLIC PROCESSING OF N AND C FROM INDIVIDUAL AMINO ACIDS AND WHOLE DUNG: A COMPOUND-SPECIFIC DUAL STABLE ISOTOPE PROBING APPROACH.

Knowles Timothy^{*[1]}, Chadwick David^[2], Bol Roland^[2], Evershed Richard^[1]

^[1]University of Bristol ~ Organic Geochemistry Unit, School of Chemistry ~ Bristol ~ United Kingdom ^[2]Rothamsted Research, North Wyke ~ North Wyke ~ Okehampton ~ United Kingdom

The availability of biologically accessible forms of N influences the diversity, dynamics and functioning of many ecosystems including soils. Organic N represents the vast majority of natural N inputs to soils and of these, proteins, peptides and amino acids are the most significant. A grassland soil was incubated with dual ¹⁵N,¹³C-labelled substrates (glutamate, glycine and cow dung) in separate incubations, enabling the fate of their N and C to be followed independently over a time course (between 3 h and 32 d). A molecular level approach was adopted throughout, whereby chemically and isotopically defined substrates were added to soil before isotopic analyses of individual soil amino acids, respired CO₂ and bulk soil. Compound-specific N and C isotope analyses of soil amino acids after the addition of individual amino acid substrates revealed highly conservative biochemical processing of these substrates by the soil microbial community. Moreover, a significant decoupling of the soil N and C cycles was demonstrated at the amino acid level, whereby the disparate fates of C and N from substrates in which they were covalently linked are clearly apparent. This approach was extended to investigations into the physical transport and biochemical transformations of dung-derived N and C after its addition to soil. Results revealed valuable information regarding the transport processes involved in dung matter incorporation into soil and significantly, the chemical forms in which it is transported and biochemical fate once within the soil.



S07.01b -7

COMBINING ANALYTICAL TECHNIQUES FOR SOIL ORGANIC MATTER CHARACTERIZATION IN THE FRENCH PREALPS: PARTICLE-SIZE FRACTIONATION, ROCK-EVAL PYROLYSIS AND MID-INFRARED SPECTROSCOPY

Saenger Anais^[1], Cecillon Lauric^[1], De Danieli Sebastien^[1], Brun Jean-Jacques^[1]

^[1]CEMAGREF ~ Mountain Ecosystems ~ Grenoble ~ France

Our objective was 1/ to characterize soil organic matter (SOM) under different land uses in the French calcareous Prealps by comparing three analytical approaches: the particle-size fractionation of soil organic matter, the Rock-Eval pyrolysis and the Fourier transform mid infrared (FT-MIR) spectroscopy and 2/ to relate structural characteristics of SOM to soil properties. We sampled the humiferous episolum (0-6 cm depths) on 127 sites including coniferous forest, mountainous grasslands and alpine meadows in the Vercors Regional Park during summer 2009 and 2010. The Rock-Eval pyrolysis opens interesting prospects for soil science but surprisingly its application remains very limited. This technique provides valuable information on the bulk composition and the stage of maturation of SOM and brings us to discuss the concept of recalcitrance for SOM stabilization. The particle-size fractionation (Feller, 1979) gives access to SOM pools and allows discussing the importance of physical protection mechanisms for SOM stabilization. The FTIR spectroscopy method brings precious insights on the chemical composition of SOM in these different fractions. We conclude that these techniques are very complementary and provide information at varying angles on the quality and dynamics of SOM in these mountain ecosystems.

S07.02 - INNOVATION AND SOIL SCIENCE - APPLICATION OF ADVANCED NMR AND MRI TECHNIQUES FOR IMPROVING OUR UNDERSTANDING OF SOIL ORGANIC MATTER FORMATION AND ITS INTERACTION WITH THE MINERAL PHASE

Chair Persons:

Anne Berns, Jülich - Germany

Heike Knicker, Sevilla - Spain

Tuesday 03 July 2012 from 08:30 to 10:00. Room Mirto

S07.02 -1

SORPTION SELECTIVITY OF NEUTRAL ORGANIC COMPOUNDS BY SOIL ORGANIC MATTER PROBED WITH NITROXYL PARAMAGNETIC NMR RELAXATION PROBES

Joseph Pignatello, New Haven, Connecticut - United States

S07.02 -2

ONE AND TWO DIMENSIONAL SOLID STATE NMR TECHNIQUES APPLIED TO STUDY THE STRUCTURE AND RIGIDITY OF SOIL ORGANIC MATTER (SOM)

Alexander Jäger, Leipzig - Germany

S07.02 -3

NEW NMR APPROACHES FOR UNRAVELLING COMPOSITION AND TURNOVER OF SOIL COMPONENTS

Jürgen Schleucher, Umea - Sweden

S07.02 -4

COMPREHENSIVE MULTIPHASE NMR: A POWERFUL NEW APPROACH FOR UNDERSTANDING CONTAMINANT SORPTION AND SEQUESTRATION IN WHOLE FULLY SWOLLEN SOILS

Denis Courtier-Murias, Toronto - Canada

S07.02 -5

RELAXOMETRY PROPERTIES OF WATER SATURATED LIGNIN CHARS

Pellegrino Conte, Palermo - Italy

S07.02 -6

MEASUREMENT AND QUANTIFICATION OF HETEROGENEITY, FLOW, AND MASS TRANSFER IN POROUS MEDIA USING NMR LOW-FIELD TECHNIQUES

Eva Paciok, Aachen - Germany



S07.02 -1

SORPTION SELECTIVITY OF NEUTRAL ORGANIC COMPOUNDS BY SOIL ORGANIC MATTER PROBED WITH NITROXYL PARAMAGNETIC NMR RELAXATION PROBES

Pignatello Joseph^{*[1]}, Lattao Charisma^[1], Li Yuan^[3], Cao Xiaoyan^[3], Mao Jindong^[3], Chappell Mark^[4], Miller Lesley^[4]

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This study aimed to address the question of whether or not there are preferred sites of sorption of organic compounds to soil organic matter (SOM) on the basis of functional group chemistry and/or domain character. C-CP/TOSS NMR spectra were acquired for stable nitroxyl free radical probes, HTEMPO (1-oxyl-2,2,6,6-tetramethyl-4-hydroxypiperidine) and TEMPO (2,2,6,6-tetramethylpiperidine-1-oxyl) sorbed to Pahokee Peat (Florida), the soft coal Beulah Zap lignite (North Dakota), and polystyrene-polyvinylmethylether (PS/PVME), a 50:50 polymer blend homogeneous on the 1 nm scale. Polydimethylsilane was used as an inert internal standard. These probes interact through van der Waals and weak H-bonding forces and induce relaxation due to strong electron-nuclear spin interactions. The result is attenuation of ¹³C signal that is within 1 nm radius of the sorbed molecule. Titration of the solids with spinprobes, therefore, reveals preferential sorption sites by the concentration rate of change of signal suppression. With SOM or PS-PVME we find little to no selectivity for probes on the basis of functional group identity (polymethylene, polar aromatic, nonpolar aromatic, polar aliphatic, carboxylic) indicating that the composition of SOM surrounding individual sorbed molecules is, on average, fairly homogeneous. Furthermore, the small black carbon content of these samples appears not to play a strong role in sorption. Thus, site selectivity more likely is a function of the thermodynamic physical state of SOM vis the configurations and conformations of the SOM strands at the microstructural level. This work demonstrates for the first time the use of free radical molecular probes to study sorption specificity.



S07.02 -2

ONE AND TWO DIMENSIONAL SOLID STATE NMR TECHNIQUES APPLIED TO STUDY THE STRUCTURE AND RIGIDITY OF SOIL ORGANIC MATTER (SOM)

Jäger Alexander^{*[1]}, Bertmer Marko^[1], Schaumann Gabriele E.^[2]

^[1]Universität Leipzig ~ Fakultät für Physik und Geowissenschaften ~ Leipzig ~ Germany ^[2]Universität Koblenz-Landau ~ Institut für Umweltwissenschaften ~ Landau ~ Germany

With solid state NMR experiments, carried out on soil samples using one and two dimensional static and magic angle spinning (MAS) techniques, one can obtain various types of information on soil organic matter (SOM) such as chemical structure, soil rigidity or interaction of soil components with water. A main focus of our work are effects of water network disruption, making use of a $1H$ wide line decomposition scheme that straightforwardly yields results on the amount of water in hydrogen bonding networks. Different soils as well as variations due to atmospheric humidity, cation content with different valency, and temperature can be identified and the long term behaviour can be followed in a time range of weeks to months. To overcome the limited resolution of $1H$ MAS spectra, we apply advanced 2D phase modulated Lee-Goldburg (PMLG) $1H$ - $1H$ correlation experiments on soils to identify and quantify signals of different functional groups in short time and identify interactions between functional groups via exchange experiments. In ^{13}C NMR spectra we focus on the temperature dependence of poly(methylene) signals coming from two conformations, trans and gauche. After temperature treatment of soil, differences caused by the cooling procedure have been observed afterwards, that are to some extent in contradiction to observations for pure polymers. Finally, ^{27}Al MAS and MQMAS (multiple-quantum) NMR spectroscopy can identify clay formations such as montmorillonite or kaolinite. But more so we are interested in the effects of cations within the water-bonding network where Al^{3+} ions are supposed to act as mediators between water molecules and SOM segments.



S07.02 -3

NEW NMR APPROACHES FOR UNRAVELLING COMPOSITION AND TURNOVER OF SOIL COMPONENTS

Schleucher Jürgen^[1], Nilsson Mats^[2], Harrysson-Drotz Stina^[2], Vestergren Johan^[3], Vincent Andrea^[4], Ilstedt Ulrik^[2], Giesler Reiner^[4], Gröbner Gerhard^[3], Persson Per^[3]

^[1]Umea University ~ Medical Biophysics ~ Umea ~ Sweden ^[2]SLU ~ Forest Ecology ~ Umea ~ Sweden ^[3]Umea University ~ Chemistry ~ Umea ~ Sweden ^[4]Umea University ~ Ecology and Environmental Sciences ~ Umea ~ Sweden

NMR is a key method to characterize environmental species on a molecular level. We present several examples how insights into soil processes can be obtained using new NMR approaches. Frozen soils still emit greenhouse gases, but these emissions cannot yet be modeled. Using 2H NMR (Sparman et al ES&T 2004) to quantify the remaining liquid water in frozen soils, we can separate the influences of water availability and of the biochemical temperature response on CO₂ evolution (Öquist et al GCB 2009). Incubating soils with 13C-labeled substrate and detecting the label by 13C NMR, we demonstrate that microbial metabolism under frozen conditions is slower but otherwise not significantly different from unfrozen conditions (Öquist et al PNAS 2010). Phosphorus is of paramount importance for productivity in natural ecosystems and agriculture. Organic P species constitute a major fraction of soil P, but little is known about their turnover and bioavailability. Commonly used 31P NMR can often not resolve individual phosphomonoesters. We demonstrate how 2D NMR can be developed to unambiguously identify organic P species (submitted), allowing to define sources and determinants of bioavailability of individual P species (Vincent et al Biogeochemistry 2011). Intramolecular distributions of stable heavy isotopes, measured by NMR, are powerful tools to define plant metabolic fluxes (Augusti et al New Phytol 2006), and allow reconstruction of climate and physiological signals over centuries (Augusti et al Chem. Geol 2008). Based on the same principles, we will present a new approach to identify sources of soil constituents, and to elucidate their turnover.



S07.02 -4

COMPREHENSIVE MULTIPHASE NMR: A POWERFUL NEW APPROACH FOR UNDERSTANDING CONTAMINANT SORPTION AND SEQUESTRATION IN WHOLE FULLY SWOLLEN SOILS

Courtier-Murias Denis^[1], Longstaffe James G.^[1], Soong Ronald^[1], Botana Adolfo^[1], Farooq Hashim^[1], Masoom Hussain^[1], Simpson Myrna^[1], Simpson André J.^[1]

^[1]University of Toronto ~ Department of Chemistry ~ Toronto ~ Canada

Contaminants can persist and accumulate in the terrestrial environment as they tend to strongly associate with soil organic matter. The success of current remedial strategies is impeded by an incomplete understanding of the mechanisms of their sorption and sequestration. One of the obstacles to a better understanding is the reality that soils contain liquid-, gel- and solid-like phases and that it is the combined effects of these phases that determine their environmental properties. Studying each phase separately can perturb the sample, therein removing important chemical information about the gel-solid interface, kinetics across phase boundaries, and conformation in the natural state. Here, a newly developed Nuclear Magnetic Resonance (NMR) hardware termed Comprehensive Multiphase (CPM)-NMR Spectroscopy is described. CMP-NMR combines all aspects of solid-state, liquid-state and gel-phase NMR (HR-MAS) into a single NMR probe permitting all bonds in all phases in an intact and unaltered sample to be observed. Using Comprehensive Multiphase (CPM)-NMR Spectroscopy signals from liquid-, gel- and solid-like phases can be differentiated in whole soils. Contaminants that do not bind to soil can be studied using T2-filtered and “inverse” diffusion editing (DE) experiments. Those pollutants that weakly interact can be monitor using DE and “inverse” T2-filtered experiments. Finally, immobile contaminants in solid phases can be observed using CP/MAS and REDOR type experiments. We demonstrate that kinetics, molecular orientation of the contaminant, and the types of organic matter in soil (lignin, protein, cellulose, etc.) to which the contaminant binds can be determined using CMP-NMR.



S07.02 -5

RELAXOMETRY PROPERTIES OF WATER SATURATED LIGNIN CHARs

Conte Pellegrino^{*[1]}, Knicker Heike^[2], Berns Anne E.^[3]

^[1]Università degli Studi di Palermo ~ Dipartimento dei Sistemi Agro-Ambientali ~ Palermo ~ Italy ^[2]Instituto de Recursos Naturales y Agrobiología de Sevilla (IRNAS-CSIC) ~ Departamento: Geoecología, Biogeoquímica y Microbiología Ambiental ~ Sevilla ~ Spain ^[3]Forschungszentrum Jülich GmbH ~ Institute of Bio- and Geosciences IBG-3: Agrosphere ~ Jülich ~ Germany

Char is a very important organic system due to its role in affecting physical and chemical soil properties. In fact, it is reported that char has a positive effect on soil texture, pH, ionic exchange capacity and water retention. In the present study two chars were produced by heating lignin at 350°C for 30 and 240 s and were saturated with deionized water. Spin-spin relaxation time (T_2) measurements revealed that two different types of water molecules were present in both chars: a longer T_2 attributed to bulk water and a shorter T_2 assigned to bound water. Noteworthy, both T_2 values measured for the water in the 240 s char were longer than the respective T_2 values for the 30 s char sample. This discrepancy was attributed to the nature of the two different chars. In fact, the char obtained after 30 s heating still contained un-charred lignin molecules capable of strongly binding water molecules through formation of hydrogen bonds. Conversely, the char obtained after 240 s heating did not contain a lot of un-charred molecules, thereby favoring higher mobility degree of water molecules. NMR dispersion (NMRD) profiles confirmed the aforementioned findings through the evaluation of the correlation times. Relaxometry appeared a very suitable technique for the understanding of water dynamics in char samples. This is a very important issue since a prediction of water mobility in soils treated with different chars can be attempted.



S07.02 -6

MEASUREMENT AND QUANTIFICATION OF HETEROGENEITY, FLOW, AND MASS TRANSFER IN POROUS MEDIA USING NMR LOW-FIELD TECHNIQUES

Paciok Eva^[1], Haber Agnes^[1], Perlo Josefina^[1], Maria Alexandra Olaru^[1], Van Landeghem Maxime^[1], Sabina Haber-Pohlmeier^[1], Sucre Oscar^[1], Casanova Federico^[1], Blümich Bernhard^[1]

^[1]Institute for Technical and Macromolecular Chemistry, RWTH Aachen University ~ Macromolecular Chemistry ~ Aachen ~ Germany

In this work, we present our recent progress in mobile low-field NMR probe design for field measurements of natural soils: a slim-line logging tool, which can be rammed into the soil of interest on-site. The performance of the device is demonstrated in measurements of moisture profiles of model soils and field measurements of relaxometric properties and moisture profiles of natural soils. Furthermore, we present our recent results in 2D exchange relaxometry and simulation. These include relaxation-relaxation experiments on natural soils with varying degree of moisture saturation, where we could draw a connection between the relaxometric properties of the soil to its pore size-related diffusivity and to its clay content, and relaxation-relaxation experiments on flow through porous media. Also, models, simulations and possibilities are discussed to derive from the so obtained information a “characteristic pore shape” that can be used to characterize and to fingerprint natural soils.

S07.03a - MOLECULAR DYNAMICS OF SOIL ORGANIC MATTER: CHALLENGES, OPPORTUNITIES AND LIMITS

Chair Persons:

Boris Jansen, Amsterdam - Netherlands

Ingrid Kögel-Knabner, Muenchen - Germany

Thursday 05 July 2012 from 08:30 to 10:00. Room Biancospino

S07.03a -1

SCALING DOWN TO MOLECULES TO MODEL SOIL ORGANIC MATTER DYNAMICS:
APPLICATION TO CARBOHYDRATE AND LIPIDS

Chabi Fabrice Elegbede, Nancy - France

S07.03a -2

COMPOUND-SPECIFIC ¹³C & ¹⁴C ANALYSIS OF SOIL LIPIDS ALONG A SAVANNA
(C4)/EUCALYPTUS (C3) CHRONOSEQUENCE (POINTE-NOIRE, CONGO): NEW INSIGHTS TO
RESOLVE SOIL ORGANIC CARBON DYNAMICS (DYNAMOS ANR-PROJECT)

Mercedes Mendez-Millan, Gif sur Yvette - France

S07.03a -3

COUPLING POSITION-SPECIFIC LABELLING AND COMPOUND-SPECIFIC ¹³C-PLFA-
ANALYSIS TO ASSESS MICROBIAL UTILIZATION OF AMINO ACIDS IN SOIL

Carolin Apostel, Bayreuth - Germany

S07.03a -4

CAN WE TRACE CHANGES IN ORGANIC MATTER QUALITY BY MULTI-ISOTOPE LABELLING
(¹³C, ¹⁸O AND ²H)?

Mirjam S. Studer, Zurich - Switzerland

S07.03a -5

DYNAMICS OF DE NOVO FORMATION OF AMINO SUGARS IN SOIL VIA CSSIA - A
PROMISING TOOL TO ASSESS MICROBIAL PHYSIOLOGY?

Samuel Bodé, Ghent - Belgium

S07.03a -6

NANOTHERMAL CHARACTERIZATION OF HETEROGRNEITY AND DYNAMICS OF
BIOGEOCHEMICAL PINTERFACES

Gabriele Ellen Schaumann, Landau - Germany



S07.03a -1

SCALING DOWN TO MOLECULES TO MODEL SOIL ORGANIC MATTER DYNAMICS: APPLICATION TO CARBOHYDRATE AND LIPIDS

Elegbede Chabi Fabrice^{*[1]}, Delphine Derrien^[1], Thanh Thuy Nguyen Tu^[5], Mercedes Mendez-Millan^[3], Christine Hatté^[3], Jérôme Balesdent^[4]

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The ability to predict future changes in soil organic carbon (SOC) stocks and potential additional sequestration lies in our understanding of the processes governing carbon storage over different periods of time. Scaling up to the molecular scale appears to be determinant to make progress on that issue as properties of functional groups rule interactions of SOC with soil phases and directly impact its turn-over. The emergence of new techniques combining isotope labelling with compound-specific isotopic analysis has recently provided a powerful means to quantify molecule fluxes and transformations over various time scales. Our intention was to implement this new knowledge on molecule cycling into numerical models for SOC dynamics. We present here C2SOM (Compound-Specific Simulation of Organic Matter dynamics), a model that represents in a simple way the dynamics of molecular constituents within total soil organic matter. C2SOM is derived from existing compartmental models of bulk soil carbon by inserting the compounds of interest inside each compartment and describing molecular fluxes and transformations between compartments. We present how C2SOM was calibrated to provide accurate description of the stocks and dynamics of lipid and carbohydrate moieties in soil and show applications. We also explore the model responses regarding critical questions such as the age of individual molecule in soil. We demonstrated that many individual lipids and carbohydrate molecules can be found in both young and old carbon pools. Finally we highlight some challenging issues arising from the development of such a molecular model.



S07.03a -2

COMPOUND-SPECIFIC 13C & 14C ANALYSIS OF SOIL LIPIDS ALONG A SAVANNA (C4)/EUCALYPTUS (C3) CHRONOSEQUENCE (POINTE-NOIRE, CONGO): NEW INSIGHTS TO RESOLVE SOIL ORGANIC CARBON DYNAMICS (DYNAMOS ANR-PROJECT)

Mendez-Millan Mercedes^[1], Nguyen Tu Thanh Thuy^[10], Egasse Céline^[10], Derenne Sylvie^[6], Derrien Delphine^[5], Zeller Bernd^[5], Balesdent Jérôme^[7], Hatté Christine^[1]

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The world experiences important land use changes which strongly affect the global carbon cycle and primarily one of its key compartments, the soil organic carbon (SOC). One way to understand the fundamental processes is to focus on SOC specific compounds, such as lipids, which are important SOC components influencing soil physical and chemical properties. The sylviculture located at the Republic of Congo, is a 30 years C4/C3 chronosequence, where native savanna (C4) was replaced with eucalyptus (C3). Molecular composition of the apolar lipids was determined in plants and soils, and 13C and 14C measurements were achieved for relevant plant markers: pentacyclic triterpene methyl ethers (PTMEs), specifics for the savanna vegetation, and odd long chain n-alkanes common to both vegetations. The PTMEs remained abundant in soils after 30 years of eucalyptus cropping and 13C analysis displayed constant d13C over the trial. Nevertheless, their 14C content increased along the chronosequence pointing to the mineralisation of more stabilized PTMEs. Compound-specific 13C analyses of soil n-alkanes showed typical trend of a C4/C3 vegetation shift, whereas 14C analysis displayed that the n-alkane pool comprised a significant amount of n-alkanes from a former C3 vegetation. 14C content also revealed high levels of mineralisation of the younger n-alkane pool within the first years of the trial. Afterwards, 14C content reflected the contribution of new n-alkanes from the eucalyptus vegetation. Therefore, combination of compound-specific 13C and 14C analyses revealed that afforestation caused dramatic changes in soil lipid composition, which will probably affect soil chemical and physical properties.

S07.03a -3

COUPLING POSITION-SPECIFIC LABELLING AND COMPOUND-SPECIFIC ¹³C-PLFA-ANALYSIS TO ASSESS MICROBIAL UTILIZATION OF AMINO ACIDS IN SOIL

Apostel Carolin^{*[1]}, Dippold Michaela^[2], Glaser Bruno^[3], Kuzyakov Yakov^[2]

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Microbial utilization of low molecular weight organic substances (LMWOS) is one of the key processes of their transformation in soil. Position-specific labeling combined with compound-specific ¹³C-PLFA-analysis is a unique tool for tracing of LMWOS transformation in soil. We assessed short-term (3 and 10 days) transformations of amino acids by adding position-specifically labeled ¹³C alanine and glutamic acid to soil in a field experiment. We quantified the microbial utilization of the functional groups by ¹³C analysis of microbial biomass by chloroform-fumigation-extraction. Furthermore, the utilization of individual C positions by distinct microbial groups was evaluated by ¹³C-PLFA approach. Microbial degradation was fastest with the highly oxidized carboxylic groups of both amino acids, whereas reduced C positions, e.g. C3 and C4, showed higher incorporation into microbial biomass and PLFA. The incorporation of C2 position differed significantly depending on amino acid, microbial group and time. Whereas C2 of alanine was still bound to C3 at day three, this fragment was already partially split at day ten. In contrast, the C2-group of glutamic acid was degraded much faster, which reflects the utilization of glutamic acid as general N donor. Thus, incorporation of C2 of glutamic acid into microorganisms can be used as marker for N metabolism of distinct microbial groups. Observing the fate of single C atoms by position-specific labeling allows conclusions about the mechanisms and kinetics of microbial utilization and interaction between these groups and therefore will improve our understanding of soil C fluxes.



S07.03a -4

CAN WE TRACE CHANGES IN ORGANIC MATTER QUALITY BY MULTI-ISOTOPE LABELLING (13C, 18O AND 2H)?

Studer Mirjam S.*^[3], Samuel Abiven^[3], Rolf T. W. Siegwolf^[2], Michael W. I. Schmidt^[3]

^[1]University of Zurich ~ Geography, Soil Science and Biogeography ~ Zurich ~ Switzerland ^[2]Paul Scherrer Institute ~ Laboratory for Atmospheric Chemistry ~ Villigen ~ Switzerland ^[3]University of Zurich ~ Department of Geography, Soil Science and Biogeography ~ Zurich ~ Switzerland

The dynamics of organic matter (OM) cycling within the plant soil-system are determined by environmental parameters, as well as chemical quality of OM input. A well-known technique to study OM dynamics is to label OM inputs with stable isotopes (e.g. 13C). Changes in OM quality in the plant and in the soil can be assessed by compound specific isotopic analysis. These techniques give a precise insight of the OM composition, but are laborious and expensive. Here we suggest a new multi-isotope labelling technique using stable 13C, 18O and 2H isotopes, which provides information on OM quality by simple bulk material analysis. The method is based on the creation of an isotopic van Krevelen diagram, which is used to describe different compound groups by plotting the atomic ratios of O/C vs. H/C. We could show that new assimilates can be labelled with 13C, 18O and 2H by adding the stable isotopes (continuously) in the gaseous phase (CO2 and water vapour). The label has been traced within the bulk material of different compartments of the plant-soil system. Our first results showed that after 2, 8 and 14 days of labelling the 18O/13C(new) ratio was significantly different in leaf, stem and root tissue (0.0024, 0.0011 and 0.0007, respectively), suggesting a change in OM quality towards more C-rich compounds (e.g. sugars -> lignin). d2H analysis will follow and an isotopic van Krevelen diagram will be produced (18O/13C(new) vs. 2H/13C(new)) to describe the changes in OM quality.



S07.03a -5

DYNAMICS OF DE NOVO FORMATION OF AMINO SUGARS IN SOIL VIA CSSIA - A PROMISING TOOL TO ASSESS MICROBIAL PHYSIOLOGY?

Bodé Samuel^[1], Zhen Bai^[2], Zhang Xudong^[2], Huygens Dries^[1], Boeckx Pascal^[1]

^[1]Ghent University, Belgium ~ Isotope Bioscience Laboratory, Ghent University, Belgium ~ Ghent ~ Belgium ^[2]Institute of Applied Ecology, CAS ~ State key laboratory of Forest and soil Ecology ~ CAS ~ China

The most significant effect that microbial communities have on their environment is their ability to recycle the essential elements. Amino sugars (ASs) are specific compounds of microbial cell wall and have widely been used to investigate the soil microbial communities and organic residue's sequestration processes. However, little is known about the dynamics of AS in soil. We conducted an incubation experiment with ¹³C-labeled wheat residues on topsoil of conventional till and no-till soil, with three different residue qualities. The isotopic composition of the AS was measured using LC-c-IRMS. Results showed that the unlabeled pool (ASSOM) was relatively stable, while the "de novo" formed ASs could be assumed to be almost entirely crop residue derived (ASR). Dynamic AS accumulation obeys the first-order kinetics $AS_t = AS_{Max} \cdot (1 - e^{-kt})$, and reaches a maximum within several days (GlcN and GalN) or even hours (MurN). Dynamic AS formation rates and maxima strongly depend on the available substrate quality, as well as by original microbial community structure due to different tillage condition in situ. High quality of grain significantly promotes the dynamic AS formation rates as well as its final concentration. However the carbon use efficiency, defined here as the amount of C mineralized to produce AS, was inversely proportional with the residue quality as root was highest and grain lowest. The responses of microbial consortia under conventional tillage to the added organic residues were faster than those in no-till; however, the total de novo AS production was higher in no-till.



S07.03a -6

NANOTHERMAL CHARACTERIZATION OF HETEROGENEITY AND DYNAMICS OF BIOGEOCHEMICAL INTERFACES

Schaumann Gabriele Ellen*^[1], Yamuna Kunhi Mouvenchery^[1]

^[1]University Koblenz-Landau, Institute for Environmental Sciences ~ Environmental and Soil Chemistry ~ Landau ~ Germany

Nanothermal analysis (nTA) coupled with Atomic force microscopy (AFM) of soil samples has potential to improve our understanding of physicochemical processes in soil and to link nanospatial and microspatial distribution of thermal characteristics with macroscopic properties of soil samples. We compared macroscale characteristics (DSC, TGA-MS) and nanoscale thermal characteristics (AFM-nTA) of natural and artificial soils treated with different organic material and fertilizers. The soil samples revealed different types of macroscopic and nanoscale characteristics and heterogeneity. Thermogram types consisted of partly structured expansion and compression phases suggesting material-specific thermal profiles. The distribution of thermogram types reflected sample-dependent nanoscale and microscale heterogeneity. We found indications for water molecule bridge (WaMB) transitions by nTA in peat and soil samples. Organic materials generally revealed strong expansion and irreversible compression phases, latter probably due to collapse of pore and aggregate structures. All investigated samples are heterogeneous on the nanoscale and microscale with respect to thermal behaviour. AFM-nTA allows distinguishing numerous different materials on nanometer and micrometer scale in soil samples. The material-dependent characteristics will help to understand and learn more about the nanoscale distribution of different materials and properties as well as biogeochemical processes. Related to the macroscopic thermal behavior, this will allow studying links between properties of biogeochemical interfaces and processes governed by them.



S07.03b - MOLECULAR DYNAMICS OF SOIL ORGANIC MATTER: CHALLENGES, OPPORTUNITIES AND LIMITS

Chair Persons:

Ingrid Kögel-Knabner, Muenchen - Germany

Boris Jansen, Amsterdam - Netherlands

Thursday 05 July 2012 from 10:30 to 12:00. Room Biancospino

S07.03b -1

*INFLUENCE OF SOURCE AND BOG HYDROLOGY ON LIGNIN DECOMPOSITION
PARAMETERS IN OMBROTROPHIC PEAT*

Judith Schellekens, Santiago - Spain

S07.03b -2

SOLUBLE PHENOLS REFLECT THE DECOMPOSITION OF LEAF AND NEEDLE LITTER

Thimo Klotzbücher, Halle - Germany

S07.03b -3

*LINKING SOIL ORGANIC MATTER DYNAMICS AND DISSOLVED ORGANIC MATTER IN SOIL
DEPTH PROFILES*

Gerd Gleixner, Jena - Germany

S07.03b -4

*MOBILITY AND STABILITY OF ROOT AND NEEDLE SPECIFIC BIOMARKERS IN A LONG-
TERM INCUBATION STUDY WITH CONTINUOUS LEACHING*

Jens G. Altmann, Amsterdam - Netherlands

S07.03b -5

*CHANGES IN PLANT BIODIVERSITY, SOM CONTENT AND COMPOSITION IN A LONG TERM
DRAINAGE EXPERIMENT*

Katharina Wolf, Bayreuth - Germany

S07.03b -6

*MORE AUTOCHTHONOUS AND RESIDUE-DERIVED C AND N ASSOCIATED IN ORGANO-
MINERAL COMPLEXES IN THE SUBSOIL THAN TOPSOIL OF A HEAVY CLAY*

Vincent Poirier, Québec - Canada



S07.03b -1

**INFLUENCE OF SOURCE AND BOG HYDROLOGY ON LIGNIN DECOMPOSITION
PARAMETERS IN OMBROTROPHIC PEAT**

Schellekens Judith^{*[1]}, Buurman Peter^[2], Martínez-Cortizas Antonio^[1], Kuyper Thom^[3]

^[1]University Santiago de Compostela ~ Departamento de Edafología e Química Agrícola ~ Santiago ~ Spain

^[2]Wageningen University ~ Earth System Science Group ~ Wageningen ~ Netherlands ^[3]Wageningen University ~ Department of Soil Quality ~ Wageningen ~ Netherlands

Most knowledge on lignin decomposition is based on wood and aerobic systems. In anaerobic systems such as peatlands, decomposition may be different. In addition to mosses, peat is built-up of both woody and herbaceous vascular plant remains, which may show different decay patterns. Lignin parameters that are generally applied to indicate the state of decay of organic matter include the abundance of lignin, ratios of different lignin moieties, and both oxygenation and chain length of lignin alkyl side-chains. The parameters are usually obtained by the CuO oxidation method. The same parameters, obtained with pyrolysis-GC/MS, are applied to a high-resolution sampled peat core. The lignin composition of dominant plant species (graminoids and ericoids) and different peat fractions (NaOH-extractable, bulk, and non-extractable residues) were also studied with pyrolysis-GC/MS. Several decomposition stages were recognized that differently affected lignin decay. These are: 1) early stage of plant decay, 2) long term anaerobic decomposition, and 3) aerobic decomposition during subsequent periods of drought. Our results indicate preferential decay of guaiacyl over syringyl moieties during the first stage of decay. This can be explained by the fact that large part of the guaiacyl moieties are not part of the lignin polymer. Anaerobic conditions during the first stage caused oxygenation of C3 alkyl side-chains; for syringyl lignin this effect was stronger than preservation. Our results show that lignin decay highly depends on composition of the source material, and suggest that lignin decomposition parameters that are commonly used in aerobic environments, may lead to erroneous interpretations in wet environments.



S07.03b -2

SOLUBLE PHENOLS REFLECT THE DECOMPOSITION OF LEAF AND NEEDLE LITTER

Klotzbücher Thimo^{*[5]}, Kaiser Klaus^[5], Filley Timothy^[4], Kalbitz Karsten^[3]

^[1]Martin-Luther-University of Halle-Wittenberg ~ Soil Science ~ Halle ~ Germany ^[2]Purdue University ~ Earth and Atmospheric Sciences ~ West Lafayette ~ United States ^[3]University of Amsterdam ~ Institute for Biodiversity and Ecosystem Dynamics ~ Amsterdam ~ Netherlands ^[4]Purdue University ~ Earth and Atmospheric Sciences ~ West Lafayette ~ United States ^[5]Martin-Luther-University of Halle-Wittenberg ~ Soil Sciences ~ Halle ~ Germany

Microbial breakdown of polyphenolic macromolecules such as lignin and tannin yields water-soluble compounds that greatly contribute to organic matter dissolved in the percolation water of soils. The compounds, mainly acidic, determine environmentally relevant reactions of dissolved organic matter such as metal complexation, sorption to mineral surfaces, and protein precipitation. We hypothesised that production of water-soluble phenolic compounds over time is directly linked to the course of litter decomposition, with hydrolysable tannins being the major sources in the beginning and lignin at later stages. An experiment was carried out, in which five types of litter (ash, beech, maple, pine, spruce) were exposed to degradation in the field for 27 months. Soluble compounds produced during decomposition were extracted into water. Litter samples as well as dried-down water extracts were analysed for lignin- and tannin-derived phenols using ¹³C-labelled tetramethylammonium hydroxide thermochemolysis. All litter samples varied more strongly in their contents of tannin than of lignin. Production of soluble tannin was largest at the initial stages of litter decomposition and diminished with time. Lignin degradation was also strongest at initial degradation stages and decreased strongly with time, presumably due to decreasing availability of easily degradable compounds. Water-soluble phenols closely reflected those changes, with large releases of both tannin- and lignin-derived phenols at early stages of decomposition. Later, the contribution of tannin-derived phenols to water soluble fractions diminished and lignin-derived phenols became more prevalent. The study again showed that dissolved organic compounds are excellent indicators of soil processes.



S07.03b -3

LINKING SOIL ORGANIC MATTER DYNAMICS AND DISSOLVED ORGANIC MATTER IN SOIL DEPTH PROFILES

Gleixner Gerd^{*[1]}, Andrea Scheibe^[1], Ashish Malik^[1]

^[1]Max Planck Institute for Biogeochemistry ~ Biogeochemical processes ~ Jena ~ Germany

The role of dissolved organic matter (DOM) for carbon flow in soils is still not well understood. We used natural labelling of plants to trace the flow of carbon into soil organic matter (SOM) and DOM size classes in order to understand the link between plants, SOM and DOM. Two experimental plots with different soils types were cultivated each with C3 and C4 plants for several years. The annual litter input was held identical for all plots avoiding input related changes in the carbon turnover. SOM, DOC and soil gases were collected at 10, 20 and 30 cm depth and their ¹³C signal was determined using isotope ratio mass spectrometry (IRMS). DOM was fractionated by size exclusion chromatography and their compound specific isotope ratios were measured on line. Our results demonstrate that the contribution of plant-derived carbon into DOM varies with parent material, depth and size classes. Plant signals are mainly found in the winter, in larger DOM fractions and in upper soil horizons. Soil-derived carbon is mainly found in smaller fractions, in the summer and in deeper soil horizons. This suggests that soil microorganisms decompose plant-derived carbon input and that this is inducing the export of smaller soil-derived DOM.

S07.03b -4

MOBILITY AND STABILITY OF ROOT AND NEEDLE SPECIFIC BIOMARKERS IN A LONG-TERM INCUBATION STUDY WITH CONTINUOUS LEACHING

Altmann Jens G.*^[1], Jansen Boris^[1], Nierop Klaas G.j.^[2], Kalbitz Karsten^[1]

^[1]University of Amsterdam ~ Institute for Biodiversity and Ecosystem Dynamics ~ Amsterdam ~ Netherlands ^[2]Utrecht University ~ Department of Earth Sciences – Geochemistry ~ Utrecht ~ Netherlands

Up to now there is only a poor understanding of the sources contributing to organic carbon in forest soils, especially the relative contribution of leaves versus roots. Compounds being specific for leaves and roots might be a promising tool to improve our knowledge of different sources of soil organic matter (SOM). Surprisingly, information about the dynamics of root- and leaf-derived biomarkers during litter decomposition is scarce. For quantitative application of the biomarker approach not only the stability of these specific molecules has to be considered, but also their mobility within the soil profile has to be determined. This information is necessary, if we want to assess the dynamics of biomarkers in soils and to use them for source identification and quantification. We analyzed the changes in chemical composition of roots and leaves and their water-extractable fraction of six temperate tree species during a 6-months incubation experiment in the laboratory. In this study we focused on the following questions: (I) How stable are species-, leaf- and root-specific molecules (e.g., lignin, cutin, suberin) during litter decomposition? (II) How mobile are these polymer-derived molecules during leaching experiments? During this long-term experiment we measured continuously carbon and nitrogen contents of the water extracts and the remaining residues, C mineralization rates, and the chemical composition of water extracts and residues by e.g., Curie-point pyrolysis mass spectrometry and thermally assisted hydrolysis and methylation.



S07.03b -5

CHANGES IN PLANT BIODIVERSITY, SOM CONTENT AND COMPOSITION IN A LONG TERM DRAINAGE EXPERIMENT

Wolf Katharina^{*[1]}, Roland Bol^[2], Jennifer Dungait^[2], Jennifer Dungait^[2], Elisabeth Dixon^[2], Dan Dhanoa^[2], Deborah Beaumont^[2], Guido Wiesenberger^[1]

^[1]University of Bayreuth ~ Agroecosystem Research Department ~ Bayreuth ~ Germany ^[2]Rothamsted Research, North Wyke ~ North Wyke Research ~ Okehampton ~ United Kingdom

Moisture and slope position can have a strong influence on soil properties and plant communities. In a long term permanent grassland experiment, sub-surface drainage was introduced in 1982 on some plots of Rowden Moor at North Wyke (SW UK). The soil is a Stagnic vertic Cambisol with a dense clay layer at shallow depth. After drainage the plant community had shifted from a Lolium perenne dominated grassland with patches of Juncus sp. towards a typical grassland plant community dominated by Lolium perenne and Trifolium sp. In addition, soil carbon and nitrogen concentrations tended to decrease. This is related to a smaller contribution of plant-derived organic matter due to the change in plant community structure, and the enhanced mineralization of SOM under lower soil moisture. Furthermore the $\delta^{13}\text{C}$ values tend to get more negative in soil, which could be related to the changing plant community. Changes in the chemical composition of soil organic matter (SOM) were examined using compositional changes of soil n-alkanes. A shift in the alkane abundance occurs from the upper part of the slope (dominated by n-C31), to the bottom parts (n-C29 enriched). The carbon preference index and average chain length of alkanes correlated between undrained and drained plots and decreased down slope. Similarly, several alkane ratios like n-C27/n-C31 declined, due to the enhanced mineralization. The study showed that drainage has a long term effect on the plant community leading to depletion in C- and N- contents and a change in the chemical composition of SOM.



S07.03b -6

MORE AUTOCHTHONOUS AND RESIDUE-DERIVED C AND N ASSOCIATED IN ORGANO-MINERAL COMPLEXES IN THE SUBSOIL THAN TOPSOIL OF A HEAVY CLAY

Poirier Vincent^[8], Basile-Doelsch Isabelle^[6], Balesdent Jérôme^[3], Borschneck Daniel^[6], Whalen Joann^[4], Angers Denis^[9]

^[1]University Laval ~ Wood and forest sciences ~ Quebec ~ Canada ^[2]Centre Européen de Recherche et d'Enseignement en Géosciences de l'Environnement (CEREGE) ~ UMR CNRS / Aix-Marseille Universités / IRD / Collège de France ~ Aix-en-Provence ~ France ^[3]Institut National de la Recherche Agronomique (INRA) ~ UR1119 GSE ~ Aix-en-Provence ~ France ^[4]McGill University ~ Natural Resource Sciences ~ Ste-Anne-de-Bellevue ~ Canada ^[5]Agriculture and Agri-Food Canada ~ Soils and crops research and development center ~ Québec ~ Canada ^[6]Centre Européen de Recherche et d'Enseignement des Géosciences de l'Environnement (CEREGE) ~ UMR CNRS / Aix-Marseille Universités / IRD / Collège de France ~ Aix-en-Provence ~ France ^[7]Centre Européen de Recherche et d'Enseignement des Géosciences de l'Environnement (CEREGE) ~ UMR CNRS/Aix-Marseille Universités/IRD ~ Aix-en-Provence ~ France ^[8]Laval University ~ Wood and Forest Sciences ~ Québec ~ Canada ^[9]Agriculture and Agri-Food Canada ~ Soils and Crops Research and Development Center ~ Québec ~ Canada

Investigating organo-mineral associations in topsoil and subsoil horizons may help understanding soil organic matter (SOM) stability in these horizons and their potential to retain C and N from recently added organic matter. We used a sequential density fractionation procedure coupled with X-ray diffraction (XRD) analysis to investigate the retention of autochthonous and residue-derived C and N in topsoil (0-20 cm depth) and subsoil (30-70 cm depth) samples coming from the profile of a weakly weathered heavy clay soil incubated without (0 g C kg⁻¹) or with (10 g C kg⁻¹) ¹³C-¹⁵N-labelled residues for 51 d. A greater proportion of soil organic carbon (SOC) and N was associated with soil mineral phases in subsoil than topsoil. Similar amounts of residue-derived C and N were retained in both soils, but greater amounts were found in organo-mineral complexes of subsoil than topsoil. In both autochthonous and residue-derived organo-mineral associations, our results are consistent with a theoretical model that predicts preferential sorption of N-derived compounds on unsaturated mineral surfaces. We conclude that these N-derived compounds have key role as binding agents during the formation of organo-mineral complexes in a weakly weathered heavy clay soil.



S07.04 - SOIL ORGANIC MATTER DYNAMICS AND CLIMATE

Chair Persons:

Adele Muscolo, Reggio Calabria - Italy

Pavle Pavlovic, Belgrade - Serbia

Maria Sidari, Reggio Calabria - Italy

Wednesday 04 July 2012 from 08:30 to 10:00. Room Acero

S07.04 -1

3-YEARS OF SIMULATED WARMING IMPACT THE DYNAMICS OF WATER-EXTRACTABLE ORGANIC MATTER IN A SPHAGNUM PEATLAND

Frédéric Delarue, Orléans - France

S07.04 -2

THE INFLUENCE OF PRECIPITATION AND TEMPERATURE ON SOIL ORGANIC MATTER DYNAMICS IN A DUTCH MIXED FARM SYSTEM

Martine Hoogsteen, Wageningen - Netherlands

S07.04 -3

DOES SOIL ORGANIC MATTER (SOM) QUALITY CONTROL SOM DYNAMICS IN ARCTIC PERMAFROST-AFFECTED SOILS?

Christophe Moni, AS - Norway

S07.04 -4

SOC DYNAMICS IN GRASSLANDS: PLANT-MEDIATED EFFECTS, DRIVING FACTORS AND MICROBIAL RESPONSE

Elke Schulz, Halle - Germany

S07.04 -5

LONG-TERM FERTILIZATION AND SOIL WARMING EFFECTS ON RECALCITRANT LITTER DECOMPOSITION

Bas Dingemans, Utrecht - Netherlands

S07.04 -6

SOIL AND PLANT CARBON LOSS ASSESSMENT AFTER LAND USE CHANGE ON STEEP SLOPES IN NORTHWESTERN VIETNAM

Volker Häring, Stuttgart - Germany



S07.04 -1

3-YEARS OF SIMULATED WARMING IMPACT THE DYNAMICS OF WATER-EXTRACTABLE ORGANIC MATTER IN A SPHAGNUM PEATLAND

Delarue Frédéric^{*[1]}, Laggoun-Défarge Fatima^[1], Jassey Vincent^[2], Chiapusio Geneviève^[2], Binet Philippe^[2], Buttler Alexandre^[3], Bragazza Luca^[4], Gogo Sebastien^[1]

^[1]Université d'Orléans, CNRS/INSU - Institut des Sciences de la Terre d'Orléans UMR 6113. Campus Géosciences - 1A, rue de la Férollerie, 45071 Orléans cedex 2, France. ~ UMR 6113. ~ Orléans ~ France ^[2]Laboratoire de Chrono-Environnement, UMR CNRS 6249, UFR des Sciences et Techniques, 16 route de Gray, Université de Franche-Comté, F-25030 Besançon, France. ~ UMR CNRS 6249 ~ Besançon ~ France ^[3]Ecole Polytechnique Fédérale de Lausanne EPFL, Ecological Systems Laboratory ECOS, Station 2, 1015 Lausanne, Switzerland ~ Ecological Systems Laboratory ECOS ~ Lausanne ~ Switzerland ^[4]Department of Biology and Evolution, University of Ferrara, Ferrara, Italy ~ Department of Biology and Evolution ~ Ferrara ~ Italy

Our aims were to determine how an *in situ* simulated short term (2009 to 2011) warming affects the properties of sensitive OM, i.e. water-extractable organic matter (WEOM) in a Sphagnum peatland (Le Forbonnet, France). This was performed through the analyses of the WEOM extracted from 4 to 6 levels of surface peat. Peat was sampled in two contrasted sites: an open bog and a transitional poor fen. Open-Top Chambers (OTCs) which were used for warming experiment led to a significantly increase of mean air temperature of ca. 1.3°C in spring and summer. OTCs did not impact vegetation communities. Therefore, WEOM changes had been assigned (i) to microbial activities at peat surface and (ii) to microbial activities and/or roots exudates with depth. After three years of warming, no effect on WEOM properties were found at the bog site even if β -glucosidase indicated that OTCs induced a lower decomposition. However, at the fen site OTCs impacted the WEOM properties following two patterns: - a lower carbon and sugars contents at the peat surface suggesting a greater microbial decomposition as shown by β -glucosidase activities. - a greater carbon and sugars contents with depth (ca. 10 cm) suggesting a lower decomposition dynamic induced by OTCs treatment. OTCs effects on WEOM properties present a strong variability following depth but also micro-environmental conditions. Therefore, it appears that 3D spatial variability is a critical key element to understand OM dynamics and carbon fate in peatlands.



S07.04 -2

THE INFLUENCE OF PRECIPITATION AND TEMPERATURE ON SOIL ORGANIC MATTER DYNAMICS IN A DUTCH MIXED FARM SYSTEM

Lantinga Egbert^[1], Hoogsteen Martine^{*[1]}

^[1]Wageningen University and Research centre ~ Organic Farming Systems ~ Wageningen ~ Netherlands

Soil organic matter (SOM) decline is identified as a major threat for agricultural soils worldwide. Furthermore, the concern about negative effects of climate change on SOM dynamics has grown. This study investigates the relation between precipitation and temperature on yearly changes in SOM for a 123 ha mixed farm in the Netherlands on a clayey soil. The crop rotation included arable food and feed crops, vegetables and grass-clover leys. The livestock component consisted of dairy cows with their young stock and sheep. The leys were predominantly grazed, and indoors both slurry and farmyard manure were produced. The cattle diet was characterised by low protein and high fiber contents. During a period of 7 successive years, a complete crop rotation cycle, the 0-30 cm layer in all of the 66 parcels was sampled each early spring period. Average yearly changes in soil organic carbon (SOC) were determined at farm level (Kurmies method) by taking into account the area variation between the individual parcels. Linear regression analyses were carried out for relating yearly differences in SOC with the preceding 365-days precipitation and average temperature. A strong decreasing correlation was found for delta SOC and precipitation ($R^2 = 0.80$) with negative values above 968 mm. However, only a weak negative correlation could be detected between delta SOC and temperature ($R^2 = 0.29$).



S07.04 -3

DOES SOIL ORGANIC MATTER (SOM) QUALITY CONTROL SOM DYNAMICS IN ARCTIC PERMAFROST-AFFECTED SOILS?

Moni Christophe*^[1], Pengerud Annelene^[2], Knoth De Zarruk Katrin^[1], Tau Strand Line^[2], Dignac Marie-France^[3], Certini Giacomo^[4], Rasse Daniel^[1]

^[1]Bioforsk ~ Jord og miljø ~ AS ~ Norway ^[2]Norwegian University of Life Sciences (UMB) ~ Plant and Environmental Sciences ~ Ås ~ Norway ^[3]Bioemco ~ Soil ~ Thiverval-Grignon ~ France ^[4]Università degli studi di Firenze ~ Scienza del suolo e nutrizione della pianta ~ Firenze ~ Italy

Soil organic matter (SOM) in arctic permafrost-affected soils is the largest terrestrial reservoir of carbon (C). With the expected climate warming, increased SOM decomposition in these soils is considered as the largest potential positive feedback from terrestrial ecosystems to the atmosphere. The chemical composition of SOM in permafrost-affected soils is not well documented, although it might be a main driver for the response of the huge C stocks in permafrost-affected soils to increasing temperatures. Here, our objective was to verify whether it was possible to relate the temperature response of SOM mineralisation to SOM molecular composition in eight contrasted permafrost-affected soils of Norway, Svalbard and Russia sampled at two different depths. To this end, precise parameterisation of the temporal response of arctic soils to increased temperatures was estimated with a two pool first-order kinetics model while molecular data concerning composition and state of decomposition of SOM were acquired. Results showed that SOM dynamics was first controlled by soil type (i.e. organic vs. mineral soils) and then by the depth and frost status, with no influence of the site, whereas SOM quality was mostly site and soil type dependent. No simple relationships could be derived between molecular data and SOM dynamics parameters, suggesting that factors other than SOM quality would be the main controllers of SOM dynamics in the studied permafrost-affected soils.



S07.04 -4

SOC DYNAMICS IN GRASSLANDS: PLANT-MEDIATED EFFECTS, DRIVING FACTORS AND MICROBIAL RESPONSE

Schulz Elke^{*[1]}, Marc Breulmann^[1], Karoline Weißhuhn^[1], Francois Buscot^[1]

^[1]Helmholtz Centre for Environmental Research - UFZ ~ Soil Ecology ~ Halle ~ Germany

The likely effects of climate change on vegetation composition and ecosystem processes have been widely studied. However, few studies have explored associated plant-mediated effects on biogeochemical processes, such as SOM dynamics and its availability to decomposers. We describe effects of plant litter on SOC and on soil microbial activity and structure in extensively managed grasslands in Central Germany to identify biotic and abiotic factors driving the SOC dynamics. The decomposition of shoot and root litter was studied in an incubation experiment. Labile C and N were isolated by hot water extraction; functional groups of microbes were identified by PLFA analysis and microbial activity was measured using a set of soil exo-enzymes. Plant community composition, particularly legume species affected SOC dynamics and microbial processes, especially via roots, reflected in different decomposition course of root litter. The labile SOC pool was found to be a key driver of the below-ground food web, controlling soil microbial processes. Below-ground responses appear to be related to the presence of legume species, which affected microbial communities, the ratio between fungal and bacterial biomass and patterns of soil enzyme activity. Low productivity fungal-dominated grasslands with slow C turnover may play an important role in SOC accumulation. The examined interrelationships between abiotic and biotic factors are important for predicting decomposition rates in soils and the loss of SOC, and thus of both present ecosystem functions and changes that may occur following anticipated climate change.



S07.04 -5

LONG-TERM FERTILIZATION AND SOIL WARMING EFFECTS ON RECALCITRANT LITTER DECOMPOSITION

Dingemans Bas^[1], Hefting Mariet^[1], Verhoeven Jos^[1]

^[1]Utrecht University ~ Ecology & Biodiversity ~ Utrecht ~ Netherlands

The decomposition of soil organic matter (SOM) can be controlled by temperature and nitrogen enrichment; the former is generally considered to be an important stimulating factor of decomposition rates, while the influence of nitrogen enrichment is strongly dependent on the phase of decomposition and the chemical structure of the substrate. The chemical structure (e.g. distribution of C compounds) of SOM is an important factor that influences SOM decomposition. The formation of SOM is essentially controlled by the quantity and quality of plant litter inputs. Temperature change and increased nitrogen deposition may affect the chemical composition of plant litter and, in turn, affect the decomposition. This study investigated how increased nitrogen deposition in addition to global warming will affect the carbon turnover in wet grassland soils and, particularly, the decomposition of recalcitrant carbon compounds. We performed a long-term lab incubation experiment with litter from fertilized geothermally heated grassland plots in order to compare temperature and fertilization effects on decomposition. We found that nitrogen fertilization mitigated the accelerating effect of increased temperature on the decomposition of recalcitrant litter in grasslands. A lower quality (i.e. higher C:N ratio) of fertilized litter may have caused this mitigating effect. However, a lower lignin content of the fertilized litter did not seem to stimulate the decomposition. This may suggest a litter quality shift due to a shift in plant species composition, introducing other types of recalcitrant compounds, rather than a shift in carbon fractions within one species.



S07.04 -6

SOIL AND PLANT CARBON LOSS ASSESSMENT AFTER LAND USE CHANGE ON STEEP SLOPES IN NORTHWESTERN VIETNAM

Häring Volker^[1], Fischer Holger^[1], Stahr Karl^[1]

^[1]University of Hohenheim ~ Institute for soil science and land evaluation ~ Stuttgart ~ Germany

*Continuous cultivation of maize is commonly practiced on steep slopes in northwestern Vietnam. Carbon losses associated with land use change from forest to maize have an impact on soil degradation and climate change. The aim of our study was to assess the carbon dynamics on three soil types. We determined soil organic carbon (SOC) loss rates by (1) soil erosion and (2) decomposition of forest-derived SOC, (3) maize derived carbon input as well as carbon storage of (4) forest and (5) maize plants. On three soil types chronosequences of up to 21 years of continuous maize cultivation after deforestation were established. Stable carbon isotopes, total organic carbon and bulk density were determined until 30 cm depth. Soil erosion was measured with ¹³⁷Cs. Plant biomass was estimated based on diameter and height of plants as well as litter fall measurements. Slash and burn of the primary forest caused emissions of 78 t CO₂ ha⁻¹. Burning of maize harvest residues caused emissions of 2.4 t CO₂ ha⁻¹a⁻¹. Decomposition of SOC caused CO₂ emissions of 1.1 t*ha⁻¹*a⁻¹. Soil erosion relocated 0.8 t C ha⁻¹*a⁻¹. The maize root biomass C which entered the SOC pool was calculated as 2.0 t*ha⁻¹*a⁻¹. The rate of maize derived SOC was 0.2 t*ha⁻¹*a⁻¹. Summarized the system was subject to a high initial C loss by deforestation followed by a net C loss of 6.1 t*ha⁻¹*a⁻¹. These results demonstrate the negative C balance since land use change and highlight the contribution of current management practices to climate change.*



S07.05 - DYNAMICS OF SUBSOIL ORGANIC CARBON IN RELATION TO SOIL PROPERTIES, CLIMATE AND BIOTA

Chair Persons:

Marcel Hoosbeek, Wageningen - Netherlands

Maarten Braakhekke, Jena - Germany

Myroslava Khomik, Jena - Germany

Monday 02 July 2012 from 13:30 to 15:00. Room Alloro

S07.05 -1

THE FORGOTTEN PART OF CARBON CYCLING: ORGANIC MATTER STORAGE AND TURNOVER IN SUBSOILS

Bernd Marschner, Bochum - Germany

S07.05 -2

SOIL ORGANIC MATTER CHEMISTRY OF SUBSOIL-C IN BROADLEAVED MARITIME TEMPERATE FOREST ECOSYSTEMS – A PYROLYSIS-GC/MS STUDY.

Karen Vancampenhout, Leuven - Belgium

S07.05 -3

THE EFFECT OF AGRICULTURAL LAND USE ON THE NATURE AND DYNAMICS OF SUBSOIL CARBON

Andrew Gregory, Harpenden, Hertfordshire - United Kingdom

S07.05 -4

CYCLING DOWNWARDS – DISSOLVED ORGANIC MATTER IN SOILS

Karsten Kalbitz, Amsterdam - Netherlands

S07.05 -5

SOIL CARBON STABILIZATION IS DRIVEN BY THE RATIO OF C INPUT TO THE MASS OF MINERAL SOIL

Jens Leifeld, Zurich - Switzerland

S07.05 -6

ARE DECOMPOSITION AND STABILISATION PROCESSES OF ORGANIC MATTER IN SUBSOILS RELATED TO REDUCED MICROBIAL BIOMASS AND ACTIVITY ?

Cornelia Rumpel, Thiverval-Grignon - France - Invited



S07.05 -1

THE FORGOTTEN PART OF CARBON CYCLING: ORGANIC MATTER STORAGE AND TURNOVER IN SUBSOILS

Marschner Bernd*^[1]

^[1]Ruhr-University Bochum ~ Soil Science/Soil Ecology ~ Bochum ~ Germany

In the past, carbon flux measurements and modelling have mostly considered the topsoil where C-concentrations, root densities and microbial activities are generally highest. However, depending on climate zone and land use, this soil compartment contains only 30-50% of the C-stocks of the first meter. If the deeper subsoil down to 3 m is also considered, the contribution of topsoil carbon stocks to total soil C-pools is only 20-40%. Another distinct property of subsoil organic matter is its high apparent ^{14}C age. The ^{14}C age of bulk soil organic matter below 30 cm depth generally increases continuously indicating mean residence times of several 10^3 to 10^4 years. Large pool size and high radiocarbon age suggest that subsoil OM has accumulated at very low rates over very long time periods and therefore appears to be very stable. Several explanations have been proposed why subsoil SOM is so seemingly old and inert: 1. Subsoil SOM largely consists of recalcitrant compounds. 2. The annual inputs of fresh OM into the subsoil are extremely low. 3.

Old SOM in subsoils is stabilized by sorption to pedogenic minerals. 4. The high radiocarbon age is caused by fossil or geogenic C. 5. Microbial activities are limited by low O_2 and low temperatures. 6. Microbial activities are limited to very few hot spots In this review, the current state of knowledge regarding these hypotheses is presented and discussed to derive open questions and research needs for the near future.



S07.05 -2

SOIL ORGANIC MATTER CHEMISTRY OF SUBSOIL-C IN BROADLEAVED MARITIME TEMPERATE FOREST ECOSYSTEMS – A PYROLYSIS-GC/MS STUDY.

Vancampenhout Karen^{*[4]}, De Vos Bruno^[2], Wouters Katinka^[4], Swennen Rudy^[4], Buurman Peter^[3], Deckers Seppe^[4]

^[1]Associate University of Leuven ~ Earth and Environmental Sciences ~ Leuven ~ Belgium ^[2]Research Institute for Nature and Forest ~ Geraardsbergen ~ Geraardsbergen ~ Belgium ^[3]Wageningen University ~ Earth System Science ~ Wageningen ~ Netherlands ^[4]Associated University of Leuven ~ Earth and Environmental Sciences ~ Leuven ~ Belgium

Between 30 and 63% of the soil organic matter (SOM) is stored below 30 cm, making subsoil SOM an important source and sink in the global carbon cycle. Nevertheless, detailed information regarding the composition of subsoil SOM remains scarce. This study aims to evaluate the extractable fraction of topsoil and subsoil horizons in broadleaved temperate marine forests from Flanders (Belgium) by analytical pyrolysis-gas chromatography/mass spectrometry. Six sites were chosen under Beech, Oak and hybrid poplar. All sites show a significant shift in chemical composition of the NaOH-extractable fraction between the topsoil and the subsoil. While the extractable SOM of the topsoil mainly differs in the accumulation of recalcitrants according to input and nutrient status, subsoil-SOM shows high relative amounts of aliphatics or polysaccharides for coarse and fine textured soils respectively. Lignins, lignin-derived phenols or aromatics are not major contributors to subsoil-SOM, regardless of soil type. Furthermore, results show that labile plant-derived molecules are present in the subsoil, i.e. long-chain aliphatics and cellulose-derived polysaccharides, which are neither inherently chemically recalcitrant nor highly humified.



S07.05 -3

THE EFFECT OF AGRICULTURAL LAND USE ON THE NATURE AND DYNAMICS OF SUBSOIL CARBON

Gregory Andrew^{*[1]}, Dungait Jennifer^[2], Dixon Elizabeth^[2], Bol Roland^[2], Whitmore Andrew^[1]

^[1]Rothamsted Research ~ Department of Sustainable Soils and Grassland Systems ~ Harpenden, Hertfordshire ~ United Kingdom ^[2]Rothamsted Research ~ Department of Sustainable Soils and Grassland Systems ~ North Wyke, Okehampton, Devon ~ United Kingdom

The significant effect of management on carbon (C) stocks in agricultural topsoils is widely reported but the effect on subsoil C is rarely considered. Conditions in the subsoil are considered to be more stable compared to the topsoil and hence the potential for C sequestration at depth has recently been highlighted. We analysed soils from some of the long-term field experiments at Rothamsted Research (UK) to investigate the nature and dynamics of subsoil C under different agricultural land uses over a range of timescales. Conversion of a grassland soil to arable uses resulted in a decrease in C contents down to 75 cm depth over a period of 60 years. In addition bulk ¹³C values were greater and plant biomarker n-alkane concentrations were lower under arable management compared to grassland, indicating a change in the composition of subsoil C. In contrast, an arable soil reverted to grassland or woodland had increased considerably its C content down to at least 70 cm depth over the intervening 130 years with a coincident reduction in the mean ¹⁴C age of subsoil C following conversion, indicating significant novel C input at depth. We have demonstrated the significant influence of agricultural management on the nature and dynamics of subsoil C, with sequestration under grassland and losses under arable management. Analysis of plant biomarkers suggests that roots provide a direct input of fresh C to the subsoil. We conclude that agricultural management significantly affects subsoil C stocks through its influence on biotic and abiotic drivers.



S07.05 -4

CYCLING DOWNWARDS – DISSOLVED ORGANIC MATTER IN SOILS

Kalbitz Karsten^{*[1]}, Kaiser Klaus^[2]

^[1]University of Amsterdam ~ Earth Surface Science, Institute for Biodiversity and Ecosystem Dynamics ~ Amsterdam ~ Netherlands ^[2]Martin Luther University Halle-Wittenberg ~ Soil Sciences ~ Halle ~ Germany

Dissolved organic matter has been recognised as mobile, thus, crucial to translocation of metals, pollutants, and nutrients in soil. We present a conceptual model of the vertical movement of dissolved organic matter with soil water, which deviates from the common view of a chromatographic stripping along the flow path. It assumes temporal immobilisation (sorptive or by co-precipitation), followed by microbial processing, and re-release (by desorption or dissolution) into soil water of altered compounds. The proposed scheme explains well depth trends in age and composition of dissolved organic matter. Our conceptual model also offers an immediate explanation of the increase in radiocarbon age and the compositional change of solid-phase (mineral-associated) organic matter with depth observed in many soils. Dissolved organic matter is probably not only indicative for transformation and transport processes but is representative for the cycling of soil organic matter in general.



S07.05 -5

SOIL CARBON STABILIZATION IS DRIVEN BY THE RATIO OF C INPUT TO THE MASS OF MINERAL SOIL

Leifeld Jens*^[1], Franz Conen^[2]

^[1]Agroscope Reckenholz-Tänikon ART ~ Air Pollution / Climate Group ~ Zurich ~ Switzerland ^[2]Universität Basel ~ Environmental Geosciences ~ Basel ~ Switzerland

Soil carbon mean residence times (MRT) increase with soil depth although combined temperature and moisture effects on organic matter (OM) decomposition may be favorable in deeper soil. Smaller OM/mineral ratios in subsoils foster organo-mineral stabilization. Additionally, the highly diluted substrate makes it less attractive for organisms to produce exoenzymes. In consequence, one would expect MRT to be a function of the amount of carbon input per unit mineral soil. This effect should be more pronounced for mineral-associated (MOM) than for particulate (POM) OM because turnover of the latter is also driven by factors such as POM quality. Carbon input and MRT of MOM and POM was calculated for various well-drained upland soils and soil layers ($n=55$) using the radiocarbon approach. 84% of MOM MRT variability is explained by the ratio of carbon input to mineral soil mass. The relationship improves to 95% when calculated per mass of clay. The mechanism becomes relevant at annual C inputs of 0.2 g C kg⁻¹ soil. Below this rate, stabilization by the mineral matrix overrides other environmental controls. Correlation between POM input per soil mass and its turnover rate is weaker but still highly significant. While soil pH and temperature are important factors for carbon turnover in the studied soils, OM MRT can be expressed as a function of C input rate per unit soil mass because it seems mainly driven by the OM stabilizing capacity and OM dilution of/in subsoil. Consequently, low-productive ecosystems should promote long soil carbon MRT.



S07.05 -6

ARE DECOMPOSITION AND STABILISATION PROCESSES OF ORGANIC MATTER IN SUBSOILS RELATED TO REDUCED MICROBIAL BIOMASS AND ACTIVITY ?

Rumpel Cornelia^[1], Sanaullah Muhammad^[2], Baumann Karen^[1], Marron Pierre Alain^[6], Chabbi Abad^[4]

^[1]CNRS ~ BIOEMCO ~ Thiverval-Grignon ~ France ^[2]University of Agriculture ~ Institute of Soil and Environmental Sciences ~ Faisalabad ~ Pakistan ^[3]University of Agriculture ~ Institute of Soil and Environmental Sciences ~ Faisalabad ~ Pakistan ^[4]INRA ~ UR Ecophysiologie des plantes fouragères ~ Lusignan ~ France ^[5]INRA ~ UR Ecophysiologie des plantes fouragères ~ Lusignan ~ France ^[6]INRA ~ Microbiology ~ Dijon ~ France

Stabilisation of organic matter (OM) in subsoils results in higher residence times compared to topsoil OM and may thus have different controls. In particular, contrasting stabilisation mechanisms, energy limitations as well as reduced number and diversity of the microbial biomass in subsoils were hypothesised to be responsible for OM accumulation. The OM input into subsoil may be root derived. A field incubation experiment with ¹³C and ¹⁵N labelled root litter in three different soil depths during 36 months showed similar decomposition but higher plant litter alteration in subsoil as compared to topsoil. Decomposition dynamics in subsoil horizons showed a lag phase. Protection of OM occurred in soil aggregates as well as by adsorption to soil minerals. These two stabilisation mechanisms were found to be equally important in top- and subsoil horizons. After three years of incubation, the amount carbon remaining was similar in top- and subsoil horizons despite contrasting microbial biomass, potential enzyme activity and microbial community structure. Loss of soil inherent ancient OM due to priming was not detectable. In our incubation experiment, abiotic conditions were found to be only slightly different in top- and subsoil horizons. The organisation of the soil profile and in particular the heterogeneity of fresh litter input may be the most important parameter determining subsoil OM dynamics. All processes, which alter the horizontal organisation of soil, such as plant rooting and preferential flow pathways might influence controls on OM stabilisation in subsoils.



S07.06a - MECHANISMS OF C STABILIZATION AND SEQUESTRATION IN SOILS

Chair Persons:

Claudio Zaccone, Foggia - Italy

Claudio Marzadori, Bologna - Italy

Friday 06 July 2012 from 08:30 to 10:00. Room Leccio

S07.06a -1

*SOIL ORGANIC CARBON STOCKS IN SOUTHEAST GERMANY AS AFFECTED BY LAND USE,
SOIL TYPE AND SAMPLING DEPTH*

Martin Wiesmeier, Freising-Weihenstephan - Germany

S07.06a -2

*THE VARYING CONTRIBUTION OF PEDOGENE OXIDES AND CLAY MINERALS TO
STABILIZE CARBON ALONG A SLOPE TRANSECT*

Sebastian Doetterl, Louvain-la-Neuve - Belgium

S07.06a -3

THE EFFECTS OF LAND CONVERSION TO BIOENERGY CROPS ON SOIL CARBON

Gary Mcclean, Edinburgh - United Kingdom

S07.06a -4

COMPOSITION AND TURNOVER OF ORGANIC MATTER IN PERMAFROST SOILS

Robert Mikutta, Hannover - Germany

S07.06a -5

*A COMPARISON OF RADIOCARBON AGES IN ORGANIC CARBON OF CHARCOAL AND
PARTICLE-SIZE FRACTIONS IN A SANDY SOIL FROM SOUTH-EAST AUSTRALIA.*

Eleanor Hobley, Newcastle - Australia

S07.06a -6

*BIOLOGICAL PATHWAYS OF LITTER DECOMPOSITION AND SOIL CARBON STABILIZATION:
RETHINKING THE ROLE OF PLANT INPUTS AND MICROBIAL COMMUNITIES*

A. Stuart Grandy, Durham, NH - United States



S07.06a -1

SOIL ORGANIC CARBON STOCKS IN SOUTHEAST GERMANY AS AFFECTED BY LAND USE, SOIL TYPE AND SAMPLING DEPTH

Wiesmeier Martin^[1], Von Lützow Margit^[1], Spörlein Peter^[1], Geuß Uwe^[2], Hangen Edzard^[2], Reischl Arthur^[2], Schilling Bernd^[2], Kögel-Knabner Ingrid^[1]

^[1]Technische Universität München ~ Lehrstuhl für Bodenkunde, Department für Ökologie und Ökosystemmanagement, Wissenschaftszentrum Weihenstephan für Ernährung Landnutzung und Umwelt ~ Freising-Weihenstephan ~ Germany

^[2]Bayerisches Landesamt für Umwelt ~ / ~ Hof ~ Germany

Precise estimations of soil organic carbon (SOC) stocks are of decided importance for the detection of C sequestration or emission potential induced by land use changes. For Germany, a comprehensive, land use-specific SOC data set has not yet been compiled. We evaluated a unique data set of 1460 soil profiles in southeast Germany in order to calculate representative SOC stocks to a depth of 1 m for the main land use types. The results showed that grassland soils stored the highest amount of SOC whereas considerably lower stocks were found for forest and cropland soils. However, the differences between extensively used land (grassland, forest) and cropland were much lower compared with results from other studies in central European countries. The depth distribution of SOC showed that despite low SOC concentrations in A horizons of cropland soils, their stocks were not considerably lower compared with other land uses. This was due to a deepening of the topsoil compared with grassland soils. Higher grassland SOC stocks were caused by an accumulation of SOC in the B horizon which was attributable to a high proportion of C-rich Gleysols within grassland soils. This demonstrates the relevance of pedogenetic SOC inventories instead of solely land use-based approaches. Our study indicated that cultivation-induced SOC depletion was probably often overestimated since most studies use fixed depth increments. We recommend SOC stocks be determined by horizon for the entire soil profile in order to evaluate C sequestration potentials more accurately.



S07.06a -2

THE VARYING CONTRIBUTION OF PEDOGENE OXIDES AND CLAY MINERALS TO STABILIZE CARBON ALONG A SLOPE TRANSECT

Doetterl Sebastian^{*[1]}, Jean-Thomas Cornelis^[2], Johan Six^[3], Kristof Van Oost^[1]

^[1]University of Louvain ~ TECLIM ~ Louvain-la-Neuve ~ Belgium ^[2]University of Louvain ~ ELIE ~ Louvain-la-Neuve ~ Belgium ^[3]University of California at Davis ~ Department of Plant Sciences ~ Davis ~ United States

Research in the Belgian Loambelt has shown that the quality and quantity of soil organic carbon (SOC) in sloping cropland differs with topographic position, despite similar soil substrate and drainage conditions. These differences were most visible in the subsoil, while the size and composition of topsoil C pools were similar along the hillslope. Relative to stable or eroding sites, three to nine times as much C is stored in the subsoil (up to 1m depth) of depositional sites. This is related to the burial of former topsoil and high amount of carbon there is stabilized mainly as microaggregate and silt associated C fractions. We assume that the presence of different forms of pedogene Oxides (PO) and varying clay mineralogy are crucial for these differences along the hillslope. Here, we present an analysis that aims to clarify the chemical and mineralogical components involved in stabilizing carbon at various depths and slope positions. The results show that forms of POs associated with different C pools differ clearly along the slope transect. At eroding sites, more POs are associated in metal-organic complexes, while at depositional sites more amorphous and poly-crystalline minerals can be found. These minerals have varying abundances within the different C fractions, with more amorphous and poly-crystalline POs associated with stable aggregates. In combination with a changing clay mineralogy based on the available substrate for soil formation, we conclude that these units are key for the understanding of the fate of eroded and buried carbon on the hillslope scale.



S07.06a -3

THE EFFECTS OF LAND CONVERSION TO BIOENERGY CROPS ON SOIL CARBON

Mcclean Gary*^[1]

^[1]University of Edinburgh ~ School of Geosciences ~ Edinburgh ~ United Kingdom

*As global demand for renewable energy increases to assist in reducing greenhouse gas (GHG) emissions, the projected future expansion in bioenergy production is expected to cause significant land-use change. The main aim of this project is to provide an improved understanding of changes in soil organic carbon (SOC) when land is converted from arable crops or grassland to willow short rotation coppice (SRC) or *Miscanthus x giganteus* bioenergy cropping systems. Studies indicate that, in addition to providing combustible material to substitute fossil fuels, these bioenergy crops may provide an additional benefit through SOC accumulation. However, other studies have found a loss in SOC following land-use change and the variation in results demonstrates the sensitivity of SOC to a range of factors such as climate, soil texture, previous land-use and SOC content. In this project soil samples have been taken from a chrono-sequence of 100 sites from across England, Scotland and Wales that are currently in transition to willow SRC or *Miscanthus* bioenergy plantations. Soil analysis for SOC content will help to determine the effects of 'time since change' for each land replacement scenario and to indicate the magnitude of any initial loss of soil C, the period of recovery and the new soil C equilibrium reached. The data collected in this study will help to quantify how land conversion from arable crops or grassland to *Miscanthus* or willow SRC will affect soil C stocks and enable identification of optimal land for conversion to bioenergy cropping systems.*



S07.06a -4

COMPOSITION AND TURNOVER OF ORGANIC MATTER IN PERMAFROST SOILS

Mikutta Robert^[1], Shibistova Olga^[1], Meyer-Stüve Sandra^[1], Marschner Bernd^[2], Guggenberger Georg^[1]

^[1]Leibniz Universität ~ Institut für Bodenkunde ~ Hannover ~ Germany ^[2]Ruhr-Universität Bochum ~ Geographisches Institut ~ Bochum ~ Germany

About 1600 Gt of organic C (OC) is stored in permafrost-affected soils, representing 21 to 27% of the world's OC. Facilitated permafrost thawing and active layer thickening in pan- and subarctic environments have raised concerns about the release of formerly stabilized C and the positive feedbacks on global warming. The response of permafrost-affected tundra soils to climate change will strongly depend on the amount of labile vs. stable OC stored in different horizons (e.g., active layer, cryoturbated horizons, permafrost) and the respective composition of organic matter (OM). In this study we focus on the turnover and composition of OM in permafrost-affected, cryoturbated tundra soils of the Siberian subarctic. Soils of three different tundra types, namely 'grass', 'tussock grass' and 'moss-shrubby' tundra, were sampled along a North-South gradient near the Kolyma river in Eastern Siberia. In each tundra type, we analyzed the contribution of particulate vs. mineral-associated OC in all main soil horizons following density fractionation with sodium polytungstate (1.6 g cm⁻³). Organic matter in each fraction was characterized by stable isotope composition (¹³C, ¹⁵N) and analysis of the lignin content (CuO oxidation). The apparent age of OM in these fractions was determined by AMS-¹⁴C dating, and the potential OM decomposability by aerobic incubation. The information about the functional and molecular composition of OM was related to apparent and potential turnover rates, providing new evidence about the role of abiotic factors (temperature, anaerobiosis) vs. OM quality and mineral protection for the bioavailability of OC in permafrost soils.



S07.06a -5

A COMPARISON OF RADIOCARBON AGES IN ORGANIC CARBON OF CHARCOAL AND PARTICLE-SIZE FRACTIONS IN A SANDY SOIL FROM SOUTH-EAST AUSTRALIA.

Hobley Eleanor^{*[1]}, Willgoose Garry^[1], Frisia Silvia^[2], Jacobsen Geraldine^[4]

^[1]University of Newcastle ~ Environmental Engineering ~ Newcastle ~ Australia ^[2]University of Newcastle ~ Geology ~ Newcastle ~ Australia ^[3]Australian Nuclear Science and Technology Organisation ~ Radiocarbon ~ Sutherland ~ Australia ^[4]Australian Nuclear Science and Technology Organisation ~ Accelerator Mass Spectrometry ~ Sutherland ~ Australia

Radiocarbon concentration of charcoal and 3 particle-size fractions (PSFs) ("macro": 2000–200 μm , "micro": 200–60 μm , and "mineral-associated OC, MAOC": < 60 μm) were compared at 4 depths to bedrock on a sandy tenosol from SE-Australia. In the topsoil (0–30cm), all PSFs were modern, although there was a slight depletion (1.3 - 1.6 pmC) with decreasing size. The charcoal from this depth was 85 years old, depleted by over 10 pmC compared with PSFs. At 30–60 cm charcoal was 2540 years old, over 12 times as old as the youngest fraction. At this depth, micro-OC was older (550 years BP) than the other PSFs, (macro: 205 years BP, MAOC: 330 years BP). Charcoal fragments were visible and possibly accumulated in the micro-fraction, inducing its lower C14 concentrations. Assuming an age intermediate to the macro and MAOC fractions for non-charcoal OC in the micro fraction, the amount of charcoal required to account for the shift in C14 dates would be 12.4% ($\pm 2.4\%$). The trend of oldest OC in the micro-fraction continued at 60–100 cm, but no charcoal was visible. Near bedrock (100–120 cm) C14 concentrations of the three PSFs did not differ significantly: all PSFs were ca. 1270 years old. Our results confirm the hypothesis that charcoal is a highly recalcitrant form of SOC. However, C14 ages of the PSFs at 100–120 cm were half those of charcoal at 30–60 cm, indicating that charcoal does not contribute to OC stabilisation near bedrock in this soil.



S07.06a -6

**BIOLOGICAL PATHWAYS OF LITTER DECOMPOSITION AND SOIL CARBON STABILIZATION:
RETHINKING THE ROLE OF PLANT INPUTS AND MICROBIAL COMMUNITIES**

Grandy A. Stuart*^[1], Wickings Kyle^[1]

^[1]University of New Hampshire ~ Natural Resources and Environment ~ Durham, NH ~ United States

Microbes are the engines that drive decomposition, but to what degree are decomposition and soil organic matter (SOM) formation dependent upon the structure and function of unique microbial communities? Historically, theories on the formation of soil organic matter have focused on two major paradigms. The first focused on the decomposition of litter inputs and the influence of litter quality therein (e.g. lignin/N ratio). The other focused on the abiotic and chemical alteration of litter inputs that can increase the chemical complexity of SOM. More recent conceptual developments and experimental evidence increasingly point to a significant direct contribution of microbially-derived products to stable SOM formation. This new model has implications that may overturn these decades-old paradigms: 1) changes in the molecular structure of decomposing plant litter are directly dependent upon decomposer community dynamics; 2) the molecular chemical diversity of microbial cells, metabolites, and transformation products – rather than the chemistry plant litter inputs – may be the origin of the molecular diversity of SOM; 3) the sorption of microbially-derived products on minerals may be the ultimate source of stable SOM; and 4) conditions that influence microbial processing and sorption (e.g. soil mineralogy, temperature, and microbial community structure) could have an overriding effect on SOM formation. This talk will explore my lab's current and future efforts to understand how decomposer communities influence SOM formation.



S07.06b - MECHANISMS OF C STABILIZATION AND SEQUESTRATION IN SOILS

Chair Persons:

César Plaza, Madrid - Spain

Manuel Tejada, Seville - Spain

Friday 06 July 2012 from 10:30 to 12:15. Room Leccio

S07.06b -1

FRACTIONS MEET FLUXES –WHAT DETERMINES THE DISTRIBUTION OF SOIL CARBON OVER DENSITY FRACTIONS AND HOW DOES IT RELATE TO TURNOVER?

Marion Schrumpf, Jena - Germany

S07.06b -2

IS STABLE ORGANIC MATTER PHYSICALLY PROTECTED ? AN APPROACH USING LONG TERM BARE FALLOW EXPERIMENTS

Remigio Paradelo Celso, Grignon - France

S07.06b -3

STABILIZATION OF ORGANIC MATTER BY ADSORPTION TO AND COPRECIPITATION WITH FERRIHYDRITE

Chunmei Chen, Newark - United States

S07.06b -4

RELATION BETWEEN LIGNINS AND ALIPHATIC CONSTITUENTS IN SOILS HIGHLIGHTED BY AN ISOLATION PROCEDURE: IMPLICATION FOR LIGNIN DEGRADATION ?

Mathieu Thevenot, Villeneuve d'Ascq - France

S07.06b -5

HUMIN: IS IT A REALLY A HUMIC SUBSTANCE?

Roger Swift, Queensland - Australia

S07.06b -6

MINERAL-ASSOCIATED SOIL C STABILIZATION IN THE 80 YEARS BARE FALLOW CHRONOSEQUENCE

Claire Chenu, Thiverval-Grignon - France



S07.06b -7

*SOIL AGGREGATE- AND PARTICLE-ASSOCIATED ORGANIC CARBON AND NITROGEN
POOLS UNDER DIFFERENT LAND USES IN ETHIOPIA*

Aweke Gelaw, Aas - Norway



S07.06b -1

FRACTIONS MEET FLUXES –WHAT DETERMINES THE DISTRIBUTION OF SOIL CARBON OVER DENSITY FRACTIONS AND HOW DOES IT RELATE TO TURNOVER?

Schrumpf Marion^{*[1]}, Kaiser Klaus^[2], Guggenberger Georg^[3], Persson Tryggve^[4], Ingrid Kögel-Knabner^[5], Ernst-Detlef Schulze^[1]

^[1]Max-Planck-Institute for Biogeochemistry ~ Biogeochemical Processes ~ Jena ~ Germany ^[2]Martin Luther University Halle-Wittenberg ~ Soil Sciences ~ Halle ~ Germany ^[3]Leibniz Universität Hannover ~ Institute of Soil Science ~ Hannover ~ Germany ^[4]Swedish University of Agricultural Sciences ~ Department of Ecology ~ Uppsala ~ Sweden ^[5]Freising ~ Chair of Soil Science ~ Technische Universität München ~ Germany

Physical fractionation procedures isolate soil fractions of different functions. We aimed at determining (1) factors that control the distribution of organic carbon (OC) over density fractions and (2) how soil OM stability relates to those fractions. We sampled 12 European sites under different land use, climate, and soil types, taking 10 replicate soil cores per site. Carbon and nitrogen concentrations, ^{13}C , and ^{14}C content were measured in three density fractions (free light fraction, fLF, occluded light fraction, oLF, heavy fraction $>1.6 \text{ g cm}^{-3}$, HF). Carbon mineralization rates were determined in the laboratory. The contribution of LF to OC stocks varied between 5 and 65% in the 0–10 cm layer and decreased with soil depth. Root litter seems to be the most important source for fLF-OC, while dissolved organic carbon determined the depth distribution and the age of HF-OC in total profiles. OC of all fractions of the upper soil layer was young and mineralization rates were related to OC in all fractions. Larger differences between fractions occurred in deeper soil layers where especially HF-OC became older. CO_2 release per g OC in samples as well as ^{14}C data were related to fLF-OC in subsoil layers, indicating larger microbial activity with more input of new organic material. Land use affects the distribution of OC across fractions by selection of different plant functional types and soil disturbance or mixing by plowing. As mineralization rates are linked to fLF-OC, distribution of belowground carbon input strongly influences carbon dynamics in subsoils.



S07.06b -2

IS STABLE ORGANIC MATTER PHYSICALLY PROTECTED ? AN APPROACH USING LONG TERM BARE FALLOW EXPERIMENTS

Paradelo Celso Remigio^{*[1]}, Claire Chenu^[1], Folkert Van Oort^[2]

^[1]AgroParisTech ~ Bioemco ~ Grignon ~ France ^[2]INRA ~ Pessac ~ Versailles ~ France

Disentangling the different processes responsible for the stabilization of soil organic matter on the long term is especially difficult. The long term bare fallow of Versailles (42 plots) offers a double opportunity: (i) after 80 years of bare fallow most of total organic carbon is kinetically stable; and (ii) the bare fallow plots have been amended annually with different treatments leading to very contracted soil structure, at least visually. We used this experiment to analyse the impact of soil structure on the amount of stable organic carbon. Reference, CaCO₃ or KCl plots soil were studied. Soil macroaggregation and microaggregation as well as C contents and stocks in the upper 20 cm layer were quantified. CaCO₃ plots soil exhibited a more aggregated soil structure than KCl and reference plot, although the differences were small for microaggregation. Only small differences were found in the C stocks between treatments, indicating that the better structure in the carbonate plots did not provide for much protection against organic matter mineralization in the long term. Two hypothesis are proposed, not exclusive: (i) at this time scale C is rather protected by adsorption to minerals and (ii) stable C is protected at finer spatial scales, i.e. in clay-size aggregates.



S07.06b -3

STABILIZATION OF ORGANIC MATTER BY ADSORPTION TO AND COPRECIPITATION WITH FERRIHYDRITE

Chen Chunmei^{*[1]}, Aufdenkampe Anthony^[2], Dynes James^[3], Wang Jian^[3], Regier Tom^[3], Sparks Donald^[1]

^[1]University of Delaware ~ Plant and Soil Sciences ~ Newark ~ United States ^[2]Stroud Water Research Center ~ none ~ Avondale ~ United States ^[3]Canadian Light Source ~ none ~ Saskatoon ~ Canada

Intimate association with mineral phases has been recognized as a fundamental mechanism of stabilizing organic matter (OM) against biological degradation, and is therefore a major control for soil carbon storage. Ferrihydrite, because of its ubiquitous occurrence in the environment and its high surface area, contributes significantly to the sorption of OM and protects it against microbial degradation in soils and sediments. In addition, ferrihydrite often forms in the presence of dissolved organic matter in the natural environment, which leads to coprecipitation of OM with ferrihydrite. However, the extent and mechanisms of OM adsorption to or coprecipitation with ferrihydrite, and the consequences of such reactions for the properties of sorbed versus coprecipitated OM remain largely unknown. In this study, we compared adsorption and coprecipitation with dissolved organic matter from a forest litter layer. The objectives of this study were (1) to compare OM loading on ferrihydrite via adsorption and coprecipitation; (2) to examine the chemical fractionation of OM and the mechanisms of organo-ferrihydrite complex formation associated with these two processes using NEXAFS and FTIR spectroscopy; (3) to assess the stability of sorbed and coprecipitated OM against desorption and thermal treatments; and (4) to study the spatial distribution, macromolecular structure and chemical composition of sorbed and coprecipitated OM at the nanometer-scale by scanning transmission X-ray microscopy (STXM). This study will improve our understanding of the coprecipitation of dissolved organic matter with iron precipitates, which is an important process for carbon accumulation in natural systems.



S07.06b -4

RELATION BETWEEN LIGNINS AND ALIPHATIC CONSTITUENTS IN SOILS HIGHLIGHTED BY AN ISOLATION PROCEDURE: IMPLICATION FOR LIGNIN DEGRADATION ?

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Lignins are a major aromatic constituent of plant biomass. Lignins were suggested to contribute to stable C in soils. Recent studies, using CuO oxidation, identified two kinetic lignin pools in soils. However, the CuO method releases phenol monomers from the less condensed part of lignins only. The milled wall enzymatic procedure was developed to isolate a fraction of intact lignin polymer (MWEL). We used this technique to study the dynamics of isolated soil-MWEL in the experimental field of "les Closeaux", where a C3/C4 vegetation succession induced a natural ¹³C labelling of soil organic matter. We isolated MWEL from maize (C4) and wheat (C3) plants, from a wheat-soil and a soil after 9-years maize cropping. Lignin yields, elementary composition, ¹³C-isotopic signature and chemical structure were analysed. ¹³C Nuclear Magnetic Resonance (NMR) spectroscopy revealed that soil-MWEL contained aliphatic compounds, while plant-MWEL were associated with polysaccharides. The presence of aliphatic moieties in soil-MWEL could explain the decrease of their O/C ratio and the increase of their H/C ratio compared to the plant-lignins. Close association of lignins with hydrophobic aliphatic constituents in soils could limit their degradability. The evolution of the ¹³C-isotopic signature of the MWEL-lignins from soil was compared to those of the lignin monomers released by the CuO method and of the bulk SOC. We conclude that lignin fate in soil is not only dependent of their chemical structure but also related to their interactions in soil with other compounds, which nature and variability remain to be defined.



S07.06b -5

HUMIN: IS IT A REALLY A HUMIC SUBSTANCE?

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The classical humic fractions are differentiated on the basis of solubilities in aqueous media. By these definitions, humin is a significant and highly-resistant soil humic component which is insoluble in both acidic and basic media. Its lack of solubility and extractability in aqueous media has greatly limited compositional studies of humin. In this study soils were exhaustively extracted with aqueous media at pH values of 7, 10.6, and 12.6, and 0.1M NaOH + 6M urea. Separations at the different pH values represent differences in solubility and charge densities of the humic components. Solid state CPMAS ¹³C NMR and functional group analyses studies have shown that all of these fractions have compositions typical of humic substances. The substantial amount of organic matter still remaining in the soil is, by definition, humin. Following the exhaustive extraction, the soil was dried then extracted with DMSO and concentrated H₂SO₄ (94:6) which solubilised and extracted the humin. Diffusion edited proton NMR spectra of the isolated humin show that it is composed of predominantly aliphatic materials comprised mainly of plant lipids, waxes, and hydrocarbon structures with small amounts of carbohydrates and peptides. There is very little evidence of aromatic or lignin-derived structures in this fraction. On this evidence humin does not satisfy the classical definitions for humic substances.



S07.06b -6

MINERAL-ASSOCIATED SOIL C STABILIZATION IN THE 80 YEARS BARE FALLOW CHRONOSEQUENCE

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Rates of soil organic matter decomposition, soil organic carbon (SOC) stabilizing processes and their relative strength are still poorly understood. Bare fallows in long-term agronomic experiments, provide unique opportunities to understand SOC decay and stabilization, as changes in amount and quality of the initial SOC can be followed with no contribution of fresh organic matter inputs. To understand the importance of SOC stabilization mechanisms we faced questions: (i) what are the rates of depletion for separable SOC fractions? (ii) What is the final stable SOC pool comprised of? We studied the chronosequence of samples from a long-term experiment of bare fallow in Versailles, France. Soil samples, taken from the 0-20 cm depth in 1929, 1939, 1949, 1962, 1972, 1991, 2008. We obtained fractionation: clay <2 µm, silt-size (2-50 µm) light (LF) and heavy fractions (HF), fine sand (50-200 µm) POM and HF, and coarse sand (>200 µm). We measured C, N and d13C concentrations as well as dissolved organic carbon. The studied soil was polluted by charcoal during the war period in 1940s. To take this into account the decay of SOC pools excluding charcoal was modeled using C/N ratio development in the chronosequence. Results show the major SOC stabilization mechanism in long-term is association with minerals. In particular, clay-size minerals had the strongest ability to stabilize SOC, whereas clay-associated labile SOC pool was the slowest among others. C turnover rates follow the order: DOM, POM (5-10yr) < LF (15-20 yr) < silt HF (20-30 yr) < clay (30-40 yr).



S07.06b -7

SOIL AGGREGATE- AND PARTICLE-ASSOCIATED ORGANIC CARBON AND NITROGEN POOLS UNDER DIFFERENT LAND USES IN ETHIOPIA

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Soil aggregation is the main process whereby soil organic carbon (SOC) and total nitrogen (TN) are retained in soils. Thus, aggregate and particle associated SOC and TN in surface and sub-surface layers were estimated following standard procedures for five land uses on a watershed in Ethiopia. The land uses were rainfed crop production (RF), agroforestry (AF), grazing/pasture (OP), silvopasture (SP), and irrigation (IR) with five replications each. Land use had significant effects on soil aggregation and SOC concentrations associated with macroaggregates ($P = 0.0017$) in the 0-10 cm layer. OP had the highest water stable aggregates and SOC associated with macroaggregates (19.95 gkg^{-1}) which were significantly higher ($P < 0.0001$; $P = 0.0017$) than those in other land uses. SOC associated with both macro and microaggregates decreased with depth. Macroaggregates contained higher SOC concentrations than microaggregates in both layers and all land uses. AF had the highest SOC associated with microaggregates indicating the potential of AF in stabilizing SOC. TN followed a similar trend to that of SOC. Land use also had significant effects on SOC and TN concentrations associated with sand particles. OP had the highest SOC and TN associated with sand particles. OP, SP and AF had higher SOC concentrations associated with clay particles showing the potentials of grass and tree based systems in stabilizing SOC. Key words: Aggregation, C-sequestration, C-sink capacity, land use, Ethiopia



S07.07a - LONG-TERM EFFECTS OF AGRONOMIC PRACTICES ON SOIL ORGANIC MATTER AND CROP PRODUCTIVITY

Chair Persons:

Domenico Ventrella, Bari - Italy

Rosa Francaviglia, Roma - Italy

Friday 06 July 2012 from 10:30 to 12:00. Room Olmo

S07.07a -1

*LONG-TERM RESEARCHES FOR TYPICAL CROPPING SYSTEMS OF SOUTHERN ITALY:
EFFECTS ON SOIL FERTILITY AND CROP YIELD*

Domenico Ventrella, Bari - Italy

S07.07a -2

*SOIL ORGANIC CARBON TRENDS IN ARABLE SOILS: INTERPRETING IMPERFECT
EVIDENCE FROM EXPERIMENTS AND MAKING PRACTICAL MANAGEMENT DECISIONS*

David Powlson, Harpenden - United Kingdom

S07.07a -3

*LONG-TERM EFFECTS OF MINERAL FERTILISERS AND ORGANIC MANURES ON SOIL
ORGANIC MATTER AND CROP PRODUCTION*

Andrew Macdonald, Harpenden - United Kingdom

S07.07a -4

*SHORT- AND LONG-TERM EFFECTS OF DIFFERENT ORGANIC CARBON INPUTS ON CROP
YIELDS AND SOIL FERTILITY EVALUATED IN SWEDISH LONG-TERM FIELD EXPERIMENTS*

Thomas Kätterer, Uppsala - Sweden

S07.07a -5

*SUSTAINABILITY OF CROPPING SYSTEMS IN NUTRIENT LIMITING CONDITIONS IN A
MEDITERRANEAN ENVIRONMENT*

Antonio Berti, Legnaro (PD) - Italy

S07.07a -6

*LONG-TERM EFFECTS OF AGRONOMIC PRACTICES ON SOIL ORGANIC CARBON AND
CROP PRODUCTIVITY IN THE INTERNAL HILLS OF SICILY*

Salvatore Luciano Cosentino, Catania - Italy



S07.07a -1

**LONG-TERM RESEARCHES FOR TYPICAL CROPPING SYSTEMS OF SOUTHERN ITALY:
EFFECTS ON SOIL FERTILITY AND CROP YIELD**

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Management of crop residues, crop rotation and soil tillage are important agronomic practices that can conserve or greatly influence the soil fertility in term of content of soil organic carbon and crop productivity. In order to determine long-term dynamics of such practices, long-term field researches have been established in Southern Italy by the Research unit for cropping systems in dry environments of the Agricultural Research Council. At the experimental farm in the Northern part of Apulia Region, three long-term trials are currently being carried out on clay-loam soil since 1977, 1989 and 1990. A series of treatments on the effects of burning or incorporation of crop residues, soil tillage and crop rotations based on winter durum wheat have been compared. At the experimental farm of CRA-SCA in the central part of Apulia, since 1976 almond plants have been submitted to different treatments consisting of weed management based on chemical weeding, weed mulching, weed incorporation through minimum and conventional tillage. In general the incorporation of straw and stubble showed slight increments in organic soil matter respect to burning. The best results for soil organic carbon and soil quality were obtained when residual incorporation included a treatment with additional mineral nitrogen. The tillage method did not influence the organic carbon, total nitrogen and available phosphorous contents of the soil, nor did crop rotations. In the almond trial, no-tillage with green mulching determined a general increase of TOC with respect to other treatments.



S07.07a -2

SOIL ORGANIC CARBON TRENDS IN ARABLE SOILS: INTERPRETING IMPERFECT EVIDENCE FROM EXPERIMENTS AND MAKING PRACTICAL MANAGEMENT DECISIONS

Powlson David^[1], Whitmore Andy^[1], Coleman Kevin^[1], Macdonald Andy^[1], Glendining Margaret^[2]

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Soil organic carbon (SOC) content in arable soils in temperate regions changes slowly in response to changing management. Consequently long-term experiments are an essential tool to detect these changes. But results require careful interpretation, taking account of any inherent limitations in experiments. A review of the impacts of cereal straw incorporation on SOC, based on 25 long-term experiments in three continents, showed (as expected) a general trend towards decreased SOC where straw was removed. However, the decreases were small (usually <10%) and only statistically significant in a quarter of cases. Yet there is evidence that small changes in total SOC can have significant effects on soil physical properties relevant to crop growth, such as aggregate stability, water infiltration and ease of tillage. Such findings have practical and policy implications for decisions on the removal of straw as a biofuel feedstock; the impact on soil quality may be significant even if the decrease in SOC is small. SOC content moves from one quasi-equilibrium value to another under the influence of management practices; it does not increase or decrease indefinitely. This, and indirect and off-site impacts of SOC changes that are sometimes overlooked, are limitations to the potential for soil C sequestration to mitigate climate change. Nevertheless, practices to increase or maintain SOC are important for soil functioning and sustainable agriculture. A combination of long-term data, measurements of specific SOC fractions, and C modelling are important elements for constructing tools for translating academic understanding of SOC into practical decision making.



S07.07a -3

LONG-TERM EFFECTS OF MINERAL FERTILISERS AND ORGANIC MANURES ON SOIL ORGANIC MATTER AND CROP PRODUCTION

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The long-term experiments at Rothamsted date from 1843 when a series of field experiments began to examine the effect of inorganic fertilisers (N, P, K, Mg & Na) and organic manures, including Farmyard Manure (FYM), on crop production and soil fertility. These included studies on winter wheat (Broadbalk 1843) and spring barley (Hoos Barley 1852). Long-term additions of FYM have substantially increased the soil organic matter (SOM) content of the plough layer (0-23cm) on some of the plots on Broadbalk and Hoosfield, but for many years this extra SOM had little benefit on grain yields compared with crops given inorganic fertilisers. However, with the introduction of cereal varieties with greater yield potential, and the appropriate use of fungicides, larger yields were achieved on soils with greater SOM plus mineral N. Currently on Broadbalk, yields of first wheats after a 2-year break given FYM plus additional N fertiliser are similar to the greatest yields achieved with mineral fertilisers alone. In contrast, yields of continuous spring barley on Hoosfield given FYM for many years, with or without additional fertiliser N, are often greater than can be achieved by mineral fertilisers alone. The reasons for this almost certainly include effects of SOM on nutrient supply (especially N), soil structure, water retention and root growth. The Rothamsted Long-term Experiments are a useful resource with which to further examine the effects of organic manures and soil organic matter on new, potentially higher-yielding, cereal varieties in future.



S07.07a -4

SHORT- AND LONG-TERM EFFECTS OF DIFFERENT ORGANIC CARBON INPUTS ON CROP YIELDS AND SOIL FERTILITY EVALUATED IN SWEDISH LONG-TERM FIELD EXPERIMENTS

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Crop residues and organic amendments applied to soil affect crop yields depending on their nutrient concentration. However, short-term effects may differ from long-term effects due to feedbacks on soil fertility. Based on results from Swedish long-term field experiments we compared effects on crop yields and soil organic matter stocks following continuous applications of high-N organic materials such as farmyard manure, sewage sludge, household compost and green manure with those after application of low-N organic materials such as straw, peat and sawdust in combination with or without mineral N fertilization. Generally, nitrogen-rich manures caused a yield increase whereas nitrogen-poor organic amendments caused a two-phase yield response; initially declining trends in crop yields converted to increases exceeding those in the control after about three decades. Combinations of low-N amendments and N fertilizer resulted in higher yields than only N fertilization. Higher soil organic matter contents induced by combining organic amendments and N fertilization are mainly explained by a higher root input. Thus, farming practices that lead to increased crop yields will also result in increasing soil organic matter stocks. This positive feedback due to N fertilization can probably also explain why soil organic matter content can be maintained on many Swedish farms even without applying manure. In more extensive arable systems, however, manure application and/or perennial crops in rotation are necessary for maintaining soil fertility. We emphasize that in addition to the short-term fertilizer value of organic amendments, the long-term effects on soil fertility should be considered.



S07.07a -5

SUSTAINABILITY OF CROPPING SYSTEMS IN NUTRIENT LIMITING CONDITIONS IN A MEDITERRANEAN ENVIRONMENT

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In the recent years the average amount of fertilisers used in Italy has markedly decreased as the result of external constraints, such as the increase of fertilizer costs and the introduction of regulations to limit phytonutrient losses. This tendency can have positive effects, promoting a more efficient use of production factors and improving environmental quality, but create a concern on which amount of reduction can be achieved maintaining a long-term sustainability of cropping systems. Soil can act as a buffer in the short term, supplying an input deficit, but its ability to sustain crop growth is limited. Deployment of soil nutrient stock has a consistent impact on other soil traits, mainly related to SOC content (eg. soil structure, water retention, C sequestration). Long-term experiment can give important information on these subjects, allowing to highlight even subtle changes in soil fertility and crop production trends. The present contribution aims to summarize the results obtained in a long-term experiment where different cropping systems and intensification practices has been compared since 1962. The sustainability of the systems has been evaluated in terms of nutrient balances, SOC dynamic and soil quality indicators (eg. aggregate stability, water retention). The implication of the observed changes and the potential effects of actual regulations on nutrient supply are then discussed.



S07.07a -6

LONG-TERM EFFECTS OF AGRONOMIC PRACTICES ON SOIL ORGANIC CARBON AND CROP PRODUCTIVITY IN THE INTERNAL HILLS OF SICILY

Cosentino Salvatore Luciano*^[1], Scalici Giovanni^[1], Ambra Riccardo^[1], Guarnaccia Paolo^[1], Copani Venera^[1]

^[1]Università degli Studi di Catania ~ DISPA ~ Catania ~ Italy

In the hilly areas of Mediterranean environment the high intensity of autumnal rains determines high level of soil erosion losses in agricultural field reducing the soil fertility in the long run. In Sicily region this phenomenon have been emphasized by the crop management and by the orography of the territory. The experimental farm of UNICT for the collection of surface runoff is located in the c.da Manca di Geracello, Enna (550 m a.s.l., 37° 21'N, 14°16'E). The establishment consists of 12 plots. In the last sixteen years (1996-2011) the study of the impact assessment of various herbaceous cropping systems, both in terms of crop rotation (one crop, alternating different crops), crop habit (annual or perennials), types of soil tillage (traditional, minimum tillage, no tillage) on the dynamics of soil organic matter was carried out. The soil organic matter content, according to the depth of measurement (0-30 and 31-60 cm), the portion on the plot where the sample was taken (high, medium, low), and the season (winter and summer), was found significantly different according to the different cropping systems. The variation of organic matter in time was depending upon the soil tillage (plowing or not and sod seeding), the habitus of crop (annual or perennial). In the case of perennial the organic matter increased from 1.2 to 2.2%. The sod seeding allowed to take the organic matter around 1.8-2.0%



S07.07b - LONG-TERM EFFECTS OF AGRONOMIC PRACTICES ON SOIL ORGANIC MATTER AND CROP PRODUCTIVITY

Chair Persons:

Rosa Francaviglia, Roma - Italy

Domenico Ventrella, Bari - Italy

Friday 06 July 2012 from 13:30 to 15:00. Room Olmo

S07.07b -1

CONTRIBUTION OF AGRICULTURAL CROP RESIDUE-C TO STABILIZED SOIL ORGANIC MATTER

Paul Voroney, Guelph - Canada

S07.07b -2

RESPONSE OF SOIL ORGANIC MATTER AND SOIL MICROBIAL ACTIVITY TO LONG-TERM REDUCED TILLAGE UNDER ORGANIC FARMING

Paul Mäder, Frick - Switzerland

S07.07b -3

DOES NO TILL INCREASE SOIL CARBON SEQUESTRATION ON THE LONG-TERM IN EUROPEAN TEMPERATE CLIMATE? ANALYSIS OF A LTE IN NORTHERN FRANCE

Bassem Dimassi, Laon - France

S07.07b -4

LONG-TERM EFFECTS OF DIFFERENT FORMS OF ORGANIC FERTILIZERS AND TILLAGE ON SOIL ORGANIC CARBON AND CROP YIELDS

Sokrat Sinaj, Changins - Switzerland

S07.07b -5

LONG-TERM TILLAGE TREATMENTS IMPACT ON THE PROPERTIES OF A HEAVY CLAY SOIL: INTERACTIONS BETWEEN ORGANIC CARBON, CLAY CONTENT, MICROBIAL ACTIVITY AND PHYSICAL PROPERTIES.

Pascal Boivin, Genève - Switzerland

S07.07b -6

IMPACTS OF ARABLE MANAGEMENT ON SOIL ORGANIC CARBON AND CROP PARAMETERS

Heide Spiegel, Vienna - Austria



S07.07b -1

CONTRIBUTION OF AGRICULTURAL CROP RESIDUE-C TO STABILIZED SOIL ORGANIC MATTER

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*Inputs of crop residues in agricultural soils are the primary means of sustaining soil organic matter levels. A field study was set out in 1990 to quantify tillage effects on crop residue-C decay and on its subsequent formation of stable soil organic matter. At crop harvest, ¹⁴C-labeled, above-ground residues representative of common agricultural crops grown in southern Ontario, corn (*Zea mays* L.), soybeans (*Glycine max* L.), winter wheat (*Triticum aestivum* L.), winter rye (*Secale cereale* L.) and tobacco (*Nicotiana tabacum* L.), were added to soils managed under conventional (CT) mouldboard plough-disc and conservation tillage (RT). Recovery of crop residue derived-C was measured as ¹⁴C remaining in the upper 40 cm depth, and expressed on an equivalent soil mass. Kinetic analysis of the pattern of crop residue decay showed that under CT the labile component was larger and decayed faster compared with RT. This suggests that incorporated residues were exposed to a more favorable environment for microbial activity compared with residues left on the soil surface. Averaged over all crops, the resistant component contributing to formation of stable soil organic matter was 50.3% larger under RT, though it decayed at a slightly faster rate, $t_{1/2} = 7.3$ y, vs $t_{1/2} = 8.6$ y under CT. While these results confirm the benefits of adoption of conservation tillage practices on slowing the decay of the labile component of crop residues, tillage practices had no effect on the proportion of residue-derived C becoming stabilized soil organic matter in the long term.*



S07.07b -2

RESPONSE OF SOIL ORGANIC MATTER AND SOIL MICROBIAL ACTIVITY TO LONG-TERM REDUCED TILLAGE UNDER ORGANIC FARMING

Mäder Paul^[1], Berner Alfred^[1], Fliessbach Andreas^[1], Krauss Maïke^[1], Gadermaier Florian^[3], Schader Christian^[2], Meier Matthias^[2], Niggli Urs^[2]

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Soil organic carbon represents an important carbon pool guaranteeing the numerous soil functions such as soil nutrient cycling and carbon sequestration. Both, organic farming and reduced tillage can enhance SOC levels, but there is a lack of information concerning the combined effects of reduced tillage under organic farming. We assessed the effects of reduced tillage (chisel/"stubble cleaner" = Stoppelhobel in German) versus an ordinary plough system over a six year crop rotation under temperate climate on a clayey loam in a ley rotation. Yields were lower during the conversion period to reduced tillage, but were higher in the second experimental phase, rendering to an all over yield increase of 11% compared to the plough system. SOC levels in the 0-10 cm soil depth increased by 17% (3.7 g kg⁻¹ soil), soil microbial biomass by 37% and dehydrogenase (DHA) was enhanced by 57% in reduced tilled plots. While no changes of SOC were measured in the soil layer 10-30 cm, DHA was increased by 16% in the soil layer 10-20 cm. SOC increase accounted for 1.3 t carbon sequestration ha⁻¹ year⁻¹. An improved climate impact model based on IPCC, including also SOC gains, revealed over 2 t CO₂ capturing ha⁻¹ year⁻¹ in the reduced tillage system, whilst in the plough system only 0.55 t of CO₂ ha⁻¹ year⁻¹ were fixed in the soil (long term storage). We conclude that reduced tillage systems under organic farming in particular have a high sink potential for CO₂, while improving productivity and soil fertility.



S07.07b -3

DOES NO TILL INCREASE SOIL CARBON SEQUESTRATION ON THE LONG-TERM IN EUROPEAN TEMPERATE CLIMATE? ANALYSIS OF A LTE IN NORTHERN FRANCE

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Many studies have shown that reduced tillage systems such as shallow till (ST) and no till (NT) can be efficient strategies to increase soil organic carbon (SOC) compared to inversion tillage (IT), with a mean rate of sequestration of 100 to 200 kg C ha⁻¹ per year (Lal, 2004; IPCC, 2007). However, several recent meta-analyses (e.g. Angers et al, 2008; Luo et al, 2010; Virto et al, 2011) add controversy, showing that C sequestration can vary from significantly positive to negative values. Long term experiments (LTE) are invaluable tools to bring reliable conclusions on these effects. We examined one of the oldest LTEs in the world, located at Boigneville in Northern France. Three tillage systems have been differentiated for 40 years, in a maize–wheat rotation: NT, ST tilled down to 5-8 cm depth and IT tilled down to 25 cm by mouldboard ploughing. SOC and SON (nitrogen) contents were measured every 4 years since 1970. Bulk density was measured in some years before 1990 and regularly from 2000 onwards. SOC stocks were calculated on the basis of constant soil mass. The first results obtained show that SOC increased slightly versus time in all treatments. The increase was faster in NT and ST than IT during the first 10-15 years, but slower (even negative) during the last 30-40 years. After 40 years, SOC distribution in soil profile was very different between treatments, suggesting different turnover times. These results will be thoroughly examined as well as the uncertainty on SOC estimates.



S07.07b -4

**LONG-TERM EFFECTS OF DIFFERENT FORMS OF ORGANIC FERTILIZERS AND TILLAGE
ON SOIL ORGANIC CARBON AND CROP YIELDS**

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Easier access to synthetic fertilizers and specialization of farms led to the decrease in the use of manure on stockless farms and to the simplification of crop rotation. The removal of manure causes a well documented decline in the content of soil organic carbon (SOC). The techniques of soil conservation (straw restoration, green manure and reduced-tillage) are known for their positive effects on the storage of SOC. They could potentially compensate for the absence of manure. However, these techniques must be integrated in sound cultural systems and their effectiveness must be evaluated. To answer these questions, two long-term field experiments were established in 1976 and 1997 by the Swiss Research Station Agroscope ACW. Both experiments were conducted on a Calcaric Cambisol with a crop rotation alternating spring and winter crops and including cereals, rapeseed and maize over a period of five to six years. The experiments were designed to compare the effects of manure and of three techniques for SOC conservation on SOC content and crop yields. The results show that the three soil conservation techniques and manure amendments to the usual dose (12 t cattle manure ha⁻¹ every year and / or 60 m³ cattle slurry manure ha⁻¹ every 3 years) were not sufficient, under Changins conditions, to maintain the initial level of SOC. In addition, the three soil conservation techniques were as effective as manure used at usual doses for storing SOC. These techniques showed lower potential yields and / or required increased nitrogen fertilizers.



S07.07b -5

LONG-TERM TILLAGE TREATMENTS IMPACT ON THE PROPERTIES OF A HEAVY CLAY SOIL: INTERACTIONS BETWEEN ORGANIC CARBON, CLAY CONTENT, MICROBIAL ACTIVITY AND PHYSICAL PROPERTIES.

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This study reports the changes in soil properties and crop yield observed after a 10 yearlong tillage experiment driven in Switzerland on a heavy clay soil. Reduced tillage (RT) and conventional tillage (CT) were compared based on yield monitoring, and soil sampling at three depths, namely topsoil, below the RT hardpan, and below the CT hardpan. Because of the well-known interactions between soil physical, chemical and biological properties, all analyses were performed together. The physical properties were determined from shrinkage analysis, thus making distinction between soil plasma and structural pores properties, and discriminating the role of pre-existing variability in soil constituents from the impact of tillage induced changes, based on analysis of covariance. After removal of the natural clay gradient effect, the results showed mostly a significant increase of SOC in RT compared to CT in topsoil. ANCOVA showed that the SOC increase determined most of the other soil properties such as increased porosity and structural porosity, increased available water and air, as well as increased microbial activity and related properties. These changes are modulated according to depth. After scaling of the soil properties with respect to SOC, an additional significant effect of the tillage treatment is revealed, that we attribute to mechanical impact of the tillage. Unsurprisingly, the yield monitoring showed a continuous increase of the production in the RT plots. On this heavy clay soil, the RT shows, therefore, promising results, and the observed changes are largely determined by the changes in SOC.



S07.07b -6

IMPACTS OF ARABLE MANAGEMENT ON SOIL ORGANIC CARBON AND CROP PARAMETERS

Spiegel Heide^{*[1]}, Dersch Georg^[1], Hösch Johannes^[1], Baumgarten Andreas^[1], Aichberger Karl^[2]

^[1]Austrian Agency for Health and Food Safety ~ / ~ Vienna ~ Austria ^[2]Austrian Agency for Health and Food Safety ~ / ~ Linz ~ Austria

Long term field experiments are indispensable to quantify the effects of changes in arable soil management such as tillage, organic and mineral fertilisation and the management of crop residues on different soil and crop parameters. The Austrian Agency for Health and Food Safety (AGES) runs field experiments since more than 20 years. The arable practices under study are: • different tillage systems ("conventional", "reduced", minimum) • different amounts and forms of nitrogen (N) and phosphorus (P) fertilisation • application of different composts (biowaste compost, green waste compost, cattle manure compost and sewage sludge compost) • management of crop residues (incorporation, removal) The results indicate that the maintenance of soil organic carbon (SOC) at the investigated sites is only possible, if tillage is reduced to a minimum and crop residues (cereal grain straw, maize stover, sugar beet leaves) remain on the field. 18 years of compost application result in a significant increase of SOC compared to mineral fertilisation. SOC decreases occur in the long-term with frequent tillage (two times a year and more). This is also the case, if crop residues are removed every year, or if crops without or only few residues (e.g. silo maize, potatoes) dominate the crop rotation, even though the residues normally remain at the field. The effects of different arable management practices on crop yields and quality will be discussed.



S07.07c - LONG-TERM EFFECTS OF AGRONOMIC PRACTICES ON SOIL ORGANIC MATTER AND CROP PRODUCTIVITY

Chair Persons:

Uwe Franko, Halle - Germany

Christopher Brock, Giessen - Germany

Hansrudolf Oberholzer, Zurich, Switzerland

Friday 06 July 2012 from 15:30 to 17:00. Room Olmo

S07.07c -1

*CHRONOSEQUENCE – A SPACE-FOR-TIME SUBSTITUTION FOR SOIL FERTILITY
ASSESSMENT OF DIFFERENT LAND-USE TYPES IN THE SOUTHERN ANDES OF ECUADOR*

Etienne Bahr, Dresden - Germany

S07.07c -2

*LONG-TERM FERTILIZATION EFFECTS ON ABIOTIC AND BIOTIC PARAMETERS OF SOIL
FERTILITY AND BIOMASS PRODUCTIVITY*

Jana Schmidt, Halle - Germany

S07.07c -3

*DYNAMICS OF SOIL C FRACTIONS DURING THE CONVERSION OF SHORT-ROTATION
COPPICES INTO ARABLE LAND AND GRASSLAND*

Charlotte Toenshoff, Witzenhausen - Germany

S07.07c -4

*SOIL CARBON BUDGET OF A 50-YEAR RESIDUE MANAGEMENT EXPERIMENT IN A
BELGIAN CROPLAND.*

Pauline Buysse, Gembloux - Belgium

S07.07c -5

*SIMULATION OF SOC DYNAMICS UNDER DIFFERENT FERTILIZING MANAGEMENT
PRACTICES USING ROTH C CARBON MODEL*

Rosa Francaviglia, Rome - Italy

S07.07c -6

USING LONG TERM EXPERIMENTS TO ASSESS SOM REPRODUCTION ON ARABLE FIELDS

Uwe Franko, Halle - Germany



S07.07c -1

**CHRONOSEQUENCE – A SPACE-FOR-TIME SUBSTITUTION FOR SOIL FERTILITY
ASSESSMENT OF DIFFERENT LAND-USE TYPES IN THE SOUTHERN ANDES OF ECUADOR**

Bahr Etienne^{*[1]}, Hamer Ute^[1], Makeschin Franz^[1]

^[1]TU-Dresden ~ Institute of Soil Science and Site Ecology ~ Dresden ~ Germany

Chronosequences as a space-for-time substitution are an important tool to assess temporal dynamics of soil fertility. This tool was used to study land-use systems without crop rotation in Ecuador based on the assumption that agricultural land-use implies a negative trend over time on soil fertility and crop productivity. Thus, effects of land-use change and subsequent dynamics of total and plant available macronutrients and soil organic carbon (SOC) were analyzed. Based on farm surveys three main land-use types pasture, perennial (cocoa, coffee, plantain) and annual (maize, cassava) were categorized into age classes and compared to the adjacent natural forest. Mineral soil (depth gradient 0-5, 5-10, 10-30 cm) and organic layers in the forest were sampled for the determination of soil physical (bulk density, texture) and soil chemical parameters (pH, total and plant available macronutrients). Generally, perennials had higher nutrient stocks than pastures of the same age class. SOC stocks declined directly after conversion from forest to annuals from 67 t ha⁻¹ to 56 t ha⁻¹. Pasture sites showed a slight increase of SOC stocks until the age of 30 years from 58 t ha⁻¹ to 64 t ha⁻¹ and a strong decrease to 54 t ha⁻¹ after exceeding this age. Decreasing nutrient stocks caused a reduction in productivity and the abandonment of annuals after 5-10 years and perennials after 20-30 years. Hence, the current land-use management cannot be regarded sustainable since all land-use types show negative effects on SOC sequestration and a decline in major nutrients in the long term.



S07.07c -2

LONG-TERM FERTILIZATION EFFECTS ON ABIOTIC AND BIOTIC PARAMETERS OF SOIL FERTILITY AND BIOMASS PRODUCTIVITY

Schmidt Jana^[1], Thomas Fester^[1], Mika Tarkka^[1], Ines Merbach^[1], Mario Hanisch^[2], Beate Michalzik^[3], Francois Buscot^[1], Elke Schulz^[1], Jessica Gutknecht^[4]

^[1]Helmholtz Centre for Environmental Research - UFZ ~ Soil Ecology ~ Halle ~ Germany ^[2]University of Leipzig ~ Inst. of Geography ~ Leipzig ~ Germany ^[3]Friedrich Schiller University of Jena ~ Inst. of Geography ~ Jena ~ Germany

^[4]Helmholtz Centre for Environmental Research - UFZ ~ Soil Ecology ~ Halle ~ Germany

In the long-term, microorganisms have a potentially important role in mediating soil fertility and plant biomass productivity. These effects were studied at the Static Fertilization Experiment Bad Lauchstädt (SFEBL), established in 1902. Previous studies have either focused on abiotic factors (accumulation or the release of SOC) or on microbial biomass and their activities. Here, we aim to bridge biotic processes and abiotic parameters by analyzing a broad set of site, management and biomass production relevant parameters. For these analyses, soil samples were taken from the SFEBL in June 2010 at the alfalfa strip [legumes (since 1926) but 25 % alfalfa since 1970] from selected treatments (unfertilized, NPK, 20 T ha⁻¹ yr⁻¹ manure, 20 T ha⁻¹ yr⁻¹ manure + NPK, 30 T ha⁻¹ yr⁻¹ manure, 30 T ha⁻¹ yr⁻¹ manure + NPK). Measured parameters include: soil bulk density, SOC, total N, labile organic C and N, microbial substrate induced respiration (SIR) biomass, and phospholipid fatty acid analysis. In addition we extracted amino acids, amino sugars, and mono-saccharides as soil quality biomarkers to evaluate their relevance and role within the carbon transformation process, when linking them with enzymatic activities as ecosystem functions of microbial biomass. Positive effects of fertilization and related contents of SOC and labile OC were reflected in plant biomass production, the total PLFA and SIR biomass, and enzymatic activities; a negative correlation was found for the colonization of alfalfa roots with arbuscular mycorrhiza and soil fungal biomarkers. Amino acids, amino sugars, and mono-saccharides responded differently to treatments.



S07.07c -3

DYNAMICS OF SOIL C FRACTIONS DURING THE CONVERSION OF SHORT-ROTATION COPPICES INTO ARABLE LAND AND GRASSLAND

Toenshoff Charlotte^[1], Wachendorf Christine^[1], Reinhold Stülpnagel^[1], Joergensen Rainer^[1]

^[1]Universität Kassel ~ Ökologische Agrarwissenschaften ~ Witzenhausen ~ Germany

Until now ecological effects of the conversion of short rotation coppices (SRC) back into arable land or grassland have rarely been examined. During conversion intensive soil tillage is performed for breaking up roots and coarse harvest residues, which remain on the sites after the harvest. It is hypothesized that reduced tillage will cause a lower mineralization of organic matter. Furthermore the mineralization intensity probably will be lower if grassland will be cultivated compared to arable crops like maize. Therefore a field trial was conducted at three former SRC sites in Northern Germany and the influence of tillage depths and following landuse on short term soil C and N dynamics was investigated. Directly and one year after the conversion the amounts of C and N in coarse roots and harvest residues (> 2mm) and different C-fractions in the fine mineral soil were compared. The incorporation of the harvest residues into the soil during the tillage increased the soil C stocks up to 20 t ha⁻¹. One year after the conversion the amount of C stored in the harvest residues have declined between 2 and 17 t ha⁻¹, nevertheless differences in SOC of the bulk soil were not significant. A density fractionation and a fractionation of water stable aggregates revealed an increase of labile C in the free particulate organic matter and in macroaggregates (250-2000µm) directly after rotary hoeing compared with the C-portions bound in these pools under the SRC. One year after conversion the C in these pools decreased again.



S07.07c -4

SOIL CARBON BUDGET OF A 50-YEAR RESIDUE MANAGEMENT EXPERIMENT IN A BELGIAN CROPLAND.

Buyse Pauline^{*[1]}, Monique Carnol^[2], Sandrine Malchair^[2], Christian Roisin^[3], Marc Aubinet^[1]

^[1]University of Liège - Gembloux Agro-Bio Tech ~ Unit of Biosystem Physics ~ Gembloux ~ Belgium ^[2]University of Liège ~ Plant and Microbial Ecology Laboratory ~ Liège ~ Belgium ^[3]Walloon Agricultural Research Centre ~ Soil and fertilization ~ Gembloux ~ Belgium

Within the context of Climate Change, crop management exerts a strong influence on the soil carbon (C) balance. This study aims (1) to estimate the C loss by soil heterotrophic respiration (SHR) in different residue management treatments through the establishment of their soil C budgets and (2) to compare these estimations with field SHR measurements. Three contrasted treatments were considered: Residue Export (RE), Farm Yard Manure addition (FYM) and Residue Restitution after harvest (RR). They were established in 1959 and continuously applied since then at an experimental field located in the Hesbaye region in Belgium. The soil C budget was calculated for each treatment on the basis of total soil organic C content measurements and C input data compiled since the beginning of the experiment. This allowed estimating the C loss by SHR in the different treatments. SHR measurements were performed in 2010 and 2011 to compare them with the budget-based estimations and to assess SHR sensitivity to temperature in the different treatments. The soil C budgets showed that the soil under the RR treatment was likely to undergo the biggest C loss by SHR since the beginning of the experiment. The SHR field measurements, performed 50 years after the experiment had begun, did however not show any significant difference between the SHR rates in the three treatments. Laboratory investigations (microbial biomass, basal respiration, metabolic diversity and soil fractionation) will be performed to better understand the effects of long-term residue management on soil C dynamics.



S07.07c -5

SIMULATION OF SOC DYNAMICS UNDER DIFFERENT FERTILIZING MANAGEMENT PRACTICES USING ROTH C CARBON MODEL

Francaviglia Rosa*^[1], Baffi Claudio^[2], Cassinari Chiara^[2], Nassisi Antonio^[3], Farina Roberta^[1]

^[1]Consiglio per la Ricerca e la Sperimentazione in Agricoltura ~ Centro di Ricerca per lo Studio delle Relazioni tra Pianta e Suolo ~ Rome ~ Italy ^[2]Università Cattolica del S.Cuore, Facoltà di Agraria ~ Istituto di Chimica Agraria e Ambientale ~ Piacenza ~ Italy ^[3]ARPA Emilia-Romagna, Sez. di Piacenza ~ Area Analitica Ambientale (A.A.A.) Suolo e Rifiuti ~ Piacenza ~ Italy

Soil can represent a sink for carbon sequestration if properly managed. In recent years many researchers have strengthen the importance of soil carbon sequestration in agro-ecosystems under different management practices. Aim of this paper was to evaluate the efficiency of RothC model to simulate C losses observed over 10 years of fertilization practices on a silty-loam soil cropped with a rotation including maize, tomato and alfalfa .Mineral fertilizers were always applied each year, while organic inputs (FYM and vinasse) were not applied consecutively for 5 years in correspondence of alfalfa cropping. RothC model simulated accurately SOC decrease with a linear relationship between predicted (y) and observed (x) C stocks (equation: $y = 0.527x + 31.882$; $R^2 = 0.7028$); moreover the model allowed to visualize the trend of C dynamics in presence of FYM (high increase of C), vinasse (low C losses), no organic matter added (sharp decrease and high C losses). Results point out that RothC model can provide useful information on soil carbon dynamics in cropping systems, and point out the importance of organic fertilization, together with mineral dressing, in particular FYM, in order to maintain good levels of OC in the soil. When other organic materials (e.g. vinasse) or no organic inputs were added, the model simulated a smooth and sharp decline of SOC respectively; in this last two cases soil acted as a source and not as a sink of CO₂, representing a real risk for the environment.



S07.07c -6

USING LONG TERM EXPERIMENTS TO ASSESS SOM REPRODUCTION ON ARABLE FIELDS

Franko Uwe^[1], Kolbe Hartmut^[2], Thiel Enrico^[2]

^[1] Helmholtz Centre for Environmental Research - UFZ ~ Soil Physics ~ Halle ~ Germany ^[2]LFULG ~ - ~ Leipzig ~ Germany

Soil organic matter (SOM) is one of the most important components of soil and its proper reproduction is the precondition for a sustainable use. Models can be used to forecast the development of SOM storage depending on soil properties, field management and climate elements. This is very helpful to avoid future SOM losses and subsequent soil degradation. But the optimal control of SOM reproduction would require an assessment of the current SOM levels because it is well known that too much of SOM may lead to environmental problems in terms of nitrogen leaching and trace gas emissions. Furthermore, the growing demand of bio-energy and crop based raw materials requires an assessment of a reasonable amount of OM that is necessary for SOM reproduction and cannot be allowed to leave the soil-plant system. Using the results of long term experiments (LTE) like SOM trends, OM-input, nitrogen balance and crop yield the efficiency and practicability of different approaches from models of SOM dynamics to decision support tools for the identification of an "optimal" SOM reproduction will be compared. Further we will discuss the advantages and challenges connected with the LTE-data experiments. Common problems with LTE data arise from the uncertainty of initial conditions, the assessment of observation errors and in some case the change of lab procedures over time. Results from several LTE's will be used to discuss different options for the identification of a reasonable SOM level that is applicable in advisory service for farmers.



S08.01a - HYDROPEDOLOGY, INCLUDING APPLICATIONS IN A KARST ENVIRONMENT

Chair Persons:

Johan Bouma, Wageningen - Netherland

Angelo Basile, Ercolano - Italy

Tuesday 03 July 2012 from 08:30 to 10:00. Room Alloro

S08.01a -1

INTRODUCING MORE PEDOLOGY IN HYDROLOGY IS BENEFICIAL FOR BOTH

Johan Bouma, Wageningen - Netherlands

S08.01a -2

*CONTROLS OF SITE FACTORS AND SOIL PROPERTIES ON PREFERENTIAL WATER FLOW
AND SOLUTE TRANSPORT*

Nicholas Jarvis, Uppsala - Sweden

S08.01a -3

*HYDROPEDEOLOGICAL IMPORTANCE OF DIAGNOSTIC HORIZONS: AN INSIGHT THROUGH
SIMULATION MODELLING*

Fabio Terribile, Portici (NA) - Italy

S08.01a -4

*RESPONSE OF SATURATED HYDRAULIC CONDUCTIVITY (KS) ON WATER TABLE
ELEVATION IN A BOREAL ACID SULFATE SOIL*

Seija Virtanen, Helsinki - Finland

S08.01a -5

*PREFERENTIAL FLOW PATHS FORMATION AND INFLUENCE ON SOLUTE TRANSPORT IN
AGRICULTURAL SOILS DEVELOPED ON GLACIAL TILL CLAYS*

Kirill Gerke, Moscow - Russian Federation

S08.01a -6

INTERACTION BETWEEN SOIL WATER REPELLENCE AND VADOSE ZONE HYDROLOGY

Coen J. Ritsema, Wageningen - Netherlands



S08.01a -1

INTRODUCING MORE PEDOLOGY IN HYDROLOGY IS BENEFICIAL FOR BOTH

Bouma Johan^{*[1]}, Basile Angelo^[2], Terribile Fabio^[3]

^[1]Wageningen University ~ Soil science and Geology ~ Wageningen ~ Netherlands ^[2]CNR ~ ISAFOM ~ Ercolano ~ Italy

^[3]University of Naples - Federico II ~ DISSPAPA ~ Portici (NA) ~ Italy

Hydropedology combines tacit knowledge from field pedology and soil survey with process knowledge in modern soil physics and hydrology, the latter increasingly using simulation modelling of dynamic soil processes. Convincing examples of hydropedology have been presented in literature but a systematic analysis of what field pedology has to offer to hydrology appears to be lacking. Soil morphological features are important in soil classification systems as they provide unique information in terms of the location and properties of specific soil features while mixed samples for laboratory analysis only provide diluted, generalized results. Such unique features are particularly useful for hydropedology. A review will therefore be presented of the significance of: (i) soil structure descriptions; (ii), occurrence of different types of diagnostic soil horizons and effects of their vertical succession; (iii) redoximorphic features; (iv) different types of coatings; (v) occurrence of macropores, and (vi) differences in types of organic matter. Micromorphological, geophysical, spectroscopic and new soil physical techniques need to be applied. Pedological data are increasingly available in well accessible soil databases. Applications in hydropedology follow two approaches by defining: (i) continuous and class pedotransferfunctions, and (ii) conditioning of the physical flow system as simulated by models. More effort is needed to “mine” pedology and soil survey data to obtain location-specific data within soil profiles, allowing improvement of modelling dynamic flow processes in field soils. In turn, improved hydrological modelling will also help to better understand pedological processes as they operated in the past and are likely to develop in future.



S08.01a -2

CONTROLS OF SITE FACTORS AND SOIL PROPERTIES ON PREFERENTIAL WATER FLOW AND SOLUTE TRANSPORT

Jarvis Nicholas^[1], Moeys Julien^[1], Koestel John^[1], Ghafoor Abdul^[1], Larsbo Mats^[1]

^[1]SLU ~ Soil & Environment ~ Uppsala ~ Sweden

In this presentation, we will discuss the extent to which preferential solute transport in soil can be predicted from basic soil properties and site factors such as land use and management. A conceptual model of the pore system characteristics that generate preferential flow is proposed. This provides the necessary support for developing hydropedological approaches to understanding and predicting preferential flow. Several example case studies will be presented, including, i.) statistical analysis of the relationships between the shape of tracer breakthrough curves and soil properties in a small agricultural catchment, ii.) statistical meta-analyses of tracer breakthrough experiments on undisturbed soil columns published in the open literature, iii.) a qualitative synthesis of characteristic flow regimes in the major soil types of the world based on a review of the literature, and iv.) the development and testing of pedotransfer functions for model parameter estimation in the dual-permeability model MACRO, and their use in pesticide risk assessment.



S08.01a -3

HYDROPEDOLOGICAL IMPORTANCE OF DIAGNOSTIC HORIZONS: AN INSIGHT THROUGH SIMULATION MODELLING

Terribile Fabio*^[1], Basile Angelo^[2], De Mascellis Roberto^[2], Bonfante Antonello^[2], Manna Piero^[1]

^[1]University of Naples Federico II ~ DISSPAPA ~ Portici (NA) ~ Italy ^[2]Italian National council of Research ~ ISAFOM ~ Ercolano (NA) ~ Italy

Diagnostic horizons and diagnostic properties have a fundamental importance for soil classification (e.g. WRB, Soil Taxonomy) and also for applications in pedology (e.g. land evaluation). Then soil databases (and soil maps) typically contain information regarding the presence and thickness of diagnostic horizons. Despite these evidences, their importance in relation to hydrological processes remains to some extent unproven. Calcic horizons are subsoil horizons formed after the migration of calcium carbonate (generally) from surface horizons. Its classic explanation is based on the evidence that calcium carbonate in the wet season after solubilised it can migrates, and after drier soil condition it typically deposit over pore walls. This leads to formation and stabilization of new macropores. Andic properties can occur in volcanic and non-volcanic environment in soils having a high content of low order clay minerals and Al-humus complexes, respectively. They induce in turn low bulk density, high specific surface, high water retention and high hydraulic conductivity. We firstly showed the distinctive hydraulic properties, namely soil water retention and hydraulic conductivity of some calcic and andic horizons measured applying the Wind's method. Then, we show how they deviate from an "average" expected behaviour (i.e. from comparison with the estimates applying several PTFs) for both the calcic and andic horizons. We performed a sensitivity analysis applying a physically based model in different upper boundary condition. Specifically, we tested the influence on the hydrological behaviour of (i) thickness and depth for the calcic soils and (ii) thickness and degree of andic properties in andic soils.



S08.01a -4

RESPONSE OF SATURATED HYDRAULIC CONDUCTIVITY (K_s) ON WATER TABLE ELEVATION IN A BOREAL ACID SULFATE SOIL

Virtanen Seija*^[1]

^[1]University of Helsinki ~ Department of Food and Environmental Sciences ~ Helsinki ~ Finland

Water table elevation is used for improving the quality of drainage waters from acid sulfate (AS) soils. We studied the effect of two water table management treatments on saturated hydraulic conductivity (K_s) of ripe and unripe horizons of an AS soil (Sulfic Cryaquept) using 10 semi-large undisturbed lysimeters in 2008-2010. The treatments were cropped high (HWC), cropped low (LWC) and bare high (HWC) water table. The plant cultivated was reed canary grass (*Phalaris Arundinacea*). The K_s of horizons (Ap, Bg2, Bgjc, BCg and Cg1) were determined by constant and falling head methods from undisturbed soil cores (c. 200 cm³) sampled from the field in the beginning (N=50) and respectively from the lysimeters in the end of the experiment (N=150). The K_s was log normally distributed. Comparisons were made by Mann-Whitney test. The K_s of HWC (Bg2 4.05 cmh⁻¹, Bgjc 6.37 cmh⁻¹, BCg 0.43 cmh⁻¹, medians) did not differ significantly from that of respective soil horizons in the field (Bg2 4.49 cmh⁻¹, Bgjc 7.40 cmh⁻¹, BCg 0.31 cmh⁻¹). Results support our hypothesis that the elevation of water table does not decrease K_s values of ripe AS soil horizons. The K_s of LWC (BCg 6.62 cmh⁻¹ and Cg1 3.22 cmh⁻¹) were higher than that of HWC and in the field (P<0.05). Drainage (LWC) increased K_s values both in ripe and unripe soil horizons in a short time period (<3 years). We conclude that the soil structure of a ripe AS soil is not easily destroyed by water table elevation.



S08.01a -5

PREFERENTIAL FLOW PATHS FORMATION AND INFLUENCE ON SOLUTE TRANSPORT IN AGRICULTURAL SOILS DEVELOPED ON GLACIAL TILL CLAYS

Gerke Kirill^[1], Shein Evgeny^[2], Korost Dmitry^[3]

^[1]Institute of Geospheres Dynamics ~ Geomechanics and Fluidodynamics Laboratory ~ Moscow ~ Russian Federation

^[2]Moscow State University ~ Soil Science Department ~ Moscow ~ Russian Federation ^[3]Moscow State University ~ Geology Department ~ Moscow ~ Russian Federation

Here we present some results of a case study in Vladimir region, Russian Federation. The main idea of a series of experiments (three in total) was to find any possible relationship between soil structure and transport properties. For that purpose 40-100 l of staining dye solutions were applied to soil areas of up to 1 m². After substantial infiltration soil blocks under application areas were vertically sliced every 10-20 cm to assess dye staining patterns. Each soil profile was carefully cleared and photographed using digital photo camera. During excavation undisturbed soil samples were taken from different stained and unstained portions of soil/genetic horizons. All samples were later processed in laboratory to assess standard hydro-physical properties (saturated hydraulic conductivity, water retention curve, etc.) and soil structure using X-ray microtomography with resolutions up to 2.5 μ m. All infiltration patterns were highly heterogeneous with pronounced preferential flow which mostly occurred via cracks in glacial till clay filled with sand. We report a definite difference in structure and permeability of such preferential flow paths. Finally, possible approach to account for these small inclusions in modeling is discussed.



S08.01a -6

INTERACTION BETWEEN SOIL WATER REPELLENCE AND VADOSE ZONE HYDROLOGY

Ritsema Coen J.*^[1], Oostindie Klaas^[1], Wesseling Jan^[1], Moore Demie^[1], Dekker Louis W.^[1]

^[1]Akterra - Wageningen University ~ Soil Science center ~ Wageningen ~ Netherlands

One of the least understood phenomena occurring in soils worldwide is the shift from a wettable to a water repellent state and vice versa, and the related effects on hydrology and ecosystem functioning. Not only information about weather conditions to trigger such shifts in soils is lacking, but the dynamic process of soil water repellence appearance and disappearance, including related effects on flow and transport remain largely unclear up to date. In this study, examples will be presented of the dynamic appearance and disappearance of water repellence in field soils. Regular measurements in fine grids reveal detailed information about spatial and temporal dynamics of soil water repellence in dependence of weather conditions. Soil water repellence can evolve rapidly during a time span of several distinct dry days, sometimes until depths of 30 cm or more. Rewetting of dry water repellent soil during wet periods appears to be a rather slow and difficult process. Evidence has been found that even after a long wet winter season, part of the soil profile still can remain water repellent. Occurrence of soil water repellence appears to regulate water infiltration and water distribution patterns in the root zone distinctly. Animations of soil water repellence development and simultaneous changes in water infiltration patterns will be presented. Soil water repellence relates to an extreme form of hysteresis in the soil water retention characteristics, and thus should be accounted for when simulating flow and transport in such soils.



S08.01b - HYDROPEDOLOGY, INCLUDING APPLICATIONS IN A KARST ENVIRONMENT

Chair Persons:

Johan Bouma, Wageningen - Netherland

Angelo Basile, Ercolano - Italy

Tuesday 03 July 2012 from 10:30 to 12:00. Room Alloro

S08.01b -1

ESTIMATION OF SOIL HYDRAULIC PROPERTIES EVOLUTION IN AN E&BT HORIZON

Anatja Samouelian, Montpellier - France

S08.01b -2

CHARACTERISATION AND CLASSIFICATION OF HYDROLOGICAL SOILSCAPES OF SOUTH AFRICA

Pieter Le Roux, Bloemfontein - South Africa

S08.01b -3

SOIL-LANDSCAPES AND RISKS OF NUTRIENT LOSS TO WATER IN SIX IRISH AGRICULTURAL CATCHMENTS

Paul Murphy, Wexford - Ireland

S08.01b -4

*HYDROLOGICAL PROPERTIES OF FOREST SOILS IN KARST ENVIRONMENTS:
PEDOTRANSFER FUNCTIONS FOR FOLIC HISTOSOLS, RENDZIC LEPTOSOLS AND
CHROMIC CAMBISOLS*

Christina M. Delaney, Vienna - Austria

S08.01b -5

*TERRAE ROSSAE, RENZINAS AND SINKHOLE PEDOSEDIMENTS IN THE CONTEXT OF
KARSTIC LANDSCAPE DEVELOPMENT AN MAYA LANDUSE IN YUCATÁN (MEXICO)*

Elizabeth Solleiro-Rebolledo, Mexico City - Mexico

S08.01b -6

GREEN WATER CREDITS: A PROMISING CONCEPT FOR HYDROPEDOLOGY

Godert Van Lynden, Wageningen - Netherlands



S08.01b -1

ESTIMATION OF SOIL HYDRAULIC PROPERTIES EVOLUTION IN AN E&BT HORIZON

Samouelian Anatja^{*[2]}, Cornu Sophie^[3], Montagne David^[4], Cousin Isabelle^[5]

^[1]INRA ~ Soil Science ~ Montpellier ~ France ^[2]INRA ~ LISAH ~ Montpellier ~ France ^[3]INRA ~ GSE ~ Aix en Provence ~ France ^[4]INRA/AgroParisTech ~ Environment and Arable Crops ~ Grignon ~ France ^[5]INRA ~ UR SOLS ~ Orléans ~ France

To predict soil evolution induced by human activities at the century scale, we need to be able to model this evolution on such a time scale. For that purpose, coupled water-geochemistry modelling approaches are one possibility. If it is well recognized that soil hydraulic properties evolve in space, their temporal change are rarely taken into account. On the one hand, models hardly support the temporal variability of soil hydraulic properties that must be constant parameters all along the simulation and, on the other hand, the temporal evolution of soil hydraulic properties is often not known. Few experimental data concern the temporal variability of soil properties in the surface horizon at the annual scale, due to agricultural practices, for example. We propose here to investigate deeper horizons. We have performed an experiment to estimate the impact of sixteen years of subsurface drainage on the hydraulic properties of an Albeluvisol. We have focused our analysis on the heterogeneous E&Bt horizon, composed by two elementary pedological volumes (EPV) organised in a complex 3D structure. The analysis of serial sections demonstrated that the proportion and spatial arrangement of the EPVs evolved with time. Based on 3D reconstructions of the structure of the two EPVs and on the knowledge of their hydraulic properties, we have quantified the evolution of the hydraulic properties at the horizon scale, by using a 3D water transfer model. An application of this work will consist in including the temporal evolution of soil hydraulic into a model of soil evolution.



S08.01b -2

CHARACTERISATION AND CLASSIFICATION OF HYDROLOGICAL SOILSCAPES OF SOUTH AFRICA

Le Roux Pieter^[1], Hensley Malcolm^[1], Van Tol Johan^[1], Lorentz Simon^[2]

^[1]University of the Free State ~ Soil, Crop and Climate Sciences ~ Bloemfontein ~ South Africa ^[2]University of KwaZulu-Natal ~ School of Bioresources Engineering and Environmental Hydrology ~ Pietermaritzburg ~ South Africa

Water distribution in the landscape is uneven ranging from freely drained upland, recharge, oxidised, acidic soils; periodically saturated midslope, interflow, redox, variable acid soils and waterlogged wetland, saturation excess responsive, reduced, less acidic soils. These soils are topographically linked in a hydrological soilscape defined as hydrosequence, catena, toposequence, etc. The difference in soil water regimes can be explained by the interaction between the upper and lower vadose zones. The systematic redistribution system implies that systematic hillslope mechanisms (factors) are controlling processes (flowpaths and storage mechanisms) which leave signatures (soil properties) of hydrological activity. Soilscapes (48) on varying geology and in climates varying from arid to sub-humid were surveyed as part of several projects. Soil properties (chemical, water regime and drainage) indicative of control mechanisms, flowpaths and storage mechanisms correlated well with soil and terrain morphology. Conceptual soilscape hydrological response models were developed, characterised and classified according to their measured and inferred hydrological characteristics. The soilscapes are hydrologically grouped as i) soil flow dominant, ii) fractured rock flow dominant and iii) interactive soil/fractured rock flow typical. Conceptually group i) soilscapes contributes largely to hydrograph shoulder flow, group ii) more to hydrograph baseflow and group iii) to shoulder and to baseflow. Hydrograph correlation with changes in soil water contents in different soil types confirm these concepts.



S08.01b -3

SOIL-LANDSCAPES AND RISKS OF NUTRIENT LOSS TO WATER IN SIX IRISH AGRICULTURAL CATCHMENTS

Murphy Paul^[1], Wall David^[2], Melland Alice^[1], Mellander Per-Erik^[1], Shortle Ger^[1], Jordan Phil^[1]

^[1]Teagasc ~ Agricultural Catchments Programme ~ Wexford ~ Ireland ^[2]Teagasc ~ Environment, Soils and Land Use ~ Wexford ~ Ireland

Soils and soil management play a key role in determining hydrologic pathways and risks of nutrient (N, P) loss from soils in water. In particular, soil properties related to soil hydrology influence the partitioning of water between overland flow and subsurface flow and soil management influences the availability of nutrients for mobilization in water. Topography also interacts with soils, both in terms of topographic controls on pedogenesis and also as the key driver of hydrologic flow, to influence soil hydrologic pathways. These factors influence both the form and magnitude of nutrients mobilized and transported from soils in water. In addition, the spatial heterogeneity in soil properties and topographic factors and spatiotemporal heterogeneity in soil management within a catchment are critical in determining risks of nutrient loss to water. The Agricultural Catchments Programme is monitoring soils, soil management, nutrient loss pathways and nutrient stream export in six instrumented Irish agricultural catchments with contrasting soils and soil management characteristics (farming systems). This paper categorizes the catchments into soil-landscapes with a characteristic soil hydrologic functioning and associated hydrologic nutrient loss risk. Soil management and nutrient status are then used to characterise nutrient source risk. Spatial and temporal data on soil properties, topography, soil management and soil nutrient status within the catchments are presented. Risks of nutrient loss between catchments are compared in terms of the form, pathway and magnitude of nutrient loss. A preliminary verification of the assessed nutrient loss risk is made by comparison with measured nutrient stream exports for each catchment.



S08.01b -4

**HYDROLOGICAL PROPERTIES OF FOREST SOILS IN KARST ENVIRONMENTS:
PEDOTRANSFER FUNCTIONS FOR FOLIC HISTOSOLS, RENDZIC LEPTOSOLS AND
CHROMIC CAMBISOLS**

Delaney Christina M.^{*[1]}, Katzensteiner Klaus^[1], Schume Helmut^[1]

^[1]University of Natural Resources and Life Sciences Vienna ~ Department of Forest and Soil Sciences, Institute of Forest Ecology ~ Vienna ~ Austria

To expand current knowledge regarding unique hydrological properties of forest soils in karst environments; characterised as highly aggregated, shallow, with high organic matter and/or stone contents, including organic layers; Follic Histosols, Rendzic Leptosols and Chromic Cambisols have been investigated to develop and validate pedotransfer functions. Few pedotransfer functions currently exist which are applicable to forest soils with calcareous parent material and organic layers. The presented pedotransfer functions are based on physical and hydrological properties that have been empirically measured, including: bulk density and water content-matrix potential relations (pF-curves) as dependent variables; as well as morphological characteristics, particle size distribution, clay mineralogy, and organic carbon content as independent variables. Samples were gathered from representative forest sites in the Northern Limestone Alps based on a stratified sampling scheme, considering soil classification and forest stand composition. Linear models including regression analyses have been used to find relationships between the measured soil properties. Ultimately, functions were developed to combine results of these analyses to compute soil parameters, including hydraulic conductivity, based on limited available data. The calculated hydraulic conductivity values were validated with measurements from selected horizons. These pedotransfer functions have been developed with support from the European Regional Development Fund and national sources for application in hydrological modelling approaches to determine leaf area carrying capacities, quantify the effects of forest disturbance on soil water storage capacity and predicting regeneration of forest sites in the Northern Limestone Alps, Austria.



S08.01b -5

TERRAE ROSSAE, RENZINAS AND SINKHOLE PEDOSEDIMENTS IN THE CONTEXT OF KARSTIC LANDSCAPE DEVELOPMENT AN MAYA LANDUSE IN YUCATÁN (MEXICO)

Solleiro-Rebolledo Elizabeth^{*[1]}, Cabadas-Báez Héctor^[1], Sedov Sergey^[1], Sedov Sergey^[1], Terhost Birgit^[2], Damm Bodo^[3]

^[1]Institute of Geology, UNAM ~ Soil Science ~ Mexico City ~ Mexico ^[2]University of Wurzburg ~ Institute of Geography ~ Würzburg ~ Germany ^[3]University of Vechta ~ 4Institute of Structural Research and Planning in Areas of Intensive Agriculture ~ Vechta ~ Germany

We have studied soils found in karstic landscapes of Yucatán in order to establish differences in pedogenetic pathways to give: Rendzinas, Terra Rossa and pedosediments in karstic pockets. At first glance, Rendzinas represent the less developed soils. However, they are structured, contain high percentages of clay, and show strong weathering. Terra Rossae are clayey, with high percentages of Fe and also strongly weathered. Karstic sinkholes have several sizes and morphologies. The smaller are infilled by pedosediments similar to Rendzinas, while the bigger ones contain materials which properties resemble Terra Rossae. First question to solve is how limestones, which are mostly compound of carbonates (>95%), can produce soils with high contents of clay, free of lime and strong weathered. We have compared the mineralogical and geochemical composition of several materials as possible sources of the parent material: limestone insoluble residue, volcanic materials from the neighboring areas, dust from Sahara and plutonic and metamorphic complexes from south Mexico. Results show a mixture of sources; however in situ strong weathering, under tropical climate, transform profoundly these materials. Second, Redzinas are shallow but not immature soils. What we propose is that Rendzinas are formed from eroded and redeposited Terra Rossa. Rendzinas in the new surface have the contribution of organic materials and nutriments from the limestone, giving high physical and chemical properties for cultivation, especially important for ancient Mayas. Finally, pedosediments of karstic pockets evidence a dynamic phase of landscape development (probably human-induced).



S08.01b -6

GREEN WATER CREDITS: A PROMISING CONCEPT FOR HYDROPEDOLOGY

Sjef Kauffman^[1], Johannes Hunink^[2], Peter Droogers^[3], Van Lynden Godert^{*[1]}

^[1]ISRIC - World Soil Information ~ WUR-ESG ~ Wageningen ~ Netherlands ^[2]FutureWater ~ . ~ Wageningen ~ Netherlands ^[3]FutureWater ~ . ~ Wageningen ~ Netherlands

Soil and Water Conservation (SWC) practices to combat soil water erosion in rainfed agricultural land are nowadays well catalogued and extensively described in literature (a.o. World Overview of Conservation Approaches and Technologies). However, implementation has been poor in many areas. How to introduce proper soil and water management remains a major challenge. The Green Water Credits (GWC) concept focuses on water in the unsaturated zone of the soil aiming at increased infiltration and reduced evaporation through SWC practices. Depending on local conditions, this may result in more soil water available for crop transpiration thus biomass production, less erosion and at the same time enhanced percolation to the underlying aquifer leading to regulated river flow, beneficial for downstream water uses - hydropower, irrigation, urban water and natural ecosystems. Land users need investments to implement and maintain SWC practices. The proposed GWC scheme, to be financed by public and private downstream beneficiaries, aims to invest in SWC practices. The capacity and response of the soil and ground water buffer are key functional properties of the GWC concept. Therefore, hydropedology plays a crucial role in defining the potential advantages of introducing SWC practices by providing soil survey data for hydrological models that show where these management interventions within a given watershed are likely to be most effective. The procedure, including cost/benefit, institutional and financial analyses, will be demonstrated for the Upper Tana catchment in Kenya where a GWC scheme is being implemented.



S08.02a - SOIL AND WATER INTERACTIONS AS ONE OF MAJOR DRIVING FORCES IN ENVIRONMENT

Chair Persons:

Beata Houskova, Bratislava - Slovakia

Luca Montanarella, Ispra - Italy

Wednesday 04 July 2012 from 08:30 to 10:00. Room Leccio

S08.02a -1

THE EXTENDED EVAPORATION METHOD (EEM) FOR QUANTIFYING SOIL HYDRAULIC PROPERTIES

Wolfgang Durner, Braunschweig - Germany

S08.02a -2

ACCOUNTING FOR MATRIX DEFORMATION IN DOUBLE-PERMEABILITY DESCRIPTIONS OF WATER FLOW IN SWELLING CLAY SOILS

Antonio Coppola, Potenza - Italy

S08.02a -3

MOISTURE DIFFERENCES IN SWELLABLE AND NON-SWELLABLE CLAYS – A SENSIBILITY STUDY OF DIFFERENT MOISTURE DETECTION TECHNIQUES

Katja Emmerich, Eggenstein-Leopoldshafen - Germany

S08.02a -4

GHG EMISSIONS FROM PEAT SOIL IN LYSIMETERS WITH A FALLING AND RAISING WATER TABLE

Örjan Berglund, Uppsala - Sweden

S08.02a -5

COUPLING HEAT, VAPOR AND LIQUID WATER TRANSPORT IN THE THREE-DIMENSIONAL CRITERIA 3D MODEL.

Marco Bittelli, Bologna - Italy

S08.02a -6

ENVIRONMENTAL IMPACT OF THREE FERTILIZER N SOURCES FOR POTATO PRODUCTION ON SANDY SOILS

Athyna Cambouris, Quebec - Canada



S08.02a -1

THE EXTENDED EVAPORATION METHOD (EEM) FOR QUANTIFYING SOIL HYDRAULIC PROPERTIES

Schindler Uwe^[1], Durner Wolfgang^{*[2]}, Von Unold Georg^[3], Müller Lothar^[4]

^[1]Leibniz Centre for Agricultural Landscape Research (ZALF) Müncheberg ~ Institut of Landscape Hydrology ~ Müncheberg ~ Germany ^[2]TU Braunschweig, Institute of GeoEcology, ~ Department of Soil Science and Soil Physics, ~ Braunschweig ~ Germany ^[3]UMS GmbH Munich ~ UMS GmbH ~ Munich ~ Germany ^[4]Leibniz Centre for Agricultural Landscape Research ~ Institute of Landscape Hydrology ~ Müncheberg ~ Germany

Knowledge of hydraulic functions is required for soil water management, modeling of water and solute fluxes and for plant-physiological studies. Generally the time and cost consuming devices sand box, kaolin box and pressure plate extractor are applied for measurement of the water retention function. The unsaturated hydraulic conductivity function is measured with the multi-step outflow method. The evaporation method provides an effective alternative. The evaporation method is frequently used for the simultaneous determination of hydraulic functions of unsaturated soil samples, i.e., the water-retention curve and hydraulic conductivity function. All methodic variants of the evaporation method suffer from the limitation that the hydraulic functions can only be determined to a maximum mean tension of ~ 50 kPa. This is caused by the limited measurement range of the tensiometers of typically 80 kPa on the dry end. We present a new, cost- and time-saving approach which overcomes this restriction (EEM). Using cavitation tensiometers and the air-entry pressure of the tensiometer's porous ceramic cup as additional defined tension value allows the quantification of hydraulic functions up to close to the wilting point. The procedure is described, uncertainties are discussed and measured as well as simulated test results are presented for soil samples of various origins, different textures (sand, loam, silt, clay, and peat) and variable dry bulk density. The experimental setup followed the system HYPROP which is a commercial device (UMS GmbH Munich) with vertical aligned tensiometers that is optimized to perform evaporation measurements.



S08.02a -2

ACCOUNTING FOR MATRIX DEFORMATION IN DOUBLE-PERMEABILITY DESCRIPTIONS OF WATER FLOW IN SWELLING CLAY SOILS

Coppola Antonio*^[1], Gerke Horst^[2]

^[1]UNIVERSITY OF BASILICATA ~ DEPT FOR AGRICULTURAL AND FORESTRY SYSTEMS MANAGEMENT - DITEC ~ Potenza ~ Italy ^[2]Leibniz-Centre for Agricultural Landscape Research (ZALF) ~ Institute of Soil Landscape Research ~ Müncheberg ~ Germany

When modeling flow through fractured soils, the fracture fraction is frequently assumed to be constant over time. However, changing fracture abundance with time may be more realistic of field soil with swelling clay which induces changes of soil structure in the soil profile. In this study, a dual-permeability model is discussed that accounts for swelling and shrinking effects on macropore and matrix domain hydraulic properties only at a local scale. The model assumes that the matrix domain or soil aggregate swell-shrink dynamics affects volume changes in macro-porosity, while the overall porosity of the total soil, and hence the layer thickness, remains constant. The specific novel aspects are the inclusion of the shrinkage characteristics in the two domain model that leads to an additional constitutive relation making the volume fraction of the fracture domain a function of the pressure head. The shrink/swell dynamics is incorporated in a one-dimensional dual-permeability model, in which water flow in both domains is described with a coupled set of Richards' equations. This simplified approach allows dealing with an expansive soil matrix at the local scale that behaves globally as a macroscopically rigid soil. The model will be tested by describing effects of shrinkage on the hydraulic behaviour of a swelling clay soil.



S08.02a -3

MOISTURE DIFFERENCES IN SWELLABLE AND NON-SWELLABLE CLAYS – A SENSIBILITY STUDY OF DIFFERENT MOISTURE DETECTION TECHNIQUES

Emmerich Katja^[2], Heike Kaden^[2], Franz Koeniger^[1], Gunnar Niklasson^[3]

^[1]Karlsruhe Institute of Technology ~ Institute for Functional Interfaces ~ Eggenstein-Leopoldshafen ~ Germany

^[2]Karlsruhe Institute of Technology ~ Competence Center for Material Moisture ~ Eggenstein-Leopoldshafen ~ Germany

^[3]Uppsala University ~ Division of Solid State Physics ~ Uppsala ~ Sweden

Water content determinations by static heating at 105°C for 24 h serve as reference. However, some soil components, i.e. clay minerals, bind substantial amounts of water strongly. Swellable clay minerals bind water in hydration shells of interlayer cations. Hence, static heating at 105°C may insufficiently remove bound water and the moisture of soils containing swellable clay minerals may be falsified. Precise water content values are prerequisite for numerous technical applications of clays. Agriculture and climate change models require correct soil moisture values to calculate irrigation requirements and climate forecasts. Three materials and methods were compared. Two swellable clays (bentonite, vermiculite) and one non-swellable clay (illitic clay) were analyzed with focus on bound water. Water contents were determined by static heating (24 h/105 °C), Simultaneous Thermal Analysis (STA) and dielectric spectroscopy using calibration functions after Topp et al., Roth et al. and the Complex Refractive Index Model. Dielectric measurements were implemented in mid (2.0E+08...1.1E+09 Hz) and low (1.0E-04...1.0E+06 Hz) frequency range. Prior to measurements the materials were equilibrated at 11% and 93% r.h.. The low frequency range could differentiate the varying moisture of all clays, whereas the mid frequency range could only display the moisture differences of the illite. For quantitative moisture determinations the low frequency range is at the moment still unsuitable, since further relaxation processes mask the bound water polarization. STA revealed the strong water content underestimation of vermiculites when determined by static heating. Dielectric spectroscopy at mid frequency range severely underestimated up to 20% the moisture of clays containing swellable clay minerals.



S08.02a -4

GHG EMISSIONS FROM PEAT SOIL IN LYSIMETERS WITH A FALLING AND RAISING WATER TABLE

Berglund Örjan*^[1], Berglund Kerstin^[1]

^[1]Swedish University of Agricultural Sciences ~ Soil and Water management ~ Uppsala ~ Sweden

A lysimeter method with undisturbed soil columns was used to investigate how the water table affects the greenhouse gas (GHG) emissions from cultivated peat soils. The study was carried out using an organic soil from Örke in Sweden. This is a typical cultivated fen peat with low pH and high organic matter content. The 50 cm high lysimeters were supplied with water from below until saturation and the water table was then lowered from the surface in 5 cm step down to 45 cm below surface and raised again back to the surface. CO₂, CH₄ and N₂O emissions from the lysimeters were measured at all water table levels and twice when the lysimeters were let to dry out even more. CO₂ emissions increased as soon as air entered the profile and reached a stable rate (602 mg m⁻² h⁻¹) when the water table level was 20 cm but decreased when the soil got too dry. N₂O emissions were low during the drainage phase but increased to 3 mg m⁻² h⁻¹ when the water table rose to the surface again. CH₄ emissions were very low or negative.



S08.02a -5

COUPLING HEAT, VAPOR AND LIQUID WATER TRANSPORT IN THE THREE-DIMENSIONAL CRITERIA 3D MODEL.

Bittelli Marco^{*[1]}, Antolini Gabriele^[2], Ventura Francesca^[1], Marletto Vittorio^[2], Tomei Fausto^[2]

^[1]University of Bologna ~ Agricultural Science ~ Bologna ~ Italy ^[2]Agenzia Regionale Prevenzione e Ambiente (ARPA) Emilia-Romagna ~ Servizio Idro-Meteo-Clima ~ Bologna ~ Italy

The quantification of soil evaporation near the soil surface is a key process in land-surface processes on local, regional and global scales. Questions remain about the correct computation of key variables such as the soil surface resistance or the soil surface temperature, and the relative importance of different variables involved in the heat transfer process, such as vapor diffusivity and thermal conductivity. Finally, these processes should be computed in a three dimensional domain, for applications where the lateral components of the fluxes are of interest, such as drip irrigation, energy dissipation of buried power lines, or water and heat transfer studies performed on slopes. This study was conducted to: (a) implement a fully coupled, three-dimensional, numerical model to solve the governing equations for liquid water, water vapor, and heat transport and (b) test the numerical model with detailed measurements of soil temperature, heat flux, water content, and soil evaporation. The code implements a non-isothermal solution of the vapor flux equation that accounts for the thermally driven water vapor transport and phase changes, as well as solutions of liquid water and heat transport. Two experiments were employed to test the model: (1) a soil evaporation study in southern California where evaporation, energy budget components, soil properties, and soil temperature were measured and (2) a soil water content and soil temperature study in a soil profile in northern Italy. The two sites were selected to test the model in different climatic and pedological conditions.



S08.02a -6

ENVIRONMENTAL IMPACT OF THREE FERTILIZER N SOURCES FOR POTATO PRODUCTION ON SANDY SOILS

Cambouris Athyna^[1], Bernie Zebarth^[2], Noura Ziadi^[1], Cynthia Grant^[3], Craig Drury^[4]

^[1]Agriculture and Agri-Food Canada ~ Research ~ Quebec ~ Canada ^[2]Agriculture and Agri-Food Canada ~ Research ~ Fredericton ~ Canada ^[3]Agriculture and Agri-Food Canada ~ Research ~ Brandon ~ Canada ^[4]Agriculture and Agri-Food Canada ~ Research ~ Harrow ~ Canada

Appropriate N fertilization is essential to optimize potato yield and minimize environmental N losses. This study evaluated the effect of N fertilization with three N sources on tuber yield and plant N uptake, and on the risk of nitrate leaching on three growing seasons. Risk of leaching was assessed using residual soil nitrate (RSN) and the soil solution nitrate (SWN) concentrations. Treatments were four N rates (60, 120, 200, and 280 kg N ha⁻¹) for each of three N sources [ammonium nitrate (AN), ammonium sulphate (AS) and a controlled-release N (CRN)] plus an unfertilized control. The SWN was sampled biweekly from planting to harvest (nine sampling periods per years) via suction lysimeters. Soil was sampled (0-0.9 m) to determine NO₃-N at planting, at harvest, and in next spring. Tuber yield increased with N rates up to 200 kg N ha⁻¹, but was not affected by N source. Plant N uptake was reduced under wet climatic conditions for AN and AS but not for CRN. Even though all CRN was applied at planting, SWN was lower for CRN than AN or AS on many sampling dates. The low RSN at harvest and in the next spring (6.5 and 9.9 kg NO₃-N ha⁻¹, respectively) demonstrates that most of our leaching occurred during the growing season. The CRN may be more advantageous in increasing plant N uptake and reducing the risk of early season leaching in sandy soils especially in a rainy growing season.



S08.02b - SOIL AND WATER INTERACTIONS AS ONE OF MAJOR DRIVING FORCES IN ENVIRONMENT

Chair Persons:

Beata Houskova, Bratislava - Slovakia

Luca Montanarella, Ispra - Italy

Wednesday 04 July 2012 from 10:30 to 12:00. Room Leccio

S08.02b -1

VEGETATION IMPACT ON THE HYDROLOGY OF AN AEOLIAN SANDY SOIL

Lubomir Lichner, Bratislava - Slovakia - Invited

S08.02b -2

SOIL FUNCTIONING INDICATORS (INFOSOL): A METHODOLOGICAL APPROACH FOR DEVELOPING AND ASSESSING DYNAMIC SOIL FUNCTIONS WITHIN THE SOIL PROTECTION STRATEGY CONTEXT

Alice Alonso, Louvain-la-Neuve - Belgium

S08.02b -3

SOIL – WATER INTERACTION EXEMPLIFIED IN THE SLOVAKIA-AUSTRIA MORAVA REGION: EFFORTS TO USE SOIL PROFILES IN FLOOD MANAGEMENT AND FLOOD PROTECTION.

Meinhard Breiling, Eschenau - Austria

S08.02b -4

SOIL AND WATER INTERACTIONS IN IBERIAN EUCALYPT AND PINE FOREST PLANTATIONS

João Pedro Nunes, Aveiro - Portugal

S08.02b -5

SPATIAL VARIABILITY OF SOIL PHYSICAL PROPERTIES IN A CULTIVATED FIELD

Coskun Gülser, Samsun - Turkey



S08.02b -1

VEGETATION IMPACT ON THE HYDROLOGY OF AN AEOLIAN SANDY SOIL

Lichner Lubomir*^[1]

^[1]Institute of Hydrology, Slovak Academy of Sciences ~ Soil Hydrology ~ Bratislava ~ Slovakia

Vegetation impact on the hydrology of sandy soil was studied at four sites with different vegetation cover: (1) no vegetation ("Pure sand"), (2) biological soil crust (BSC), consisting of algae, fungi and mosses ("Glade soil"), (3) grass ("Grassland soil"), and (4) Scots pines ("Forest soil"). Three algal species were isolated from glade soil and grown in the laboratory on sterile pure sand as monoalgal and bialgal crusts. The persistence of water repellency was estimated using the WDPT test, the water S_w and ethanol S_e sorptivity, hydraulic conductivity k , index of water repellency R and water repellency cessation time t_c were estimated from the cumulative infiltration vs. time relationship obtained using a minidisk infiltrometer at $h = -2$ cm. The heterogeneity of water flow during dye tracer infiltration experiments was assessed using two parameters. Vegetation cover influenced the hydrophysical parameters and heterogeneity of water flow in sandy soil considerably. WDPT and R increased in the order: Pure sand < Glade soil < Grassland soil < Forest soil, and in pure sand they were more than 3000-times and 240-times smaller compared to forest soil, respectively. This was reflected in S_w and k , which had the opposite trend, and in forest soil were almost 170-times and 690-times smaller compared to pure sand, respectively. Despite the smaller impact on WDPT, the algal crusts had nearly the same impact on S_w and k of pure sand as the BSC at glade site. t_c increased with an increase in WDPT for all the dried algal crusts.



S08.02b -2

SOIL FUNCTIONING INDICATORS (INFOSOL): A METHODOLOGICAL APPROACH FOR DEVELOPING AND ASSESSING DYNAMIC SOIL FUNCTIONS WITHIN THE SOIL PROTECTION STRATEGY CONTEXT

Alonso Alice^{*[1]}, Charles Bielders^[1], Martin Germeau^[1], Mathieu Javaux^[1], Marnik Vanclooster^[1], Samuel Mattern^[1], Eric Laloy^[1], Christian Roisin^[2]

^[1]Université catholique de Louvain ~ ELle ~ Louvain-la-Neuve ~ Belgium ^[2]Centre wallon de Recherches agronomiques ~ Département Agriculture et Milieu naturel - Unité Fertilité des sols et Protection des eaux ~ Gembloux ~ Belgium

Soils are subjected to multiple pressures which cause their degradation and endanger their ecological, economic, social and cultural functioning. This justifies the development of indicators for driving sustainable soil management strategies and policies. In this context, numerous soil quality indicators are currently available that allow measuring the physical, chemical and biological status of soil. Yet, only few approaches are available for assessing the soil functioning. This study develops and evaluates indicators for the water flux regulation function of soil. The methodological approach encompasses three steps: (i) the definition and measurement of the relevant reference physical properties of the soil (basic indicators) allowing to assess the physical qualities relative to the environmental function mentioned above; (ii) the development and definition of a set of synthetic indicators of soil functioning, based on 2-dimensional simulation of water fluxes using Hydrus 2D/3D, which explicitly considers the soil structural heterogeneity generated by tillage; and (iii) the establishment of relations between the developed synthetic indicators of soil functioning and the more easily measurable basic indicators. We illustrate this approach for two different land cultivation strategies (ploughing and reduced tillage), two soil types (silt loam and sandy loam) and 2 levels of compaction due to traffic.



S08.02b -3

**SOIL – WATER INTERACTION EXEMPLIFIED IN THE SLOVAKIA-AUSTRIA MORAVA REGION:
EFFORTS TO USE SOIL PROFILES IN FLOOD MANAGEMENT AND FLOOD PROTECTION.**

Jaroslava Sobocka^[1], Eduard Klaghofer^[2], Beata Houskova^[1], Breiling Meinhard^{*[3]}

^[1]VUPOP ~ Soil Science ~ Bratislava ~ Slovakia ^[2]WPA Beratende Ingenieure ~ WPA ~ Wien ~ Austria ^[3]BIENE ~ BIENE ~ Eschenau ~ Austria

The aim is to demonstrate that soil has stored the information of flood events from former centuries and that soil information can be used to protect the current inhabitants from future flooding. Soil information is likely to become a more important tool in flood management and flood protection. Fluvisols are built up from many layers and have archived the sediments from previous flood periods in unique soil layers. These soil profiles were built up for several hundred and even thousands of years. Only during the last century dams against flooding were built and floods therefore became rare or “extreme” events. Then the flooding exceeds the height of the dam and despite the protective measures there will be huge damages and even threatening to human lives. Therefore in recent decades an increasing amount of flood forecast models were developed to cope with the risk for the concerned population. Here we present an alternative to flood forecast models based on analyzing soil profiles. This was demonstrated in Gars am Kamp, Lower Austria, at the flood event of 2002. The “forecasting ability” of soil profiles from Gars am Kamp was comparable to advanced flood risk models. In a current approach within the EU SONDAR (Soil awareness network in the Danube Region) project the trans-boundary Slovak Austrian region of Zahorska Ves/Angern and the river Morava is subject to detailed tests. Finally an outlook will be given on how this “SONDAR” method can be used at larger scales in the entire Danube River Basin.



S08.02b -4

SOIL AND WATER INTERACTIONS IN IBERIAN EUCALYPT AND PINE FOREST PLANTATIONS

Nunes João Pedro^{*[1]}, Tavares Wahren Filipa^[2], Santos Juliana Marisa^[1], Gosch Lennart^[2], Malvar Maruxa^[1], Wahren Andreas^[2], Rial-Rivas María Ermitas^[1], Schwärzel Kai^[2], Bernard-Jannin Léonard^[1], Hawtree Daniel^[2], Vieira Diana Catarina^[1], Prats Sergio^[1], Rodríguez-Blanco María Luz^[4], Van Hall Imre^[3], Van Beersum Sander^[3], Boulet Anne-Karine^[1], Schumacher Frederike^[2], Pinto Renata^[1], Cuco Ana^[1], Petzold Rainer^[5], Keizer Jan Jacob^[1], Feger Karl-Heinz^[2]

^[1]University of Aveiro ~ CESAM & Dept. Environment and Planning ~ Aveiro ~ Portugal ^[2]Technische Universität Dresden ~ Faculty of Forest, Geo and Hydro Sciences, Institute of Soil Science and Site Ecology ~ Dresden ~ Germany ^[3]Wageningen University and Research Centre ~ Van Hall Larenstein, University of Applied Sciences ~ Wageningen ~ Netherlands ^[4]Universidad de A Coruña ~ Facultad de Ciencias ~ A Coruña ~ Spain ^[5]Public Enterprise Sachsenforst ~ Kompetenzzentrum Wald und Forstwirtschaft ~ Pirna ~ Germany

The wet climate regions of the northwestern Iberian Peninsula have large areas of commercial plantations with eucalypt and maritime pines. Forestry practices may affect the soil water characteristics which regulate water balance, and therefore have impacts on plant-water availability, groundwater recharge and runoff. However, characterizing soil hydrological properties and estimating water balance in these forests poses several challenges, especially due to the distinct seasonality of rainfall and water availability and the strong soil water repellency in the dry season, which impacts infiltration and soil water behavior. Given the economic importance of forestry and the frequent occurrence of drought years, it is important to gain more understanding on the soil and water relations to support the sustainable management of forest stands. This work will present the results of a bilateral Portuguese-German project investigating soil and water interactions in eucalypt and pine stands in central Portugal. For both forest types water retention curves and unsaturated conductivities were analysed in the laboratory. In the field, the undisturbed infiltration capacities were measured quantitatively (disk and ring infiltrometers) and qualitatively (brilliant blue dye tracer) under repellent and non-repellent conditions. The temporal patterns of soil moisture, repellency and associated meteorological conditions were also measured during the hydrological year 2011/12. The results are expected to provide insights on the seasonal behavior of forest soils, the role of soil water repellency in this seasonality, and the mechanisms by which repellency influences infiltration rates and pathways. These insights will help improve water balance calculations for eucalypt and pine plantations.



S08.02b -5

SPATIAL VARIABILITY OF SOIL PHYSICAL PROPERTIES IN A CULTIVATED FIELD

Gülser Coskun^[1], Ekberli Imanverdi^[1], Candemir Feride^[1], Demir Zeynep^[1]

^[1]Ondokuz Mayıs University, Faculty of Agriculture ~ Soil Science and Plant Nutrition ~ Samsun ~ Turkey

*Prediction of soil physical properties is important for site specific management practices in precision agricultural systems. Generally, the aim of soil cultivation is to form a homogeneous media to supply optimum growth conditions for seeds and plants. In this study, spatial variability of some soil physical properties in a cultivated field such as; bulk density (BD), penetration resistance (PNT), saturated hydraulic conductivity (Ks), field capacity (FC) and permanent wilting point (PWP), were determined by geostatistical method. While BD values varied between 1.12 and 1.41 g cm⁻³, PNT resistance in 15 cm soil layer varied between 0.66 and 1.88 MPa. Also, Ks (1.46 to 3.37 mm h⁻¹), FC (30.40 to 39.66%) and PWP (19.22 to 24.42%) values showed variations among the soil samples. In kriging interpolation for the spatial variability of soil physical properties, the biggest r² and cross validation r² values were determined with spherical model for BD, PNT, Ks, FC values, and exponential model for PWP values. Spatial dependences of the physical properties were found to be strong in the field. The semivariograms for BD, PNT, Ks, FC and PWP showed spatial dependences with the ranges of 12.75, 12.17, 12.82, 10.24 and 112.23 m, respectively. While PNT values significantly increased with increasing BD (0.366**) and decreasing moisture content (-0.408**), Ks values significantly increased with increasing BD (0.340*), and decreasing clay content (-0.905**) and PNT (-0.288*) values in the field.*

S08.03 - PEDOTRANSFER FUNCTIONS IN SOIL HYDROLOGY: STILL A MYTH, OR A PLEASANT REALITY? APPLICATIONS, VALIDATIONS, AND CASE STUDIES

Chair Person:

Nunzio Romano, Napoli - Italy

Friday 06 July 2012 from 15:30 to 17:30. Room Biancospino

S08.03 -1

APPLYING PEDOTRANSFERFUNCTIONS: THE SORCERER'S APPRENTICE AT WORK?

Johan Bouma, Wageningen - Netherlands

S08.03 -2

SOIL INFERENCE SYSTEMS: MAKING THE MYTH INTO A REALITY

Jason Morris, Sydney - Australia

S08.03 -3

HOW ACCURATE AND RELIABLE ARE PAN-EUROPEAN PEDOTRANSFER FUNCTIONS?

Mélanie Weynants, Ispra - Italy

S08.03 -4

THE ROLE OF PEDOTRANSFER FUNCTIONS IN THE UNCERTAINTY AND SENSITIVITY ANALYSIS OF SIMULATED SOIL MOISTURE

Lien Loosvelt, Ghent - Belgium

S08.03 -5

APPLICATION OF PEDOTRANSFER FUNCTIONS FOR 3D-DISTRIBUTED HYDRAULIC PROPERTIES OF GENERATED CATCHMENT MODELS

Horst H. Gerke, Muencheberg - Germany

S08.03 -6

INFLUENCE OF PARTICLE-SIZE DISTRIBUTION MEASUREMENT METHOD ON THE PREDICTION OF SOIL WATER RETENTION CURVE

Massimo Iovino, Palermo - Italy

S08.03 -7

PEDOTRANSFER FUNCTION BASED MULTI-MODEL ENSEMBLE ESTIMATION OF SOIL WATER STORAGE, DRAINAGE AND ACTUAL EVAPOTRANSPIRATION

Jacques Diederik, Mol - Belgium



S08.03 -8

WHY DO THEY KEEP REJECTING MY MANUSCRIPT - DO-S, DON'T-S AND NEW HORIZONS OF PTF STUDIES

Attila Nemes, College Park - United States



S08.03 -1

APPLYING PEDOTRANSFERFUNCTIONS: THE SORCERER'S APPRENTICE AT WORK?

Bouma Johan*^[1]

^[1]formerly Wageningen University ~ soils ~ Wageningen ~ Netherlands

J. Bouma, em.prof. soil science, Wageningen University, The Netherlands Pedotransferfunctions (PDF) use easily available soil survey (pedological) data to predict complex physical and – chemical soil characteristics that are difficult and expensive to measure. Examples are e.g. texture, bulk density and %C to predict by regression analysis hydraulic conductivity and moisture retention and the phosphate adsorption capacity by regressing the Fe and Al content. Two types were initially distinguished: continuous and class PDF's. Continuous PDF's provide poor results when: (i) based on poor measurements of both the complex soil characteristics and the pedological data; (ii) applied beyond the range of measured data on which PDF's were based; (iii) used for applications for which they are not suitable. An example is K_{sat} , which cannot be estimated by PDF's, and (iv) no attention is paid to the soil series from which PDF's are derived because use for quite different soil series may be problematic. We suggest more attention for class PDF's, such as, for example, hydraulic conductivity and moisture retention curves for certain pedogenic soil horizons in a given soil series. This also allows expressions for spatial variability, useful for e.g. Monte Carlo simulations. In conclusion, PDF's can be a "pleasant reality" when they are not used by sorcerer apprentices who know how to start but not how to stop.



S08.03 -2

SOIL INFERENCE SYSTEMS: MAKING THE MYTH INTO A REALITY

Morris Jason^{*[1]}, Mcbratney Alex^[1], Minasny Budiman^[1]

^[1]The University of Sydney ~ Faculty of Agriculture, Food & Natural Resources ~ Sydney ~ Australia

The soil inference system was proposed in 2002 by the authors as a way of collecting and making better use of pedotransfer functions that have been abundantly generated. The idea is to generate an expert system that will predict various soil properties with their confidence of prediction given a limited amount of input data. The inference system makes use of PTFs as its knowledge-base. The initial proof-of-concept was made using a simple MS Excel spreadsheet. A proper SINFERS prototype was then developed by Tranter and Morris in 2008 using a rule engine to match facts containing known soil property data with rules that “know about” using pedotransfer functions (PTFs). SINFERS uses these rules to select appropriate PTFs, then it computes new property values and error estimates, and then it reasserts those computed property values as new facts. This causes more matching patterns and more PTFs to fire cyclically until the knowledge base is exhausted and SINFERS has inferred everything it can about what it was originally given. To-date, there have been no research applications that do what SINFERS aims to do. There have been some attempts at pattern matching using nearest-neighbour algorithms and neural nets. Significant research has been done to establish the validity of pedotransfer methods and their application to multiple domains. In this paper, we will demonstrate the realization of SINFERS implemented in the Java expert System Shell (Jess).



S08.03 -3

HOW ACCURATE AND RELIABLE ARE PAN-EUROPEAN PEDOTRANSFER FUNCTIONS?

Weynants Mélanie^[1], Tóth Gergely^[1], De Brogniez Delphine^[1]

^[1]European Commission Joint Research Centre ~ Land Management and Natural Hazards Unit ~ Ispra ~ Italy

Availability of soil hydraulic properties at the European scale provides input data for hydrological modelling. HYPRES database was created to develop pedotransfer functions (PTF) for Europe, based on FAO texture classes (class PTF) or on continuous clay, silt, organic matter contents and bulk density (continuous PTF). The objective of this study was to compare the hydraulic properties obtained with the two methods in terms of expected accuracy and geographical reliability. The class PTF were applied on the Soil Geographical Database of Europe (SGDBE) and on LUCAS-soil database. The continuous PTF were applied on LUCAS-soil database. Our results showed that differences between both datasets were larger when using different PTF. Using the class PTF, differences occurred when comparing point data (LUCAS-soil) with the dominant and the subdominant soil typological units of SGDBE. Differences were larger in geographic areas where there are fewer HYPRES training data. This showed that the use of continuous PTF allows for more variability in the results and that the reliability of HYPRES PTF is spatially very variable. We therefore suggest to create a second version of HYPRES, filling in the gaps of the first version.



S08.03 -4

THE ROLE OF PEDOTRANSFER FUNCTIONS IN THE UNCERTAINTY AND SENSITIVITY ANALYSIS OF SIMULATED SOIL MOISTURE

Loosvelt Lien^[4], Vernieuwe Hilde^[2], Pauwels Valentijn^[4], Cornelis Wim^[3], De Lannoy Gabrielle^[4], De Baets Bernard^[2], Verhoest Niko^[4]

^[1]Ghent University ~ Water and Forest Management ~ Ghent ~ Belgium ^[2]Ghent University ~ Department of Mathematical Modelling, Statistics and Bioinformatics ~ Ghent ~ Belgium ^[3]Ghent University ~ Department of Soil Management ~ Ghent ~ Belgium ^[4]Ghent University ~ Department of Water and Forest Management ~ Ghent ~ Belgium

For simulations in basins where soil information is limited to soil type maps, modellers are forced to rely on pedotransfer functions (PTFs) to estimate the soil hydraulic parameters (SHPs). However, PTFs are often applied outside the geographic region for which the PTF was originally developed. In this presentation, it is shown that the geographic origin of the PTF (region specific versus non-region specific) plays a crucial role (i) in assessing the uncertainty on the simulated soil moisture, arising from within-class-variability of the soil hydraulic parameters, and (ii) in quantifying the sensitivity of the simulated soil moisture to changes in soil texture composition. Continuous PTFs are applied to 3200 texture samples distributed over the entire textural triangle to construct discrete probability distributions of the SHPs for each individual USDA soil class. The parameter distributions are propagated through a hydrologic model to result in a discrete probability distribution of the simulated soil moisture content. Results show that both the range and the shape of the probability distributions are highly affected by the geographic origin of the PTFs. Furthermore, the continuous PTFs are incorporated in a sensitivity analysis to determine the effect on simulated soil moisture by perturbing the soil texture composition. We present a methodology to make sensitivity indices suitable for the compositional nature of soil textural information. Based on the calculated sensitivity index, zones of high and low sensitivity are indicated on the texture triangle.



S08.03 -5

APPLICATION OF PEDOTRANSFER FUNCTIONS FOR 3D-DISTRIBUTED HYDRAULIC PROPERTIES OF GENERATED CATCHMENT MODELS

Bartsch Robert^[1], Maurer Thomas^[1], Schneider Anna^[2], Gerke Horst H.*^[4]

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Knowledge of the spatial distribution of hydraulic properties is essential for the assessment of water flow and hydrological catchment models. In artificially-created catchments, sediment distributions are determined by the technological processes, which provide the initial spatial distributions of hydraulic properties. The question was how the 3D-distributed model of catchment structures and spatial sediment patterns could be transformed into an 3D-distributed model of the hydraulic properties that can be used to run hydrological catchment modeling. We compared pedotransfer functions for application to initial soils of an artificially-constructed hydrological catchment located near Cottbus, Germany. The aim was to evaluate the functions and analyze the impact of generated sediment distributions on the distribution of hydraulic parameters in the catchment. Three pedotransfer functions were tested: (i) Arya and Paris (1981), (ii) Vereecken et al. (1989) and (iii) Vereecken et al. (1990). The functions were applied to different realizations of spatial sediment and structure distributions, and were evaluated by determining hydraulic properties from a lower resolution sediment spatial distribution with those obtained from a higher resolution spatial model. Hydraulically different regions were obtained by integration and upscaling. The angle of the basic grid cell hydraulic structures were included into the upscaled regions to account for hydraulic anisotropy in the spatial model. These approaches will help improving the understanding of effects of small-scale sediment structures on hydraulic properties in initial soils. This example also helps understanding the effect of sediment structures on hydraulic properties in initial soils of typical reclaimed mine spoil sites.



S08.03 -6

INFLUENCE OF PARTICLE-SIZE DISTRIBUTION MEASUREMENT METHOD ON THE PREDICTION OF SOIL WATER RETENTION CURVE

Antinoro Chiara^[1], Bagarello Vincenzo^[1], Ferro Vito^[1], Giordano Giuseppe^[1], Iovino Massimo^{*[1]}

^[1]Università degli Studi di Palermo ~ Dipartimento dei Sistemi Agro-Ambientali ~ Palermo ~ Italy

Application of the Arya and Paris (AP) model to estimate the soil water retention curve requires detailed particle-size distributions (PSD) that can be obtained by fitting a continuous model to traditional sieve-hydrometer (SH) data or using the laser diffraction (LD) method. The AP model was applied to 40 Sicilian soils for which PSD was measured by both SH and LD methods. The scale factor alpha was set equal to 1.38 (procedure AP1) or estimated by a logistic model with parameters gathered from literature (procedure AP2). To simplify application of the AP model, a relationship for estimating a soil-specific alpha value from clay content was developed (procedure OPT). For both SH and LD data, procedure AP2 allowed a more accurate prediction of the water retention than procedure AP1 confirming that a unique value of alpha for soils very different in texture is not suggested. Discrepancies in estimated water retention curves were attributed to underestimation of PSD by the LD method for the finer particle diameters. Overall, SH data resulted in more accurate predictions of the water retention curve than LD data. From comparison of alpha-distributions it was supposed that the PSDs determined by the traditional sieve-hydrometer method are in more close similarity with the measured water retention curve than those determined by the LD method. For a validation dataset of 170 Sicilian soils, the most accurate predictions of the water retention curve were obtained by procedure OPT that can be considered a valid alternative to the more complex logistic model.



S08.03 -7

PEDOTRANSFER FUNCTION BASED MULTI-MODEL ENSEMBLE ESTIMATION OF SOIL WATER STORAGE, DRAINAGE AND ACTUAL EVAPOTRANSPIRATION

Diederik Jacques*^[1]

^[1]Belgian Nuclear Research Centre ~ Performance Assessment ~ Mol ~ Belgium

Estimation of soil water fluxes and water storage is a key parameter for different applications. However, exact soil hydraulic parameters are often missing. Basic soil properties might be available which allows for estimating soil hydraulic parameters using pedotransfer functions (PTF). To assess the uncertainty associated with the use of PTFs, ensemble predictions with multiple PTFs (multi-model predictions) are carried out resulting in an ensemble (i.e. statistical) estimate of the variable of interest. In this study, ensemble estimates of the actual evapotranspiration, drainage and water storage are obtained based on 27 PTFs. The analysis is done for soil profiles in different textural classes and a 37-year long record of daily values of meteorological data for the Campine region in Belgium. Statistics are analyzed at different temporal scales (daily, seasonally, and annually). The variability among the estimated hydraulic properties is large between the different estimates within one textural class. Consequently, the difference between the minimum and maximum values within a textural class was large. On the other hand, for the yearly drainage and actual evapotranspiration, the interquantile range was small. Therefore, the medium of the 27 simulations can be taken as an estimate of the yearly drainage and actual evapotranspiration. The approach is also used to characterize the variability between year and within years (between the PTF) and can thus be used to define the uncertainty in the drainage, the actual evapotranspiration and the water storage.



S08.03 -8

WHY DO THEY KEEP REJECTING MY MANUSCRIPT - DO-S, DON'T-S AND NEW HORIZONS OF PTF STUDIES

Nemes Attila*^[1]

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In recent years, a score of manuscripts have been – and keep being - submitted to soils journals of international interest on the general topic of developing pedotransfer functions (PTFs). Many of them are returned to the authors, not being accepted, and many of those manuscripts get resubmitted to other journals without substantial changes – and without success. This presentation is based on the opinion and insights of a number of scientists experienced in writing, reviewing, editing and/or advising pedotransfer related papers, and gives advice on how to make PTF-related research efforts more fruitful for authors and more interesting and useful to the general readership.



S08.04a - DYNAMIC NON-EQUILIBRIUM OF FLOW IN UNSATURATED PORUS MEDIA

Chair Person:

Gerrit H. de Rooij, Halle (Saale) - Germany

Thursday 05 July 2012 from 08:30 to 10:00. Room Mirto

S08.04a -1

EVALUATING THE WATER CONTENT MATRIC POTENTIAL RELATIONSHIP OBTAINED FROM MULTI STEP OUTFLOW EXPERIMENTS WITH HIGH RESOLUTION GAMMA DENSIMETRY

Franz Lennartz, Dresden - Germany

S08.04a -2

NUMERICAL DETERMINATION OF EFFECTIVE HYDRODYNAMIC PROPERTIES FOR AN HETEROGENEOUS SOIL

Virginie Rossa, Avignon - France

S08.04a -3

REVIEW ON NON-EQUILIBRIUM WATER FLOW IN SOIL

Wolfgang Durner, Braunschweig - Germany

S08.04a -4

EFFECT OF NON-EQUILIBRIUM SOLID SURFACE WETTING PROPERTIES ON TIME-DEPENDENT CAPILLARY RISE

Agnieszka Reszkowska, Hannover - Germany

S08.04a -5

DYNAMIC NON-EQUILIBRIUM EFFECTS IN SOIL HYDRAULIC PROPERTIES ESTIMATED WITH THE EVAPORATION METHOD: EXPERIMENTAL AND MODELING APPROACH

Efstathios Diamantopoulos, Braunschweig - Germany



S08.04a -1

EVALUATING THE WATER CONTENT MATRIC POTENTIAL RELATIONSHIP OBTAINED FROM MULTI STEP OUTFLOW EXPERIMENTS WITH HIGH RESOLUTION GAMMA DENSIMETRY

Lennartz Franz^{*[1]}, Andre Bieberle^[2], Mario Wanski^[1], Yvonne Diesner^[1]

^[1]University of Technology, Dresden (TUD) ~ Institut of Hydrology and Meteorology (IHM) ~ Dresden ~ Germany

^[2]Helmholz-Zentrum Dresden-Rossendorf ~ Institut für Sicherheitsforschung / Abteilung Experimentelle Thermo-fluiddynamik ~ Dresden ~ Germany

Dynamic Multi Step Outflow (MSO) experiments serve for the estimation of the parameters from soil hydraulic functions like e.g. the Mualem/ van Genuchten model. The soil hydraulic parameters are derived from outflow records and corresponding matric potential measurements from commonly a single tensiometer using inverse modeling techniques. We modified the experimental set up allowing for the simultaneous measurement of the matric potential with three tensiometers and the water content using high resolution gamma densimetry (Bieberle 2008). The soil hydraulic parameters were derived using the data of the tensiometer in the middle of the sample together with the outflow record. The HYDRUS 1D model with these parameters then allowed for the simulation of the MSO experiments. Subsequently we compared the matric potential and water content measurements at different levels of the soil samples with the values derived from the model simulations. While the measurements and the model results were overall in good agreement for the location of the tensiometer that was used within the inverse parameter estimation, we obtained partly significantly deviating results for the other tensiometer positions and thus, different water content matric potential relationships at different levels of the sample. The highest deviations were achieved at the levels with the highest flow dynamics. Considering the soil samples as homogenous we concluded that non equilibrium flow during the dynamic outflow experiments is the major cause for the observed results.



S08.04a -2

NUMERICAL DETERMINATION OF EFFECTIVE HYDRODYNAMIC PROPERTIES FOR AN HETEROGENEOUS SOIL

Rossa Virginie^[1], Stéphane Ruy^[2], Hervé Bolvin^[1], Samuel Buis^[2], Gaelle Lefeuvre-Mesgouez^[1], Arnaud Mesgouez^[1]

^[1]Université d'Avignon et des Pays du Vaucluse-INRA ~ UMR EMMAH Environnement Méditerranéen et Modélisation des Agro-Hydrosystèmes, Département Physique ~ Avignon ~ France ^[2]INRA ~ UMR EMMAH Environnement Méditerranéen et Modélisation des Agro-Hydrosystèmes ~ Avignon ~ France

Working out scenarios of sustainable use of groundwater resources in a global climate change context involves the development of continuum surface-soil-groundwater models in agro-ecosystems. These models require an effective parameter set at unit cell scale, typically an agricultural field, which takes into account ground heterogeneities at smaller scale. Characterizing these heterogeneities represents an issue since they depend mainly on the spatial soil structure variability and the constitutive material properties. We propose a two scale approach in order to numerically estimate the recharge draining to groundwater. Soil properties are those of an agricultural stony soil in La Crau area (South of France) where an intensive irrigation is applied. At local scale (m^2), a numerical methodology is proposed to determine hydrodynamic behavior for highly heterogeneous stony soils. The purposes consist in identifying and studying the sensitivity of effective parameters. Digital samples mixing fine soil and stones are generated. Effective parameters, particularly the retention and hydraulic conductivity curves, are determined with numerical simulations based on the use of a C++ object oriented programming software named FAFEMO. The sensitivity analysis is performed by numerous simulations with various material proportions, and according to the spatial organization (following a vertical gradient of distribution) and the hydrodynamic properties. At global scale (ha), the overall field response by stochastic modeling and spatialization of effective parameters is defined. The presentation proposed here concerns the first point.



S08.04a -3

REVIEW ON NON-EQUILIBRIUM WATER FLOW IN SOIL

Durner Wolfgang^[1], Efstathios Diamantopoulos^[1]

^[1]TU Braunschweig ~ Soil Physics ~ Braunschweig ~ Germany

Water flow in unsaturated soils is frequently not following the process assumption of a local equilibrium between water content and matric potential, and thus cannot be described by the standard Richards equation with time-invariant hydraulic properties. With the generic term "dynamic non-equilibrium", a wide variety of phenomena that are acting on different time and length scales is encompassed, e.g., water-air interface dynamics on a pore-scale, effects of partial and time variable water repellency, effects caused by restricted air permeability, or effects associated with local soil heterogeneity. This contribution gives an overview on the various phenomena that cause "dynamic non-equilibrium" of water flow in soils. Starting from historic and recent measurements of flow experiments on the macro scale, current perceptions and effective modeling approaches will be discussed. We conclude that there is an urgent need for precision measurements that are designed to quantify dynamic effects, in order to improve understanding and modeling of these phenomena, and also in order to assess their importance for field scale water flow.



S08.04a -4

EFFECT OF NON-EQUILIBRIUM SOLID SURFACE WETTING PROPERTIES ON TIME-DEPENDENT CAPILLARY RISE

Reszkowska Agnieszka^{*[1]}, Bachmann Jörg^[1], Diamantopoulos Stathis^[2], Durner Wolfgang^[2]

^[1]Leibniz University Hannover ~ Institute of Soil Science ~ Hannover ~ Germany ^[2]Technische Universität Braunschweig ~ Institute of Geoecology ~ Braunschweig ~ Germany

Capillary rise of water is a well known phenomenon where water moves against gravity until reaching a hydraulic equilibrium. Until now, not only hydraulic but also solid surface wetting equilibrium has been assumed. However, our investigations showed that in some cases water can interact with the surface functional groups leading to decline in local contact angles and, as a consequence, increase in the height of the capillary rise. In our studies we used disturbed, sandy soil samples taken from the Fuhrberg in Germany from two sites: forest and field; and two soil layers: topsoil (forest and field) and subsoil (field). The samples were air-dried, homogenized, dried to different temperatures (50, 60, 90°C), and packed to PVC columns (50 cm height). Afterwards a capillary rise experiment was performed for different periods of time. The results showed that with time the capillary rise increased over months for the soils taken from the topsoil while there was no time effect for samples taken from the subsoil. In the wetted part of the column, we measured always hydraulic equilibrium with respect to the supply water level. Nevertheless, even during hydraulic equilibrium we observed an increase of the water content with time. These results indicate that in case of unstable surface conditions (topsoil) the functional groups of soil can rearrange in contact with water leading to changes in hydraulic soil properties while in case of stable surface conditions the surface of soil remains unchangeable and the hydraulic properties do not vary.



S08.04a -5

DYNAMIC NON-EQUILIBRIUM EFFECTS IN SOIL HYDRAULIC PROPERTIES ESTIMATED WITH THE EVAPORATION METHOD: EXPERIMENTAL AND MODELING APPROACH

Diamantopoulos Efstathios^[1], Durner Wolfgang^[1]

^[1]Technische Universität Braunschweig ~ Institut für Geoökologie ~ Braunschweig ~ Germany

The knowledge of soil hydraulic properties is fundamental to characterizing water retention and flow in soils for many soil hydrologic applications. The traditional approach for modeling soil water dynamics is to use the soil hydraulic properties estimated under static methods. However, experimental observations have shown that the soil hydraulic properties estimated under static and dynamic methods can differ substantially. These observations are often described by the term “dynamic non-equilibrium” or “dynamic effects”. To investigate the occurrence and extent of dynamic effects in transient flow experiments, we conducted evaporation experiments with flow interruptions. In the evaporation experiments, non-equilibrium effects appear as a relaxation of the pressure head over time, while the macroscopic water content distribution appears static. We developed a simple non-equilibrium model to quantitatively describe the observations. The model considers two continua at the macroscopic scale: one continuum is described by the Richards equation and the second, associated with non-equilibrium water flow, is described by an extended Richards equation using the Ross and Smettem non-equilibrium approach. This model can describe the dynamic effects occurring in our evaporation experiments very well.



S08.04b - DYNAMIC NON-EQUILIBRIUM OF FLOW IN UNSATURATED PORUS MEDIA

Chair Person:

Wolfgang Durner, Braunschweig - Germany

Thursday 05 July 2012 from 10:30 to 12:00. Room Mirto

S08.04b -1

HYDRAULIC NON-EQUILIBRIUM DURING INFILTRATION INDUCED BY STRUCTURAL CONNECTIVITY

Steffen Schlüter, Halle - Germany

S08.04b -2

STUDY OF MACROPORE FLOW USING ELECTRICAL RESISTIVITY TOMOGRAPHY?

Ursula Noell, Hannover - Germany

S08.04b -3

THE PROCESS OF IN SITU WATER INFILTRATION IN STRUCTURED AND NON-STRUCTURED FIELD SOILS: COMPLEMENTARY ANALYSIS OF GEOPHYSICAL ERT DETECTION AND SOIL HYDRAULIC MEASUREMENTS

Christina Ganz, Hannover - Germany

S08.04b -4

FRONT INSTABILITY IN STRATIFIED MEDIA: SIMULATION USING PHASE-FIELD MODEL AND EXPERIMENTS

Philippe Beltrame, Avignon - France

S08.04b -5

EVIDENCE FOR HYDRAULIC NON-EQUILIBRIUM AT THE AQUIFER SCALE DURING LATERAL FLOWS DRIVEN BY EXCESSES OR SHORTAGES OF WATER IN THE SOIL PROFILE.

Gerrit De Rooij, Halle (Saale) - Germany

S08.04b -6

INFLUENCE OF VISCOUS FINGERING ON CAPILLARY PRESSURE VERSUS SATURATION CURVES DURING DRAINAGE

Yves Meheust, Rennes - France



S08.04b -1

HYDRAULIC NON-EQUILIBRIUM DURING INFILTRATION INDUCED BY STRUCTURAL CONNECTIVITY

Schlüter Steffen^{*[1]}, Vanderborght Jan^[2], Vogel Hans-Jörg^[1]

^[1]Helmholtz-Centre for Environmental Research ~ Soil Physics ~ Halle ~ Germany ^[2]Forschungszentrum Jülich ~ ICG 4 ~ Jülich ~ Germany

Water infiltration into heterogeneous, structured soil leads to hydraulic non-equilibrium across the infiltration front. That is, the water content and water potential are not in equilibrium according to some static water retention curve. The water content increases more rapidly in more conductive regions followed by a slow relaxation towards an equilibrium state behind the front. An extreme case is preferential infiltration into macropores. The aim of our study is to develop an upscaled description of water dynamics which conserves the macroscopic effects of non-equilibrium and which can be directly linked to structural properties of the material. A critical question is how to define averaged state variables at the larger scale. We propose a novel approach based on flux-weighted averaging of hydraulic potential, and compare its performance to alternative methods for averaging. Further, we suggest some meaningful indicators of hydraulic non-equilibrium that can be related to morphological characteristics of infiltration fronts in quantitative terms. These methods provide a sound basis to assess the impact of structural connectivity on hydraulic non-equilibrium. We demonstrate our approach using numerical case studies for infiltration into two-dimensional heterogeneous media using three different structure models with distinct differences in connectivity. Our results indicate that an increased isotropic, short-range connectivity reduces non-equilibrium, whereas anisotropic structures enforce it. We observe a good agreement between front morphology and upscaled non-equilibrium. Thus, the new approach may help to better represent hydraulic non-equilibrium including preferential flow in models based on Richards equation.



S08.04b -2

STUDY OF MACROPORE FLOW USING ELECTRICAL RESISTIVITY TOMOGRAPHY?

Noell Ursula^{*[1]}, Ganz Christina^[2], Lamparter Axel^[1], Wießner Claudia^[1]

^[2]Leibniz University ~ Soil Science ~ Hannover ~ Germany ^[1]Federal Institute for Geosciences and Natural Resources ~ Groundwater and Soil ~ Hannover ~ Germany

Water flow in unsaturated soil can relatively easily be observed using time lapse high resolution electrical resistivity tomography (ERT). However, in order to conclude from the inversion results the “true” process critical questions with regard to resolution, inversion bias and non unique relationships between water content and resistivity need to be answered. There can be no general answers because i.e. resolution depends on the resistivity, its absolute values, contrasts and heterogeneity. In order to study those critical questions in 2011 two different experiments were carried out on a Loess soil close to Hannover, Germany. Firstly, a ponded infiltration experiment and secondly an irrigation experiment both using water coloured with brilliant blue. Before, during, and after both experiments ERT array measurements were conducted. After the experiments the areas were excavated, undisturbed soil samples (soil cores) were taken, water content and matric potential was measured. From the ponded infiltration experiment where within 25 min 30 l water infiltrated in a circular area of 40cm diameter (716mm/h) it became clear that macropore flow is of major significance at this site. The ERT inversion revealed indeed hints for this rather quick process. Contrary to the irrigation experiment (4.2 mm h⁻¹ for 48h) and greatly different to the experiments in sand the inversion showed narrow infiltration paths for a short time. Three different time lapse inversion strategies were tested and showed significant differences. After the calculation of the time correction the process could be reconstructed with higher reliability.



S08.04b -3

THE PROCESS OF IN SITU WATER INFILTRATION IN STRUCTURED AND NON-STRUCTURED FIELD SOILS: COMPLEMENTARY ANALYSIS OF GEOPHYSICAL ERT DETECTION AND SOIL HYDRAULIC MEASUREMENTS

Ganz Christina^{*[1]}, Ursula Noell^[2], Bachmann Jörg^[1], Axel Lamparter^[2], Wilhelmus H.m. Duijnisveld^[2]

^[1]Leibniz Universität Hannover ~ Institut für Bodenkunde ~ Hannover ~ Germany ^[2]Bundesanstalt für Geowissenschaften und Rohstoffe ~ Bodengeophysik ~ Hannover ~ Germany

To assess the specific transport dynamics of water under different boundary conditions it is crucial to detect the process in situ with dynamically operating sensors. Measuring the state variables with TDR and tensiometers is a common procedure, but only punctual information from a few locations about their time-dependency can be obtained. Therefore, time-lapse Electrical Resistivity Tomography measurements are simultaneously conducted together with measurements of matric potential and water content. Ponded infiltration and irrigation experiments were carried out with dyed water (Brilliant Blue) on a poorly structured sandy soil and on a structured loess soil. Data were recorded using the ERT, TDR and tensiometer techniques. In the sandy soil, infiltration characteristics are defined by saturation and pressure overshoot caused by water repellency. The specific shape of the infiltrating water plume can be reproduced by the ERT results, but there is still a discrepancy between resolving the anomalous saturation distribution during the infiltration due to the uncertain relationship between resistivity and water content. In the loess soil simultaneous macropore and matric flow under saturated flow conditions under ponding occur, whereas during the irrigation experiment only matric flow is observed. We conclude from our results that combining non-destructive geophysical and soil hydraulic sensors helps significantly to describe the observed phenomena and the simultaneously measured parameters can together be used improving the ERT inversion and the hydraulic modeling.



S08.04b -4

FRONT INSTABILITY IN STRATIFIED MEDIA: SIMULATION USING PHASE-FIELD MODEL AND EXPERIMENTS

Beltrame Philippe^[3], Sammartino Stéphane^[2]

^[1]Université Avignon / UMR EmmaH 1114 ~ Dept. Phys. ~ Avignon ~ France ^[2]UAPV ~ UMR 1114 EmmaH, INRA ~ Avignon ~ France ^[3]Université d'Avignon - UMR 1114 EmmaH ~ Dept. Phys. ~ Avignon ~ France

Preferential flow in unsaturated soils may due to local heterogeneities like worm burrows but also to front instability leading to unstable finger flow (fingered pattern) in sandy textured soils. This last spontaneous preferential flow cannot be described by the standard Richards equation. Cueto-Felgueroso and Juanes proposed recently a phase field model in order to take into account a macroscopic surface tension effect at the front [1]. The validity domain of this model is poorly known as is the link between the equation parameters and the soil characteristics. This presentation aims at answering these questions using simulations and experiments. The governing equation is analogous to the lubrication equation for which we pointed out the numerical difficulties due to the fourth order term. A numerical code to perform time integration and bifurcation analysis was developed in [2] allowing to determine the onset of instability and its resulting dynamics in the parameter space [3]. We apply these numerical tools to stratified media problems, like sand layers with different granulometries. Instability onset and flow pattern are obtained in a wide parameter domain. Additionally, we perform experiments using, for instance, X-ray tomography allowing to track in space and in time the development of fingered flows [4]. [1] Cueto-Felgueroso and Juanes, Water Res. Res., 45, 2009. [2] Beltrame and Thiele, SIADS, 9, 2010. [3] Beltrame et al. PRE, 83, 2011. [4] Tang and Kovscek, Transp. Porous Med., 86, 2011.



S08.04b -5

EVIDENCE FOR HYDRAULIC NON-EQUILIBRIUM AT THE AQUIFER SCALE DURING LATERAL FLOWS DRIVEN BY EXCESSES OR SHORTAGES OF WATER IN THE SOIL PROFILE.

De Rooij Gerrit^[1]

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Catchment-scale hydrological models make can benefit from a simple, yet physically realistic model for lateral subsurface water flows to and from surface water and drains. Ideally, the hydrological parameters should be valid directly at the aquifer scale. A theory is presented for such flows in terms of the difference between the average hydraulic head in the subsurface and the surface water level. The theory is based on analytical solutions of the linearized Boussinesq-equation. The resulting aquifer-scale flow equations are shown to be first order ordinary differential equations in which an upscaled hydraulic conductivity appears. Unlike the Darcian hydraulic conductivity, it depends on aquifer properties as well as on the forcings (recharge/extraction rate, initial and boundary conditions). Depending on the nature of recharge/extraction, the upscaled hydraulic conductivity trends to one of three asymptotic values that may be reached within a few days for realistic scenarios. Then, the aquifer-scale flow is quasi-Darcian: the flux leaving or entering the surface water is proportional to the difference between the head in the surface water and the average head in the aquifer. But a sudden change in the forcings causes deviations from the asymptotic value, and can even lead to negative and infinite upscaled hydraulic conductivities. These episodes reflect non-equilibrium conditions at the aquifer-scale, even though equilibrium at the Darcian is ensured. This is an analogy at the super-Darcian scale of the non-equilibrium that was recently simulated during Darcian-scale unsaturated flow. The causes, mechanisms and implications for this aquifer-scale non-equilibrium will be discussed.



S08.04b -6

INFLUENCE OF VISCOUS FINGERING ON CAPILLARY PRESSURE VERSUS SATURATION CURVES DURING DRAINAGE

Lovoll Grunde^[1], Jankov Mihailo^[1], Maloy Knut^[1], Schmittbuhl Jean^[2], Schäffer Gerhard^[3], Meheust Yves^{*[4]}

^[1]University of Oslo ~ Department of Physics ~ Oslo ~ Norway ^[2]CNRS and University of Strasbourg (EOST) ~ Institut de Physique du Globe (IPGS) ~ Strasbourg ~ France ^[3]Université de Strasbourg ~ Laboratoire d'Hydrologie et de Géochimie de Strasbourg (UMR 7517 CNRS) ~ Strasbourg ~ France ^[4]Université de Rennes 1 ~ Geosciences Rennes ~ Rennes ~ France

We address primary drainage of a quasi-two-dimensional porous medium, using transparent experimental models. The entire displacement structure, as well as the amount of extracted liquid and global pressure difference over the setup, are monitored in space and time, for various imposed displacement velocities. By analyzing the geometry of the displacement structure, we obtain a scaling relation relating pressure, saturation, system size and capillary number. This scaling relation allows curves of capillary pressure versus saturation for a wide range of capillary numbers to be collapsed onto a unique master curve. The recordings of pressure and saturation are measured to be consistent with that scaling relation for all imposed flow rates. In particular, the capillary pressures's dependence on the mean displacement velocity is entirely included in the Ca-dependence of the scaling law. Consequently, this dynamic property of the measured capillary pressure results solely from the geometry of the displacement structure created by the interplay between viscous and capillary forces. This suggests that what is called dynamic effects in the literature of experimentally-measured capillary pressure curves might be explained by the combined effect of capillary pressure along the invasion front of the gaseous phase, and pressure changes caused by viscous effects, from the pore scale and up to the Darcy scale.

S09.01 - SOIL MICROMORPHOLOGY: A JOURNEY FROM SOIL GENESIS TO NEW INTERDISCIPLINARY ADVANCEMENTS

Chair Persons:

Karl Stahr, Hohenheim - Germany

Fabio Terribile, Napoli - Italy

Thursday 05 July 2012 from 15:30 to 17:15. Room Biancospino

S09.01 -1

PODZOL AND ALBELUVISOL DEVELOPMENT ON LAND SURFACES OF KNOWN AGE IN S NORWAY: PROCESSES OBSERVED IN THE FIELD AND UNDER THE MICROSCOPE

Daniela Sauer, Dresden - Germany

S09.01 -2

TIME-EVOLUTION OF CONNECTED POROSITY DURING 120 KY WEATHERING OF BISHOP CREEK GRANODIORITE: NEW INSIGHT USING ¹⁴C-PMMA METHOD

Laurent Caner, Poitiers - France

S09.01 -3

PETROPLINTHITE FORMATION IN A QUATERNARY COMPLEX PALEOSOL ALONG NW ITALIAN COAST: FROM MICROMORPHOLOGY TO LANDSCAPE EVOLUTION

Ivano Rellini, Genova - Italy

S09.01 -4

ORIGIN OF CARBONATES IN TERMITE MOUNDS ON FERRALSOLS IN KATANGA, D.R. CONGO

Eric Van Ranst, Ghent - Belgium

S09.01 -5

MICROMORPHOLOGY AND CHEMISTRY OF BURIAL SOILS FROM CHALCOLITHIC GRAVES OF THE 3RD MILLENNIUM BC (MONTE CLARO CULTURE), NEAR GANNÌ, SARDINIA

Maria-raimonda Usai, York - United Kingdom

S09.01 -6

SOIL MICROMORPHOLOGY FOR CONSTRUCTION SCIENCE: THE MORTAR ARCHAEOOMETRY

Selim Kapur, Adana - Turkey



S09.01 -7

LASER ABLATION(LA)-ICP-MS ON SOIL THIN SECTIONS: A POWERFUL TOOL FOR ASSESSING TRACE ELEMENT DISTRIBUTION, PEDOGENETIC PROCESSES AND SOIL POLLUTION

Fabio Scarciglia, Arcavacata di Rende (CS) - Italy



S09.01 -1

PODZOL AND ALBELUVISOL DEVELOPMENT ON LAND SURFACES OF KNOWN AGE IN S NORWAY: PROCESSES OBSERVED IN THE FIELD AND UNDER THE MICROSCOPE

Sauer Daniela*^[1], Sperstad Ragnhild^[4], Sørensen Rolf^[3], Svendgård-Stokke Siri^[4], Fuchs Markus^[5], Podtschaske Beate^[6], Prade Christoph^[6], Schüllli-Maurer Isabelle^[6], Stahr Karl^[6]

^[1]Dresden University of Technology ~ Institute of Geography ~ Dresden ~ Germany ^[2]Norwegian Institute of Forest and Landscape ~ Soil Survey ~ Aas ~ Norway ^[3]Norwegian University of Life Sciences ~ 1432 ~ Aas ~ Norway ^[4]Norwegian Institute of Forest and Landscape ~ 1431 ~ Aas ~ Norway ^[5]University of Giessen ~ Department of Geography ~ Giessen ~ Germany ^[6]Hohenheim University ~ Institute of Soil Science ~ Stuttgart ~ Germany

The Oslofjord region in SE-Norway has undergone steady glacio-isostatic uplift over the Holocene. Hence, land surface age continuously increases with elevation. A soil chronosequence on beach sand, showing progressive podzolization, is currently investigated on the western side of the Oslofjord. 31 pedons from 85 years (0.25 m a. s. l.) to 9650 years (62 m a. s. l.) are analysed. Micromorphological analysis reveals progressive accumulation of cloudy, iron-rich fine material on sand grains of the Bs horizons leading to chitonic c/f-related distribution there. In addition to podzolisation features, illuvial clay is observed below the Bs horizons. Apparently, the sand is sufficiently buffered during the first millennia of soil formation so that acidification proceeds slowly enough to allow for clay translocation prior to podzolisation. Earlier, 12 pedons in loamy marine sediments developing towards Albeluvisols were studied. Two of the oldest soils (11050 and 9000 years) exhibited initial podzolisation in their upper parts. In addition, one only 6,550 year-old soil showed beginning podzolisation. All three podzolised soils were under coniferous forest, in contrast to the other soils that were under mixed forest. The fact that another 9750 year-old soil under mixed forest was not yet podzolised, indicates that in this case the start of podzolisation primarily depends not on time but on vegetation. In conclusion, the Albeluvisol sequence includes podzolization, and the Podzol sequence shows clay illuviation preceding podzolization. These two directions of soil development are not totally exclusive in this case but may occur within the same profile to varying degree.



S09.01 -2

TIME-EVOLUTION OF CONNECTED POROSITY DURING 120 KY WEATHERING OF BISHOP CREEK GRANODIORITE: NEW INSIGHT USING 14C-PMMA METHOD

Mossler Pierre^[1], Caner Laurent^{*[1]}, Sardini Paul^[1], Siitari-Kauppi Marja^[2], Hellmuth Karl-Heinz^[3], Rossi Ann Marie^[4], Graham Robert C.^[5], Mazurier Arnaud^[6], Parneix Jean-Claude^[6]

^[1]HYDRASA UMR 6269 CNRS-INSU, Université de Poitiers ~ Geosciences ~ Poitiers ~ France ^[2]Laboratory of Radiochemistry, University of Helsinki, FI-00014, Helsinki, Finland ~ Radiochemistry ~ Helsinki ~ Finland ^[3]Finnish Centre for Radiation and Nuclear Safety (STUK), FI-00881 Helsinki, Finland ~ Radiochemistry ~ Helsinki ~ Finland ^[4]Dep. of Environ. Science and Technol. Univ. of Maryland, College Park ~ Environmental Sciences ~ College Park - Maryland ~ United States ^[5]Dep. of Environ. Sciences, Univ. of California, Riverside ~ Environmental Sciences ~ Riverside ~ United States ^[6]Société Etudes Recherches Matériaux, Poitiers ~ ERM ~ POITIERS ~ France

Understanding the mechanisms of porosity evolution during rock weathering (total porosity, connectivity, pore size) is a key issue in obtaining reliable qualitative and quantitative descriptions of weathering processes. The aim of this study was to measure the porosity development in granodiorite clasts and determine porosity and pore morphology changes with time. Samples were collected in soils of the Bishop Creek moraines, Sierra Nevada, California (Rossi et al., 2010). The soils formed a chronosequence linked to the advance and retreat of Pleistocene glaciers. The total porosity and pore morphology was measured using 14C-PMMA autoradiograph technique, including impregnation with 14C-MMA (MethylMethAcrylate), in-situ polymerization and autoradiograph (Hellmuth et al. 1993). Intensities on autoradiographs are converted into bidimensional porosity maps using 14C-PMMA calibration sources. This method allows connected porosity quantifications of the impregnated samples. Moreover, quantification of crack network changes is specifically described in terms of pore density, and pore aperture distribution (pore aperture ranging from 0.1 μ m to several mm). The results indicate that the unaltered reference sample has a total porosity of 2.61% (± 0.28 %) and a connected crack network at the grain joints. With increasing age of soil formation total porosity increases: 1.98% ± 0.57 (15.2ky), 3.96% ± 0.57 (24.3ky) 12.82% ± 1.16 (78.5ky) and 14.68% ± 2.48 (119.5ky). Apparent connectivity as well as opening of crack network increases with age in these samples. Porosity increases in a first step at inter-grain boundaries and with increasing weathering progresses within minerals due to dissolution (feldspars) or expansion (biotite). Clay minerals filling pores were also characterized to specify weathering processes.



S09.01 -3

PETROPLINTHITE FORMATION IN A QUATERNARY COMPLEX PALEOSOL ALONG NW ITALIAN COAST: FROM MICROMORPHOLOGY TO LANDSCAPE EVOLUTION

Rellini Ivano^[1], Trombino Luca^[2], Carbone Cristina^[1], Firpo Marco^[1]

^[1]University of Genova ~ Territory and Resources Study Department (Dip. Te.Ris) ~ Genova ~ Italy ^[2]University of Milano ~ Earth Sciences Department ~ Milano ~ Italy

According to the World Reference Base for Soil Classification a petroplinthic horizon is a continuous, fractured or broken layer of indurated material, cemented mainly by Fe (and in cases also Mn) and in which organic matter is either absent or present only in traces. Petroplinthic horizons are closely associated with plinthic horizons, from which they develop when exposed to repeated wetting and drying cycles. At the present time (petro)plinthite is commonly found in soils forming in subhumid tropical climates with distinct wet and dry seasons and it pertains to the material called "laterite". The aim of this work is to document the evolution of costal complex paleosol developed in NW Italy during the Quaternary, and discuss the genesis of its petroplinthic horizon, within the context of the environmental changes recorded in this sector of Mediterranean coast from the Late Pliocene to Holocene. The strong development of the paleosol sequence is mainly due to superimposed pedogenetic phases (e.g. overlapping of illuvial horizons) in an accretional landscape. In particular the petroplinthitic horizon represents the response to seasonal fluctuation of the water table, and doesn't show any genetic link with the weathered bedrock. In this light, the plinthitisation/ferruginization derived from iron enrichment and accumulation from an external upslope source, mainly by post-depositional precipitation of neo-formed iron and alumina oxyhydroxides (hisingerite), originated from the dissolution of pre-existing hematite in detrital Pliocenic lateritic soils (duricrust) fragments, which developed in higher landscape positions.



S09.01 -4

ORIGIN OF CARBONATES IN TERMITE MOUNDS ON FERRALSOLS IN KATANGA, D.R. CONGO

Mujinya Basile^[1], Florias Mees^[2], Pascal Boeckx^[3], Samuel Bode^[3], Geert Baert^[4], Hans Erens^[1], Ann Verdoodt^[1], Michel Ngongo^[5], Van Ranst Eric^{*[1]}

^[1]Ghent University ~ Geology and Soil Science ~ Ghent ~ Belgium ^[2]Royal Museum for Central Africa ~ Geology and Mineralogy ~ Tervuren ~ Belgium ^[3]Ghent University ~ Laboratory of Applied physical chemistry ~ Ghent ~ Belgium ^[4]University college Ghent ~ Plant Production ~ Ghent ~ Belgium ^[5]Lubumbashi University ~ Laboratory of Soil Science ~ Lubumbashi ~ Congo, the Democratic Republic of the

*The present study attempted to identify the origin (pedogenic, inherited, or mixed) of the calcium carbonates accumulated within mounds built by *Macrotermes falciger* (ca. 8 m in height; ca. 15 m in width), using both field and laboratory techniques. Carbonate features were investigated in a profile through the centre of a termite mound and in a cross section of an entire termite mound. Field evidence for a pedogenic origin includes the morphological type (soft powdery materials, nodules, and coatings on ped surfaces) and distribution patterns of the carbonates. Thin-section studies reveal that the carbonates occur predominantly as impregnative orthic nodules and less commonly as coatings, both clearly pedogenic; calcareous pellets are interpreted as locally reworked pedogenic carbonates. X-ray diffraction (XRD), scanning electron microscopy/energy dispersive X-ray spectrometry (SEM-EDS) and stable isotope (d13C) analyses show that all isolated carbonate features consist of high-Mg calcite (4.9-12.3 mol% MgCO₃) with d13CPDB values ranging from -13.2‰ to -11.5‰. Weddellite (CaC₂O₄ · 2H₂O) is identified in thin-section and by XRD analysis, with indications for local transformation into calcite. The stable isotope composition of carbon suggests that calcite precipitated in equilibrium with soil CO₂ generated during decomposition of soil organic matter. Locally, carbon is most likely derived from oxidation of oxalates, yielding anomalously light d13C signatures. This study proves that carbonates which accumulated in *Macrotermes* mounds are pedogenic precipitates, whose deposition is largely related to microbial decay of organic matter, subsequently redistributed to some extent by abiotic dissolution-reprecipitation and by termite activity.*



S09.01 -5

MICROMORPHOLOGY AND CHEMISTRY OF BURIAL SOILS FROM CHALCOLITHIC GRAVES OF THE 3RD MILLENNIUM BC (MONTE CLARO CULTURE), NEAR GANNÌ, SARDINIA

Usai Maria-raimonda^{*[1]}, Wilson Clare^[2], Hall Allan^[1], Pickering Matt^[3], Manunza Maria Rosaria^[4], Pittoni Emanuele^[5], Garbi Ilaria^[5], Keely Brendan^[3], Brothwell Don R.^[1]

^[1]University of York ~ Department of Archaeology ~ York ~ United Kingdom ^[2]University of Stirling ~ Department of Biological and Environmental Sciences ~ Stirling ~ United Kingdom ^[3]University of York ~ Department of Chemistry ~ York ~ United Kingdom ^[4]Soprintendenza Beni Archeologici e Culturali ~ / ~ Cagliari ~ Italy ^[5]/ ~ / ~ Cagliari ~ Italy

Two Chalcolithic Age burials were discovered in Southern Sardinia, Italy, within Miocene marl and Quaternary alluvial gravel deposits. The tombs included vertical access tunnels leading to funerary chambers with grave goods of the first half of the III millennium. Red staining and large patches of loose grey fibrous deposits were situated in different areas of the graves and on one skeleton. Micromorphological, organic chemical, XRD and SEM–microprobe analysis were carried out to establish whether the observed features resulted from rock/soil weathering, or from burial rituals. Investigations of the chamber vault, local weathered control materials, and within-grave samples, demonstrated that the red-stained contexts were inorganic, containing a remarkably variable quantity of iron oxides (including haematite), quartz and CaCO₃. Micromorphological analysis also showed that the fibrous grey contexts consisted of silica ‘skeletons’, where silica had replaced the original cellulose cells of monocotyledonous plant tissues, very likely from grasses that had possibly been burnt under strongly oxidising conditions (similar to what has been observed in deposits from some prehistoric and medieval sites in England). Both red-stained and grey fibrous contexts were attributed to burial rituals. Micromorphological analysis of the soil under the pelvis and head suggested that the rock and soil had been affected by burial-related decay features along a vertical, but not lateral, gradient in relation to the ground surface and burial resting plane. Acknowledgements: The research is funded by the European Research Council under the European Community's Seventh Framework Programme (FP7/2007-2013) / ERC grant agreement n° 230193



S09.01 -6

**SOIL MICROMORPHOLOGY FOR CONSTRUCTION SCIENCE: THE MORTAR
ARCHAEOMETRY**

Kapur Selim^[1], Binici Hanifi^[2], Akça Erhan^[3], Zucca Claudio^[4]

^[1]Cukurova University ~ Soil Science & Archaeometry ~ Adana ~ Turkey ^[2]Kahramanmaraş Sutcu Imam University ~ Department of Civil Engineering ~ Kahramanmaraş ~ Turkey ^[3]Adiyaman University ~ Technical Programs ~ Adiyaman ~ Turkey ^[4]University of Sassari ~ Territorial Engineering and Desertification Research Group (NRD) ~ Sassari ~ Italy

Micromorphology revealed in depth evaluation of materials particularly soil micromorphology yielded numerous data on processes such as formation, neoformation and transformation of minerals and microstructure in soils, pottery and construction materials. Mortars, one of the first human made materials for construction of Byzantine and the Ottoman worlds were compared in terms of micromorphology and mineralogy. The Byzantines were the first to introduce the Roman mortar/concrete, the Opus Signinum, to the eastern world as was used in prestigious buildings, where the architectural and materials production knowledge was extended to the other parts of the Ottoman world for religious complexes. Mortars of different types and compositions were widely known and used in the ancient world and the lime mortar–putty was widespread throughout the Roman and Byzantine Empires especially for earthquake resistivity. These mortars, besides being suitable for building purposes were also preferred as a water-tight layer on building mortars or to enhance the water-tight aspects of a building mortar. Adding limestone to the mix has been known to enhance the mortar strength and the formation of ettringite minerals in pores as strengtheners. The better freeze–thaw resistance of the mortars prepared with limestone and volcanic aggregates is probably due to an appropriate pore structure and sufficient mechanical strength. The processes ongoing in mortars were evaluated by soil micromorphology and archaeometry which yielded precise knowledge on the additives and new minerals formation in mortars.

S09.01 -7

LASER ABLATION(LA)-ICP-MS ON SOIL THIN SECTIONS: A POWERFUL TOOL FOR ASSESSING TRACE ELEMENT DISTRIBUTION, PEDOGENETIC PROCESSES AND SOIL POLLUTION

Scarciglia Fabio*^[1], Barca Donatella^[1]

^[1]Università della Calabria ~ Dipartimento di Scienze della Terra ~ Arcavacata di Rende (CS) ~ Italy

We recently proposed a new methodological approach for investigating trace element distribution in soils, combined with traditional micromorphological and geochemical techniques. We performed compositional spot analyses on 100µm-thick thin sections prepared from undisturbed soil samples, using laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS). This method was integrated with conventional observations using a polarizing optical microscope and a scanning electron microscope equipped with chemical microprobe analysis (SEM-EDS). This study, based on chemical analysis of different subportions of soil horizons (illuvial pedofeatures, pedogenic matrix and skeletal grains), permits a detailed assessment of microscale spatial variability and particle/element retention and mobility. Chemical concentrations can be measured with a high degree of accuracy and precision, reaching detection limits of 1-10 to 0.1-0.01 mg/kg, which are considerably lower than those obtained using other microanalytical techniques (EDS, WDS). We focused on behaviour of trace elements (including rare earths, heavy metals and radionuclides) in different types of silty/clay coatings and mineral or organic matrix with respect to parent rock. Main trends of increase from rock to matrix to coatings observed for many trace elements revealed a clear pedogenetic control on element fractionation, related to weathering of primary components, neogenesis of clay minerals, metal adsorption onto reactive sites of clays or organic matter, and further concentration by translocation processes of the fine fraction. In situ laser ablation techniques can be used as detailed tracers of chemical element behaviour in soils, pedogenetic/morphodynamic processes and as potential tools for assessing microsite location and mobility of soil pollutants.



S09.02 - BIOGEOCHEMICAL INTERFACES IN SOIL: ARCHITECTURE, PROPERTIES AND FUNCTIONS

Chair Person:

Kai Uwe Totsche, Jena - Germany

Thursday 05 July 2012 from 13:30 to 15:00. Room Biancospino

S09.02 -1

COMBINED VIS-NIR IMAGING SPECTROSCOPY AND NANOSIMS ANALYSES OF INTACT CORES OF PERMAFROST AFFECTED SOILS

Carsten W. Mueller, Freising - Germany

S09.02 -2

BIOGEOCHEMICAL INTERFACE DEVELOPMENT IN ARTIFICIAL SOILS

Geertje Pronk, Freising - Germany

S09.02 -3

THE SOIL-LITTER INTERFACE IS A HOTSPOT FOR BACTERIAL ALKANE-DEGRADATION

Julia Giebler, Leipzig - Germany

S09.02 -4

CHARACTERIZATION OF IN-SITU WETTING PROPERTIES BY HIGH RESOLUTION CONTACT ANGLE MEASUREMENTS

Marc-Oliver Goebel, Hannover - Germany

S09.02 -5

IMPACT OF BIOLOGICAL ACTIVITY ON SOIL STRUCTURE BY THE COMBINED ANALYSIS OF SOIL THIN SECTIONS AND 0-20 μ M SOIL FRACTIONS

Françoise Watteau, Vandoeuvre-lès-Nancy - France

S09.02 -6

ORGANO-MINERAL ASSOCIATIONS IN AN ANDISOL DEVELOPED FROM VOLCANIC ASHES (PART 1): DOES PARTICLE SIZE MATTER?

Maki Asano, Tsukuba - Japan



S09.02 -1

COMBINED VIS-NIR IMAGING SPECTROSCOPY AND NANOSIMS ANALYSES OF INTACT CORES OF PERMAFROST AFFECTED SOILS

Mueller Carsten W.*^[1], Steffens Markus^[1], Buddenbaum Henning^[2], Hoeschen Carmen^[1], Kao-Kniffin Jenny^[3], Bockheim James^[4]

^[1]TU Muenchen ~ Lehrstuhl fuer Bodenkunde ~ Freising ~ Germany ^[2]University Trier ~ Department for Remote Sensing ~ Trier ~ Germany ^[3]Cornell University ~ Department of Horticulture ~ Ithaca ~ United States ^[4]University of Wisconsin ~ Department of Soil Science ~ Madison ~ United States

Soils exhibit a structurally heterogeneous matrix across a wide range of spatial scales, whereas, processes controlling the stabilisation of soil organic matter (SOM) happen at submicron scales. Although the knowledge about the factors controlling the preservation of SOM has substantially improved, these processes are still difficult to evaluate in situ. We analysed intact soil cores from Cryosols (Typic Aquiturbel) of Northern Alaska (Barrow, USA) with nano-scaled secondary ion mass spectrometry (NanoSIMS) and VIS-NIR imaging spectroscopy. This approach enabled the combination of submicrometer-scale elemental mapping with the micrometer-scale maps of OM and mineral particle distribution. The analysis of biogeochemical soil interfaces at the submicron scale is strongly improved by the novel NanoSIMS technique. This technique allows the simultaneous analysis of up to seven ion species with high sensitivity and lateral resolution. Imaging spectroscopy is used to record the VIS-NIR reflection of a complete, undisturbed soil sample with a high spatial and spectral resolution. NanoSIMS analyses show the initial formation of aggregates and soil interfaces in the permafrost soils. A special feature are iron oxide layers in a soil core showing different amounts of sulphur indicating changing environmental conditions during their formation. Imaging spectroscopy enabled the mapping and upscaling of the micro-distribution of OM and mineral spheres to the millimetre scale. We demonstrate the great potential of a multi-scale approach for soil system research focusing on the study of soil architecture with respect to its functional properties and soil processes.



S09.02 -2

BIOGEOCHEMICAL INTERFACE DEVELOPMENT IN ARTIFICIAL SOILS

Pronk Geertje*^[1], Heister Katja^[1], Ding Guo-Chun^[2], Babin Doreen^[2], Smalla Kornelia^[2], Kögel-Knabner Ingrid^[1]

^[1]Technische Universität München ~ Lehrstuhl für Bodenkunde ~ Freising ~ Germany ^[2]Julius Kühn-Institut Bundesforschungsinstitut für Kulturpflanzen ~ Institut für Epidemiologie und Pathogendiagnostik ~ Braunschweig ~ Germany

The effect of mineral composition on the formation and properties of biogeochemical interfaces in soil was studied in a newly developed incubation experiment with so-called “artificial soils” composed of mixtures of clean and well-defined model materials. Artificial soils with 8 different compositions of illite, montmorillonite, ferrihydrite, boehmite, charcoal and quartz sand, and manure as organic matter source were inoculated with the same microbial extract obtained from an arable topsoil and incubated up to 18 months under constant temperature and water content. The formation of organo-mineral associations and microaggregates during incubation was determined by density and particle size fractionation, and the development and turnover of organic carbon and N was characterized. The CO₂ respiration was similar in all artificial soil compositions, indicating that microbial activity was limited by nutrient availability, even though the microbial communities present developed differently, depending on mineral composition and charcoal presence. Density fractionation showed that significant microaggregation and formation of organo-mineral associations took place within 3 months, and increased until the end of incubation. Solid-state ¹³C NMR spectroscopy further indicated an accumulation of proteinacious material in the fine fractions of the artificial soils. Overall, the artificial soils developed quickly into aggregated systems with established microbial communities of soil-like complexity, that contained different habitats for microorganisms depending on composition. The artificial soils therefore provided a useful and well-defined model system in which the formation and maturation of biogeochemical interfaces in soil could be studied.



S09.02 -3

THE SOIL-LITTER INTERFACE IS A HOTSPOT FOR BACTERIAL ALKANE-DEGRADATION

Giebler Julia^{*[1]}, Stephan Schulz^[2], Antonis Chatzinotas^[1], Lukas Y. Wick^[1], Michael Schlöter^[3], Hauke Harms^[1]

^[1]Helmholtz Centre for Environmental Research - UFZ ~ Environmental Microbiology ~ Leipzig ~ Germany ^[2]Technische Universität München ~ Chair of Soil Ecology ~ Munich ~ Germany ^[3]German Research Center for Environmental Health ~ Terrestrial Ecogenetics ~ Munich ~ Germany

*The plant litter-soil interface is characterised by a constant turnover of plant material and the concomitant release of alkanes (as major constituents of the waxy plant tissue) to soil microbes. Here, we describe community changes of alkane-degrading bacteria harbouring and expressing the alkane monooxygenase gene *alkB* in response to either maize or pea litter at different soil microsites neighbouring the plant material (litter layer; soil-litter interface; soil layer 1-1.5 cm below interface). In microcosm experiments spatio-temporal changes of released alkanes were analysed over a period of 30 weeks and related to bacterial community changes in a cambisol and a luvisol, respectively. Bacterial communities were analysed by cell enumeration and a T-RFLP method targeting *alkB* genes. Both the number and community composition of alkane-degrading bacteria varied significantly in litter-amended soils: Alkane availability and the microsite relative to the plant litter source correlated with the spatio-temporal community changes on the DNA-level. By contrast, poor impact of soil type was observed. The expression of *alkB* genes (RNA-level) however significantly depended on the soil type which considerably influenced the alkane quality. Furthermore, the community profiles on the RNA-level were remarkably similar in litter and soil layers indicating common active degraders at the different microsites. We consequently hypothesise that the soil-litter interface is a hotspot for microbial alkane-degradation which also shapes the natural alkane-degradation rates and potential in the soil zones underneath. Moreover, litter-addition to contaminated soils would actively create soil-litter interfaces thus enhancing the intrinsic alkane-degradation capacity in terms of a biotechnological approach.*



S09.02 -4

CHARACTERIZATION OF IN-SITU WETTING PROPERTIES BY HIGH RESOLUTION CONTACT ANGLE MEASUREMENTS

Goebel Marc-Oliver^{*[1]}, Georg Guggenberger^[1], John Maximilian Köhne^[2], Kai Uwe Totsche^[3], Hans-Jörg Vogel^[2], Susanne Karoline Woche^[1], Bachmann Jörg^[1]

^[1]Leibniz Universität Hannover ~ Institute of Soil Science ~ Hannover ~ Germany ^[2]Helmholtz Centre for Environmental Research GmbH ~ Department of Soil Physics ~ Halle/Saale ~ Germany ^[3]Friedrich-Schiller-Universität Jena ~ Chair of Hydrogeology, Institute of Geosciences ~ Jena ~ Germany

Soil particle wetting properties play an important role for the development and the functioning of biogeochemical interfaces as they control the spatial distribution and continuity of the fluid phases in the soil matrix. In turn, the wetting properties can be modified during soil development by sorption of organic substances. To investigate the role of wetting properties and their alteration during initial soil formation processes we perform percolation experiments with columns composed of an organic top-layer as a source for dissolved organic matter and a downstream reception layer consisting of pure mineral particles. Before and after percolation with a CaCl₂ solution for several weeks, the entire column was investigated by X-ray μ CT at a resolution of 0.1 mm for pore structural changes and formation of flow paths. Then the mineral part of the column was sliced in 1 cm thick layers and air-dried. The wetting properties of the exposed surfaces were evaluated by contact angle measurements at a high spatial resolution with the sessile drop method. Experiments with O horizon material as source layer and a quartz/illite mixture as mineral receptor layer showed that leaching results in spatially heterogeneous sorption of organic substances on mineral particles, optically visible as dark spots. These locations are characterized by a distinctly decreased wettability with contact angles up to 80° while the surrounding material has not been altered in its wetting properties. The experimental procedure allows us to allocate soil interfacial properties with respect to their location within the three-dimensional structure of the pore space.



S09.02 -5

IMPACT OF BIOLOGICAL ACTIVITY ON SOIL STRUCTURE BY THE COMBINED ANALYSIS OF SOIL THIN SECTIONS AND 0-20 μ M SOIL FRACTIONS

Watteau Françoise^[1], Villemin Geneviève^[1], Begin Jean-Claude^[1], Séré Geoffroy^[1], Cortet Jérôme^[1]

^[1] Université de Lorraine ~ LSE UMR 1120 INRA ~ Vandoeuvre-lès-Nancy ~ France

Soil structure is a significant resulting characteristic of soil bio-functioning. Thus, imaging structure, by describing the spatial organization of pores and aggregates, can help to understand the evolution of soils submitted to different impacts, especially as these investigations are realized at different scales. In this way, we combined morphological and analytical characterization of organo-mineral structures at two different scales (1) of soil thin sections by using light microscopy and SEM/EDX and (2) of 0-50 μ m soil fractions by using TEM/EDX. By this approach, we highlighted the role of biological activity on soil structure in agrosystems or more anthropised soils, such as: -

the root impact on the genesis of stable aggregates in a silty soil under maize underlining the part of the nature and the humification state of the root organic matter - the impact of rhizospheric activity (root, earthworm and bacteria) on the structure of a constructed Technosol resulting from the combination of paper-mill sludge, thermally treated soil material and green waste compost - the contribution of the mesofauna activity, e.g. Oribatid mites, through their faecal pellets to the re-distribution of pollutants (Pb, Zn, Mn) in the humus layer of a Technosol developed on a settling pond used in steel industry for blast furnace sludge forage. Such results gave relevant in situ information on the state and availability of the organic matter and associated elements involved in aggregates.



S09.02 -6

**ORGANO-MINERAL ASSOCIATIONS IN AN ANDISOL DEVELOPED FROM VOLCANIC ASHES
(PART 1): DOES PARTICLE SIZE MATTER?**

Asano Maki^{*[1]}, Wagai Rota^[1]

^[1]National Institute for Agro-Environmental Sciences ~ Carbon & Nutrient Cycling Division ~ Tsukuba ~ Japan

Volcanic-ash soils are characterized by a high content of soil organic matter (SOM) and consist mainly of short-range-order minerals such as allophane, imogolite and ferrihydrite. Allophane/imogolite are unique nanoclays of hollow spherule/tube structures with the diameter of <5 nm and have high AEC and CEC as well as extensive, variable-charge surfaces. Due to the dominance of these nanoclays, SOM stabilization process in volcanic soils may differ from that in non-volcanic soils consisting of well-crystalline minerals. Particle-size fractionation is an effective approach to distinguish different types of organo-mineral aggregates and to elucidate SOM stabilization processes. However, because these nanoclays form sonication-resistant aggregates, the effectiveness of this approach on volcanic-ash soils remain obscure in the literature. Here we hypothesized that, with an appropriate dispersion technique, major portions of SOM is stabilized in finer size fractions (<2 μm) as sub-micron aggregates of short-range-order minerals with microbially-processed organic matter in volcanic-ash soils. To test this, we chose a surface (Ap) horizon of typical allophanic Andisol in Japan. We compared dispersion techniques (sonication at several levels and chemical treatments), analyzed each particle-size fraction by selective-dissolution, isotopic (N-15, C-13, C-14), and spectroscopic techniques, and found strong particle-size control on the physicochemical nature of organo-mineral aggregates. Together with the results from a companion study (Wagai et al., in the same session) which used sequential density fractionation approach, we speculate on the progression in organo-mineral associations from fresh plant detritus to the organo-mineral aggregates of varying stability for the volcanic-ash soil studied.



S10.01a - PLANT SOIL INTERACTIONS FROM THE RHIZOSPHERE TO THE FIELD SCALE

Chair Person:

Mathieu Javaux, Louvain - Belgium

Monday 02 July 2012 from 13:30 to 15:00. Room Olmo

S10.01a -1

20 YEARS OF RESEARCH ON BIOLOGICAL NITRIFICATION INHIBITION (BNI) PROCESSES FROM ROOTS TO LANDSCAPE IN WET SAVANNAS OF WEST AFRICA: IMPACT OF GRASS AND TREE SPECIES

Jean-Christophe Lata, Paris - France

S10.01a -2

IS ORGANIC NITROGEN UPTAKE A RELEVANT N SOURCE FOR PLANTS?

Daniel Moran-Zuloaga, Bayreuth - Germany

S10.01a -3

FORAGING IN NUTRIENT PATCHES: ARBUSCULAR MYCORRHIZAL FUNGI, THE PLANT'S EXTENDED ROOT SYSTEM.

Edith Hammer, Lund - Sweden

S10.01a -4

SOIL ARCHITECTURE CONTROLS THE PLANT AVAILABILITY OF P IN FOREST SOILS

Ivo Voß, Berlin - Germany

S10.01a -5

MODELING MINERAL NUTRIENT UPTAKE OF SPRUCE TREE ROOTS AS AFFECTED BY THE ION CONCENTRATION CHANGES IN THE RHIZOSPHERE: UPSCALING OF MODEL RESULTS TO FIELD PLOT SCALE

Heino Niefeld, Göttingen - Germany

S10.01a -6

DATA GATHERING FOR MODELING THE NUTRIENT ACQUISITION FROM THE SUBSOIL: CARBON AND NITROGEN CONTENTS OF THE DRILOSPHERE

Timo Kautz, Bonn - Germany



S10.01a -1

20 YEARS OF RESEARCH ON BIOLOGICAL NITRIFICATION INHIBITION (BNI) PROCESSES FROM ROOTS TO LANDSCAPE IN WET SAVANNAS OF WEST AFRICA: IMPACT OF GRASS AND TREE SPECIES

Lata Jean-Christophe^{*[1]}, Barot Sébastien^[2], Boudsocq Simon^[1], Raynaud Xavier^[1], Abbadie Luc^[1]

^[1]UPMC CNRS ~ UMR7618 Biogéochimie et Ecologie des Milieux Continentaux (Bioemco) ~ Paris ~ France ^[2]IRD ~ UMR7618 Biogéochimie et Ecologie des Milieux Continentaux (Bioemco) ~ Paris ~ France

Nitrification process, being involved in plant N nutrition and N losses through leaching and denitrification of nitrate, plays a key-role in ecosystem functioning and particularly in N-limited ones like wet tropical savannas. Regulating nitrification is thus central to any strategy for improving NUE. Biological Nitrification Inhibition is an active plant-mediated natural function, where nitrification inhibitors released from roots suppress soil-nitrifying activity, thereby forcing N into other pathways. 20-years studies in Lamto savannas (Ivory Coast) showed that they exhibit two different types of N cycle, with high- and low-nitrification sites. The dominant perennial grass, Hyparrhenia diplandra, is mainly responsible for this duality at subpopulation level, with one widespread ecotype being able to inhibit nitrification causing the general low nitrification status of savannas. The other is less common, unable to reduce nitrification and leads to the existence of nitrifying zones. At rhizosphere scale, we demonstrated high sensitivity negative or positive relationships depending on ecotypes between root densities and nitrification. At plant scale, the different nitrification rates led to huge differences in NUE that can explain differences in primary production that is 2-times higher for nitrification inhibiting subpopulation. These differences are at least partly explained by different plant intrinsic growth characteristics. Finally, at landscape scale, all grass species mainly expressed an inhibiting effect but inversely, all tree species expressed a very high stimulation impact, with nitrification up to 377-fold greater near trees. All these inhibition/stimulation effects of biotic landscape elements seem site-dependant, linked to the overall baseline nitrification level of the two systems.



S10.01a -2

IS ORGANIC NITROGEN UPTAKE A RELEVANT N SOURCE FOR PLANTS?

Moran-Zuloaga Daniel*^[1], Dippold Michaela^[1], Kuzyakov Yakov^[2]

^[1]University of Bayreuth, Germany ~ Department of Agroecosystem Research, BAYCEER ~ Bayreuth ~ Germany

^[2]Georg-August-University of Göttingen ~ Soil Science of Temperate Ecosystems ~ Göttingen ~ Germany

Some recent studies suggested that in beside to inorganic nitrogen plants can also take up organic N, but ecological relevance or this N source is not yet clarified. The aim of this study is to understand the significance of organic N uptake by three agricultural species: maize (Zea mays), chicory (Cichorium intybus) and white lupine (Lupinus albus). To understand the fate of Low Molecular Weight Organic Substances (LMWOS) ¹⁵N and ¹⁴C labeled alanine (uniformly and position-specifically labeled) were injected into the rhizosphere. N free LMWOS (acetic acid) and inorganic ¹⁵N were used as control. The significance of organic N uptake and the fate of LMWOS were evaluated based on ¹⁴C and ¹⁵N content in soil, shoot and root biomass as well as in respired CO₂. For the N free LMWOS (acetic acid) the uptake was higher for C1 group than for C2. This is a result of fast decarboxylation and release of HCO₃⁻ which was taken up passively. For amino acids the uptake percentage ranged from 0.01-0.05% of the added alanine with C3>C2>C1, i.e. no preference for the carboxylic group was observed. Position-specific differences were obtained only in maize and lupine, which might indicate a specific and fast uptake of alanine by chicory. In summary, these results showed that there are position-specific differences in LMWOS utilization of maize, chicory and lupine. This reveals that N nutrition by LMWOS is a complex process and mechanisms as well as influencing factors have to be investigated to assess its relevance in field.



S10.01a -3

FORAGING IN NUTRIENT PATCHES: ARBUSCULAR MYCORRHIZAL FUNGI, THE PLANT'S EXTENDED ROOT SYSTEM.

Hammer Edith*^[1], Wallander Håkan^[1], Nasr Hafedh^[2]

^[1]Lund University ~ Microbial Ecology ~ Lund ~ Sweden ^[2]National Research Institute for Rural Engineering, Water and Forest ~ INGREF ~ Tunis ~ Tunisia

Soil is a very heterogeneous substrate, and especially its organic matter fraction can be very unequally distributed. We examined the influence of different organic matter- and nutrient patches on the extended parts of plant's root systems: arbuscular mycorrhizal fungi (AMF). Experiments were conducted in field in semi-desert soils in Tunisia and under controlled sterile laboratory conditions. Organic matter patches, inaccessible to the host plant roots, stimulated AMF more strongly than mineral nutrient patches, even though they - as obligate biotrophs – are not dependent on organic matter as an energy source. Also the plant's investment in form of carbon flow to the rhizosphere (to AMF, rhizobia and other soil bacteria, measured by ¹³C pulse labelling) was strongly enhanced by organic matter patches. Under sterile conditions, mineral nutrient patches as P and K attracted and amplified AMF growth, while patches of high salinity, inhibited AMF. Even sterile soil and charcoal promoted AMF growth. Nutrient uptake and storage was investigated with proton induced x-ray emission (PIXE) analysis, allowing to map the elemental composition of the tissue.



S10.01a -4

SOIL ARCHITECTURE CONTROLS THE PLANT AVAILABILITY OF P IN FOREST SOILS

Voß Ivo^{*[1]}, Lang Friederike^[1]

^[1]Tu Berlin ~ Institute of Ecology/Department of Soil Science ~ Berlin ~ Germany

The structure of soils is partly regulated by plant roots and their exudates. There is also evidence that the availability of Phosphorus (P), being a strongly sorbed and immobile nutrient depends on soil structure. We hypothesized that (i) the diffusion of P out of small aggregates limits its mobilization and (ii) that the effect of this structure-limited P mobilization increases with increasing aggregate stability. We analyzed two sandy topsoil samples and two loamy topsoil and subsoil samples in an end-over-shaking batch experiment. We determined P desorption kinetics by anion exchange resin of aggregated soil samples and of soil samples dispersed by ultrasonic treatment. After different times of extraction we determined aggregate size distribution and amount of mobilized P. When compared to standard chemical dispersion, ultrasonic breakup of aggregates resulted in similar grain size distribution, indicating complete dispersion of aggregates. There was no difference in P mobilization between the dispersed and non-dispersed sandy topsoils whereas we observed a significantly slower P mobilization in the aggregated loamy soils. Other than expected the difference in P mobilization was smaller in the topsoil which shows more stable aggregates than the subsoil. We explain this effect with a possibly higher porosity of aggregates in the topsoil resulting in a smaller diffusion resistance or/and P accumulation on aggregate surfaces in these samples. Our results emphasize the relevance of soil aggregation for P availability. Thus further research should consider the ability of plants to control nutrient availability via the pathway of influencing soil architecture.



S10.01a -5

MODELING MINERAL NUTRIENT UPTAKE OF SPRUCE TREE ROOTS AS AFFECTED BY THE ION CONCENTRATION CHANGES IN THE RHIZOSPHERE: UPSCALING OF MODEL RESULTS TO FIELD PLOT SCALE

Nietfeld Heino^{*[1]}

^[1]Georg August University ~ Soil Science of Temperate and Boreal Ecosystems ~ Göttingen ~ Germany

A multi-ion rhizosphere model has been developed which describes the reactive transport of all major ions in the rhizosphere. The model is used in a Monte Carlo upscaling approach to calculate the heterogeneity of the actual nutrient uptake rates (U), the H/OH root excretion rates and the ion concentrations in the inner rhizosphere (Rh ; 2.0 mm soil volume around the root). The variability of the model parameter values has been derived from measurements conducted on the F1 spruce-plot in Solling, Germany. Rh -to-Bulk ratios (Rh -enrichment factors) of modeled and measured Rh -concentrations (F1-plot) are determined. The Rh -enrichment factors around non-mycorrhizal long roots cover a range between 0.5 and over 3.0 (Nietfeld et al., 2011a; Nietfeld et al., 2011b; submitted) depending on the ion considered and are characterized by a high short-term dynamics. Around mycorrhizal roots mostly ion depletions in Rh have been modelled (Nietfeld et al., in prep.) which are due to the uptake activity of the emanating hyphae. Modeled enrichment factors agree with enrichment factors determined by measured Rh -concentrations. Around long roots mostly OH -root excretions have been calculated which cause depletions of exchangeable protons or exchangeable aluminum ions; the latter one is determined by the formation of $Al(OH)_3$ (gibbsite). At OH root excretions the U -rates of Mb cations (Ca , Mg , K) are considerably smaller than the Mb root uptake capacities. This is caused by small desorption rates of exchangeable Mb cations which is due to depletions of exchangeable H or Al ions.



S10.01a -6

DATA GATHERING FOR MODELING THE NUTRIENT ACQUISITION FROM THE SUBSOIL: CARBON AND NITROGEN CONTENTS OF THE DRILOSPHERE

Kautz Timo^{*[1]}, Athmann Miriam^[1], Perkons Ute^[1], Köpke Ulrich^[1]

^[1]University of Bonn ~ Institute of Organic Agriculture ~ Bonn ~ Germany

Biopores are considered to play a major role for the nutrient acquisition from the subsoil. Within the DFG research unit 1320 'Crop sequence and the nutrient acquisition from the subsoil', data are collected for modeling nutrient mobilization, uptake and turnover in the subsoil. To characterize the drilosphere with respect to C and N contents, individual biopore coatings and loose soil material inside the pore volume (biopore fillings) were sampled in 45-55cm, 55-65cm, 65-75cm soil depth by taking soil monoliths of 2500 cm³ volume each and three repetitions per depth. Total C and N contents of the individual samples (elementary analysis, Euro EA 3000, HEKAtech, Germany) were related to C and N contents of bulk soil samples of the same soil volume. In all biopore coatings and fillings analyzed, C and N contents were higher than in the bulk soil. Nevertheless, the individual values fluctuated in a big range (compared to bulk soil samples: factor 1.02-3.03 for C and factor 1.02-2.69 for N). A significant correlation between C and N contents of coatings and of fillings collected within the same biopore was determined. The results show that a detailed consideration of nutrient contents in biopore coatings and fillings is necessary for precisely quantifying the contribution of the drilosphere to the nutrient acquisition from the subsoil. More research is needed to relate genesis and further usage of the individual biopores by plant roots and earthworms to nutrient contents.



S10.01b - PLANT SOIL INTERACTIONS FROM THE RHIZOSPHERE TO THE FIELD SCALE

Chair Person:

Walter Wenzel, Vienna - Austria

Monday 02 July 2012 from 15:30 to 17:00. Room Olmo

S10.01b -1

ROOT-INDUCED DECREASE IN METAL BINDING CAPACITY OF DISSOLVED ORGANIC MATTERS IN THE RHIZOSPHERE: EVIDENCES FROM TWO CONVERGENT STUDIES

Matthieu N. Bravin, Saint-Denis, La Réunion - France

S10.01b -2

COMPARISON OF DIFFERENT ROOT EXUDATE SAMPLING METHODS INCLUDING A NOVEL APPROACH USING RHIZOBOXES COMBINED WITH AN IN-SITU ROOT EXUDATE COLLECTING TOOL

Eva Oburger, Vienna - Austria

S10.01b -3

THE ROLE OF ROOT EXUDATES IN CHANGING SOIL MINERALOGY AND MOBILIZING TRACE ELEMENTS

Roberto Terzano, Bari - Italy

S10.01b -4

INFLUENCE OF THREE ROOT SYSTEMS ON SUBSOIL AERATION

Daniel Uteau Puschmann, Kiel - Germany

S10.01b -5

DROUGHT AND WATER STRESS OF CROPS: A LOOK AT THE SOIL-ROOT SYSTEM INTERPLAY

Claude Doussan, Avignon - France

S10.01b -6

IMPACTS OF ROOT SPATIAL DISTRIBUTION ON PHYSICAL & HYDRAULIC PROPERTIES IN PEAT GROWING MEDIA USED IN HORTICULTURE

Patrice Cannavo, Angers - France



S10.01b -1

ROOT-INDUCED DECREASE IN METAL BINDING CAPACITY OF DISSOLVED ORGANIC MATTERS IN THE RHIZOSPHERE: EVIDENCES FROM TWO CONVERGENT STUDIES

Bravin Matthieu N.^[1], Doelsch Emmanuel^[2], Hinsinger Philippe^[3]

^[1]CIRAD ~ UPR Recyclage et risque ~ Saint-Denis, La Réunion ~ France ^[2]CIRAD ~ UPR Recyclage et risque ~ Aix-en-Provence ~ France ^[3]INRA ~ UMR Eco&Sols ~ Montpellier ~ France

*The parallel understanding of dissolved organic matters (DOM) impact on trace metal speciation in soil and root ability to change DOM concentration and composition in the rhizosphere strongly suggests a substantial alteration of metal binding capacity of DOM in the rhizosphere, with consequent impacts on metal phytoavailability. This hypothesis is investigated in the present communication on the basis of two independent set of experiments. Both experiments used the RHIZOtest experimental set-up, which enables an easy and fast recovery of both plants (i.e. shoots and roots) and rhizosphere, to grown either lettuce (*Lactuca sativa*) or durum wheat (*Triticum turgidum durum*) on two different soil samples notably varying in pH, organic matter content and geographical origin (tropical vs. temperate area). Usual chemical properties (i.e. pH, concentration of DOM, major cations/anions and metals) and free copper activity were measured in the rhizosphere solution. Copper speciation was then modelled in the rhizosphere solution with the humic ion-binding model VI (Model VI) by adjusting the metal binding capacity of DOM to fit experimental data. Compared with bulk soil measurements, a large increase in both pH and DOM concentration was observed in durum wheat rhizosphere while these two parameters did not change significantly in lettuce rhizosphere. Alternatively, the fraction of DOM involved in copper binding decreased similarly by 40 % in both durum wheat and lettuce rhizosphere. These very convergent pictures of a decrease in metal binding capacity of DOM in both experiments lead to discuss the hypothetical governing mechanisms and the genericity of this finding.*



S10.01b -2

COMPARISON OF DIFFERENT ROOT EXUDATE SAMPLING METHODS INCLUDING A NOVEL APPROACH USING RHIZOBOXES COMBINED WITH AN IN-SITU ROOT EXUDATE COLLECTING TOOL

Oburger Eva^[1], Dellmour Madeleine^[2], Hann Stephan^[2], Wenzel Walter^[1], Puschenreiter Markus^[1]

^[1]University of Natural Resources and Life Sciences ~ Department of Forest and Soil Science ~ Vienna ~ Austria

^[2]University of Natural Resources and Life Sciences ~ Department of Chemistry ~ Vienna ~ Austria

LMW organic compounds (e.g. organic acids, amino acids, etc.) released by living plant roots are known to significantly contribute to the development of chemical, physical as well as microbial rhizosphere gradients. Suitable and accurate sampling procedures are therefore crucial in order to better understand root exudate driven dynamics of rhizosphere processes. The aim of this study was to compare commonly used sampling techniques including a novel exudate collecting tool that allows non-destructive and repetitive collection of unaltered root exudates from a root mat developed in rhizoboxes. Root exudates from Zea mays were collected using the following experimental designs: (i) hydroponic growth & sampling, (ii) soil growth & hydroponic sampling (iii) micro-suction cups in a high spatial resolution and (iv) rhizoboxes combined with the novel in-situ root exudate collecting tool. The effect of different sampling solutions (deionised H₂O & 0.5 mM CaCl₂) on the exudation patterns of organic and amino acids was also compared. Results showed that exudation rates differed qualitatively and quantitatively between soil-grown and nutrient-solution-grown plants with higher exudation rates being observed from soil grown plants and a better exudate compound recovery in H₂O. Soil solution concentrations obtained from micro-suction-cup sampling in defined distance to the root surface showed a decrease in exudate concentration towards the root surface probably due to higher microbial activity in the rhizosphere compared to the bulk soil. Rhizoboxes combined with an exudate collecting tool show great potential to further elucidate the complex root exudation dynamics of soil grown plants.



S10.01b -3

THE ROLE OF ROOT EXUDATES IN CHANGING SOIL MINERALOGY AND MOBILIZING TRACE ELEMENTS

Terzano Roberto^[1], Medici Luca^[2], Lettino Antonio^[2], Fiore Saverio^[2], Mimmo Tanja^[3], Tomasi Nicola^[4], Pinton Roberto^[4], Cesco Stefano^[3]

^[1]University of Bari ~ Department of Agroforestry and Environmental Biology and Chemistry ~ Bari ~ Italy ^[2]I.M.A.A.-C.N.R. ~ Institute of Methodologies for Environmental Analyses ~ Tito Scalco (PZ) ~ Italy ^[3]Free University of Bozen ~ Faculty of Science and Technology ~ Bozen ~ Italy ^[4]University of Udine ~ Department of Agricultural and Environmental Sciences ~ Udine ~ Italy

Root exudates such as low molecular weight organic acids (e.g. citric acid, malic acid, oxalic acid), phenolic compounds (e.g., flavonoids), and siderophores of microbial or plant origin can alter soil mineralogy in the rhizosphere thereby releasing trace elements in solution, which can act as essential micronutrients or dangerous pollutants for plants. This research assesses the effect of various root exudates (citric acid, malic acid, oxalic acid, genistein, quercetin and siderophores) on the mineralogy of two different soils (an agricultural calcareous soil and an acidic polluted soil) and evaluates possible synergic or competitive behaviors. X-ray diffraction (XRD) coupled with Electron Probe Micro Analysis (EPMA) was used to identify the crystalline and amorphous phases which were subjected to mineral alteration when exposed to the action of root exudates. Solubilization of trace metals such as Cu, Zn, Ni, Cr, Pb, Cd as well as of major elements such as Si, Al, Fe and Mn was assessed by means of Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES). It was also found that soil microorganisms attenuated mineral weathering by reducing the concentration of active root exudates in solution. This information is an important cornerstone to better understand the biogeochemical processes acting in the rhizosphere which can play an important role in the availability of trace elements (either nutrient or toxic) for plant acquisition. Research supported by MIUR – FIRB “Futuro in ricerca” (RBFR08L2ZT), internal grant of Unibz (TN5031) and Provincia BZ Rhizotyr TN5218.



S10.01b -4

INFLUENCE OF THREE ROOT SYSTEMS ON SUBSOIL AERATION

Uteau Puschmann Daniel^[1], Pagenkemper Sebastian Kouso^[1], Peth Stephan^[1], Horn Rainer^[1]

^[1]Institute for Plant Nutrition and Soil Science of the Christian-Albrechts-University Kiel ~ Soil Science ~ Kiel ~ Germany

*Soil structure is an important factor for soil quality and productivity by providing “healthy” interactions between physical functions and soil biota. One of the main aspects in soil structure is soil aeration, as it influences microbiological activity and root respiration. In this work we analyzed the ability of three root systems for generating macropores thus improving soil aeration: shallow roots (*Festuca arundinacea*), taproot-herringbone (*Cichorium intybus*) and taproot-multibranch (*Medicago sativa*). Soil aeration was determined by gas diffusion, air permeability and air capacity measurements on undisturbed soil cores at different matric potentials and depths. Microdiffusivities in the meso-micropores were measured with Clark-type microelectrodes. By means of computer tomography, connectivity and tortuosity of pores could be determined in vertical and horizontal directions. A field monitoring system allowed determining water saturation in soil which combined with laboratory measurements was used to derive in situ critical aeration conditions. Results show a better aeration of the topsoil with the shallowroot crop and in the subsoil with the taproot crops. *Medicago sativa* had a significant influence on the aeration below 60cm depth as it creates deeper and more continuous macropores than the other two species.*



S10.01b -5

DROUGHT AND WATER STRESS OF CROPS: A LOOK AT THE SOIL-ROOT SYSTEM INTERPLAY

Doussan Claude*^[1], Iyad Srayeddin^[2]

^[1]INRA ~ UMR EMMAH - INRA/UAPV ~ Avignon ~ France ^[2]Damascus University ~ Soil Science ~ Damascus ~ Syrian Arab Republic

Climate change may induce in parts of the world a decrease of rainfall. Such a change is already at work in the Mediterranean region where a decrease in rainfall rate seems to have started 40 years ago. Likewise, drought and particularly extreme drought could increase in a near future, like the 2003 heat and drought wave over Europe. As a consequence, rainfed crops or natural ecosystems will be more often drought stressed but, also, irrigated crops because of the increasing pressure over renewable water resource. There is always a need to increase the efficiency of water uptake by plant. In the different component of water efficiency of plant or crop, the soil-root system is less known and lots remain to be gain in the efficiency of water use by a better knowledge of the soil-root system interplay. With experimental data of two crops, Maize and Sorghum which exhibit different susceptibility to drought stress, we will show the difference in development of root systems of the two crops in conjunction with water use for variable water stress levels. Some emphasis will be given to the spatial variability of uptake, with the use of new imaging techniques like Electrical Resistivity Tomography. We will conclude by a look on new experimental or modelling avenues that could be helpful in improving our knowledge and optimisation of crops (and soil) in facing drought stress.



S10.01b -6

IMPACTS OF ROOT SPATIAL DISTRIBUTION ON PHYSICAL & HYDRAULIC PROPERTIES IN PEAT GROWING MEDIA USED IN HORTICULTURE

Cannavo Patrice*^[1], Michel Jean-Charles^[1]

^[1]Agrocampus Ouest, Centre d'Angers ~ UR EPHor ~ Angers ~ France

Plants growing in pots are generally limited by the volume of substrate in which water and gas availability can fluctuate over a short period of time. The hydraulic properties of growing media generally provide precise information about their ability to guarantee good growth conditions. However, the root development and the heterogeneity of their distribution raise the question of the evolution and heterogeneity of hydraulic properties inside the pot. We monitored a 110-day experiment in a greenhouse, by using two peat growing media -mainly used in the world- with 2 particle sizes (0-10 mm and 20-40mm) and rose "knock out" growing in 1.1L cylindrical pots. Three layers (H1 0-3cm, H2 3-6cm, H3 6-10cm) were defined and each one was divided into 2 parts, the internal zone (3cm radius), and the external zone (rest of the layer). In each of the 6 zones, the volumetric root content, the water retention and hydraulic conductivity curves, tortuosity and the relative gas diffusivity were analysed. Peat particle size did not affect the root volume (6% at day 110). A low air-filled porosity (<0.1 v/v) in all zones of the fine peat was observed at the end of the experiment, whereas only H3 layer was affected in the coarse peat. Tortuosity was the highest in the coarse peat, with high variations depending on the zone. Roots tended to decrease tortuosity favouring a better water conductivity, but also decreased the relative gas diffusivity, especially at the base and the border of the pot.



S10.01c - PLANT SOIL INTERACTIONS FROM THE RHIZOSPHERE TO THE FIELD SCALE

Chair Person:

Jan Vanderborght, Juelich - Germany

Tuesday 03 July 2012 from 08:30 to 10:00. Room Olmo

S10.01c -1

*4-D IMAGING OF ROOT RESPONSES TO ABIOTIC STRESS USING X-RAY MICRO
COMPUTED TOMOGRAPHY (CT)*

Sacha Mooney, Nottingham - United Kingdom

S10.01c -2

*ASSESSMENT OF THE ROOT WATER UPTAKE PATTERN OF A PARTIAL DRIP IRRIGATED
PEAR TREE*

Pieter Janssens, Heverlee - Belgium

S10.01c -3

ROOT WATER UPTAKE IN HETEROGENEOUS MEDIA

Anna Kuhlmann, Hannover - Germany

S10.01c -4

ROOT EFFECTS ON SOIL HYDRAULIC PROPERTIES

Gernot Bodner, Vienna - Austria

S10.01c -5

*NON-DESTRUCTIVE IMAGING OF CROP ROOT GROWTH IN RHIZOTRONS USING
ELECTRICAL IMPEDANCE TOMOGRAPHY*

Johannes Pfeifer, Jülich - Germany

S10.01c -6

*WATER UPTAKE PATTERNS AND RECONSTRUCTION OF ROOT SYSTEM ARCHITECTURES
FROM MRI IMAGES*

Andreas Pohlmeier, Jülich - Germany



S10.01c -1

**4-D IMAGING OF ROOT RESPONSES TO ABIOTIC STRESS USING X-RAY MICRO
COMPUTED TOMOGRAPHY (CT)**

Mooney Sacha^{*[1]}

^[1]University of Nottingham ~ Biosciences ~ Nottingham ~ United Kingdom

*Recently, the application of X-ray microCT for rhizosphere research has gained considerable attention due to the ability to visualise in situ root-soil interactions without disturbance. The aim of this research was to quantify the spatio-temporal effect of compaction and drought on root growth. Using tomato (*Solanum lycopersicum*) as a model plant we used X-ray CT at 10µm with daily scanning for several weeks to measure the effect of soil compaction and drying conditions on root elongation and other root traits. The treatments included soil type, bulk density and the effects of layering (total number of scans was c. 500). A new in-house root tracking algorithm, Roottrak, was used for image segmentation overcoming previous limitations associated with the overlap in attenuation values with roots and water filled pores. Soil compaction significantly affected root volume ($P<0.001$) over time. Plants in compacted soil had reduced volume and length ($P<0.01$), but a greater root diameter ($P<0.05$). Visualising the rhizosphere soil under drying conditions illustrates the variability in root-soil contact across short time scales. CT in combination with root phenotyping approaches supports enhanced understanding of the influence of abiotic stresses on root growth which will feed through to improvements in plant breeding programmes.*



S10.01c -2

ASSESSMENT OF THE ROOT WATER UPTAKE PATTERN OF A PARTIAL DRIP IRRIGATED PEAR TREE

Janssens Pieter*^[1], Jan Diels^[2], Jan Vanderborght^[3], Frank Elsen^[1], Annemie Elsen^[1], Tom Deckers^[4], Hilde Vandendriessche^[5]

^[1]Soil Service of Belgium ~ Soil Service of Belgium ~ Heverlee ~ Belgium ^[2]Katholieke Universiteit Leuven ~ Division of Soil and Water Management ~ Leuven ~ Belgium ^[3]Forschungszentrum Jülich GmbH ~ Agrosphere, IBG-3 ~ Jülich ~ Germany ^[4]PCFruit Research Station ~ PCFruit Research Station ~ Sint-Truiden ~ Belgium ^[5]Katholieke Universiteit Leuven ~ Division of Crop Biotechnics ~ Heverlee ~ Belgium

Drip irrigation is used in 'Conference' pear tree in Belgium and the Netherlands to maximize fruit size in dry years. Besides regulated deficit irrigation, partial root zone irrigation (PRI) is an irrigation strategy used for increasing the water use efficiency. Trees under PRI take up more water in the irrigated part compared to the non irrigated part. However the importance of this "compensation effect" and the magnitude of this effect on tree transpiration on an irrigated tree in a temperate climate is unknown. To evaluate the impact of compensation in the pear tree root system, the root water uptake pattern was obtained in HYDRUS 2D using the dimensionless water stress index ψ_c (Jarvis 1989), recently implemented in HYDRUS. For the simulation detailed observations of soil hydraulic properties and root distribution were carried out. Simulation results were compared to measurements of soil hydraulic head and soil water content as well as sap flow rate in the trunk. Evolution of soil hydraulic head was successfully simulated for a non irrigated and partially irrigated tree for a period of 87 days. During this period, soil hydraulic head did not drop below 450 cm while it decreased to -800 cm for the non irrigated treatment. Water stress was observed in the non irrigated treatment but not in the partial irrigated treatment. Simulations with HYDRUS indicate that compensation did not interfere with the course of sap flow nor with the soil moisture content evolution.



S10.01c -3

ROOT WATER UPTAKE IN HETEROGENEOUS MEDIA

Kuhlmann Anna*^[1], Neuweiler Insa^[1], Van Der Zee Sjoerd^[2]

^[1]University of Hannover ~ Institute of Fluid Mechanics and Environmental Physics in Civil Engineering ~ Hannover ~ Germany ^[2]Wageningen University ~ Soil Physics, Ecohydrology and Groundwater Management, Environmental Sciences Group ~ Wageningen ~ Netherlands

To predict flow in the unsaturated zone with respect to environmental problems, models are needed which are preferably simple but account for important factors such as heterogeneity of the soil and water uptake by plant roots (RWU). The presentation compares different approaches for RWU in heterogeneous media to discuss how complex RWU models on large scales need to be. Flow in the unsaturated zone is modeled with the Richards equation. The variability of the soil parameters is modeled by a stochastic approach, where the soil parameters, such as saturated hydraulic conductivity, are described as correlated random fields. If the RWU rate is modeled according to a standard macroscopic approach as sink term in the Richards equation determined by atmospheric demand, root density and stress-reduction factor (according to the Feddes-function), extremely dry regions occur in fields with large lenses of coarse material. These spots lead to large variances of the pressure head and reduce the global uptake of roots. This rather doubtful result rises the question if such a strongly simplified concept for RWU is applicable to heterogeneous media or if small scale processes such as soil physical and plant physiological mechanisms have to be taken into account. Therefore, simulation results obtained with the standard macro-model for RWU are compared to simulations where the wilting point depends on the soil properties, and to simulations with a micro-model where root architecture and growth mechanisms are included.



S10.01c -4

ROOT EFFECTS ON SOIL HYDRAULIC PROPERTIES

Bodner Gernot^[1], Scholl Peter^[1], Yu Yang^[3], Loiskandl Willibald^[2], Kaul Hans-Peter^[1]

^[1]University of Natural Resources and Life Sciences ~ Department of Crop Sciences ~ Vienna ~ Austria ^[2]University of Natural Resources and Life Sciences ~ Institute of Hydraulics and Rural Water Management ~ Vienna ~ Austria

^[3]Chinese Academy of Forestry ~ Department of Soil Sciences ~ Beijing ~ China

Soil hydraulic properties are subject to several environmental and management influences. Therefore they generally show high spatial and temporal variability, particularly in the range of structural porosity. Plant roots have been described as driving forces for the formation of soil structure and porosity at different scales. A major difficulty in quantifying root-soil interactions in the structural range however is their high spatial variability. A better quantitative understanding of root effects on soil hydraulic properties could allow a more targeted use of plants for soil protection and improvement of soil structure. The objective of this study is to provide quantitative evidence for the role of roots for structural porosity and to analyze the plant impact compared to other environmental driving forces of soil structure. We measured soil hydraulic properties in the near saturated and structural range under plants with different root systems using a tension infiltrometer and a capillarimeter in a spatial measurement design. Plant roots were quantified using image analysis. Data will be compared to measurements of temporal hydraulic property dynamics to analyze the magnitude of root effects in relation to other environmental impacts on structural porosity. Finally a model will be presented that allows studying hypothesis on root effects on the soil pore system and their consequences for water flow in the soil.



S10.01c -5

NON-DESTRUCTIVE IMAGING OF CROP ROOT GROWTH IN RHIZOTRONS USING ELECTRICAL IMPEDANCE TOMOGRAPHY

Pfeifer Johannes^[1], Weigand Maximilian^[8], Nagel Kerstin A.^[1], Blossfeld Stephan^[1], Zimmermann Egon^[9], Walter Achim^[6], Kemna Andreas^[7]

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A better understanding of root-soil interactions and associated processes is essential to achieve progress in crop breeding and management. To date it is still difficult to analyze root growth and function in the field because of a lack of satisfactory non-destructive monitoring methods. A promising technique in this respect is electrical impedance tomography (EIT), which utilizes electrical conduction and polarization properties – here of the root-soil system – in an imaging framework. We investigate the capability of laboratory-scale EIT to image crop root growth in rhizotrons by comparing the electrical imaging results with those obtained from established optical methods. A series of experiments were done in soil-filled containers of 80 × 30 × 2 cm³ size using wheat and oilseed rape as model plants. In each experiment root growth was monitored daily over several weeks using EIT and the custom-made image analysis system GROWSCREEN-Root. EIT data were collected with the acquisition system Medusa-II and EIT images were computed with the complex resistivity inversion code CRTomo. Root growth parameters were additionally validated using the software WinRHIZO. Correlations between EIT imaging data, optical readings and root growth parameters were analyzed. The results demonstrate the capability of EIT to image root growth at rhizotron scale and suggest that EIT can be developed into a non-invasive tool for imaging and monitoring of crop roots at the field scale. The presented work is part of the subproject ImpTom, funded by DFG within the research Unit FOR 1320 “Crop Sequence and Nutrient Acquisition from the Subsoil”.



S10.01c -6

WATER UPTAKE PATTERNS AND RECONSTRUCTION OF ROOT SYSTEM ARCHITECTURES FROM MRI IMAGES

Pohlmeier Andreas^[1], Stingaciu Laura^[2], Schulz Hannes^[3], Merz Steffen^[2], Haber-Pohlmeier Sabina^[4], Zilken Herwig^[2], Javaux Mathieu^[5], Van Dusschoten Dagmar^[6], Behnke Sven^[3], Vereecken Harry^[2]

^[1]Research Centre Jülich ~ IBG-3 ~ Jülich ~ Germany ^[2]Research Centre Jülich ~ IBG-3 ~ Jülich ~ Germany ^[3]University Bonn ~ Institute for Computer Science VI, Autonomous Intelligent Systems ~ Bonn ~ Germany ^[4]RWTH Aachen University ~ ITMC ~ Aachen ~ Germany ^[5]Université Catholique de Louvain-la-Neuve ~ Earth and Life Institute ~ Louvain-la-Neuve ~ Belgium ^[6]Research Centre Jülich ~ IBG-2 ~ Jülich ~ Germany

Water uptake of plant roots is monitored using non-invasive imaging by Nuclear Magnetic Resonance Imaging (MRI). The evaluation of observed patterns and conclusions on the underlying mechanisms require further comparison with numerical simulation using basic physical principles on water fluxes in soils. This also requires an unambiguous reconstruction of the entire root system from the partly noisy and discontinuous 3D information. In this paper we compare two methods for doing this: a manual method using 3D virtual reality system with manual tracking of root strands and an automated image processing method. The procedures are elucidated on the basis of 3D MRI images of maize and lupin root systems in sand and loamy sand soils with a resolution of 0.39 mm combined with images of water content changes over a period of 2 weeks during increasing drought stress. Both reconstruction methods yield similar root architectures which are validated with standard parameters like root length density determination. The simulated water uptake patterns show first that the reconstructed root systems can be used as input and second that calculated and experimentally observed water content changes agree. The desiccation patterns are rather uniform during the initial stages of transpiration, only near the end stronger depletion in the rooting zone is observed. Reason is the always sufficiently high hydraulic conductivity of the soil, and one may conclude that the bottleneck for root water uptake is the transfer bulk soil to roots.



S10.02 - NEW TECHNOLOGIES TO DETERMINE THE SOIL INFLUENCE ON WINE GRAPE AND OTHER QUALITY CROPS

Chair Persons:

Edoardo Costantini, Firenze - Italy

María Concepción Ramos, Lleida - Spain

Friday 06 July 2012 from 10:30 to 12:00. Room Alloro

S10.02 -1

INFLUENCE OF THE SOIL TYPE ON THE MUST QUALITY IN A VINEYARD OF THE D.O.CA RIOJA

Urtzi Leibar, Derio - Spain

S10.02 -2

SR ISOTOPES AS A ROBUST TRACER FOR HIGH-QUALITY WINES AND PRODUCTION TERROIR

Eleonora Braschi, Firenze - Italy

S10.02 -3

UNEXPECTED RELATIONSHIPS BETWEEN DC13, WATER DEFICIT, AND WINE GRAPE PERFORMANCE

Edoardo A. C. Costantini, Firenze - Italy

S10.02 -4

REALISATION OF TERRONS IN THE LOWER HUNTER VALLEY, AUSTRALIA

Alex Mcbratney, Sydney - Australia

S10.02 -5

SOIL-PLANT WATER STATUS AND WINE QUALITY: INNOVATIVE IMPLEMENTATION IN VITICULTURE ZONING.

Antonello Bonfante, Ercolano (NA) - Italy

S10.02 -6

RELATIONSHIPS BETWEEN DIGITAL SOIL MAP UNITS AND CROP RESPONSE THROUGH THE NDVI ANALYSIS IN A VINEYARD REGION OF THE NE SPAIN

José A. Martínez-Casasnovas, Lleida - Spain



S10.02 -1

INFLUENCE OF THE SOIL TYPE ON THE MUST QUALITY IN A VINEYARD OF THE D.O.CA RIOJA

Leibar Urtzi*^[1], Aizpurua Ana^[1], PÉrez-Parmo Roberto^[1], Castro Cesar^[2], Unamunzaga Olatz^[1]

^[1]NEIKER ~ ENVIRONMENTAL QUALITY ~ Derio ~ Spain ^[2]BODEGAS Y VIÑEDOS LABASTIDA ~ I+D ~ Labastida ~ Spain

The influence of the soil on vine behaviour and wine quality is complex, because the soil properties affect vine mineral nutrition and water uptake conditions, but also rooting depth and temperature in the root zone. The aim of this study was to analyze the quality of the must in different soil groups determined by the winery. The study was carried out in 2009 and 2010 on the vineyards of the winery Bodegas y Viñedos Labastida which covers an area of 525 ha. Prior to this study the winery had classified soils in four groups (based on a soil map of the zone) depending on their yield and quality behaviour of the vineyard over time, which differs mainly in the soil's water holding capacity. In the years 2009 and 2010 at 300 and 270 grape samples respectively the following quality parameters were measured: weight of 100 berries, malic acid, tartaric acid, pH, K, anthocyanins and colour intensity. Statistical analysis was performed using a HJ-Biplot. Different types of soil did not show the same qualitative behaviour of the must. Furthermore, it can be differentiated soils with lower water holding capacities since they presented musts with higher alcohol and tonality and higher anthocyanin content, from soils with higher water holding capacities which presented musts with higher levels of malic acid.



S10.02 -2

SR ISOTOPES AS A ROBUST TRACER FOR HIGH-QUALITY WINES AND PRODUCTION TERROIR

Braschi Eleonora^[1], Marchionni Sara^[1], Bucelli Pierluigi^[2], Priori Simone^[2], Costantini Edoardo^[2], Bollati Andrea^[3], Mattei Massimo^[3], Conticelli Sandro^[1], Tommasini Simone^[1]

^[1]Università degli Studi di Firenze ~ Dipartimento di Scienze della Terra ~ Firenze ~ Italy ^[2]CRA ~ Dipartimento Agronomia Foreste e Territorio ~ Firenze ~ Italy ^[3]Università di Roma 3 ~ Dipartimento di Scienze della Terra ~ Firenze ~ Italy

The work presented here is the result of a research project aimed to define a geochemical marker suitable to associate the wine to its grape terroir. We determined Sr isotope ratios in a number of microvinifications on single grapevines belonging to the “Azienda Barone Ricasoli” at Brolio, during the 2008 and 2009 grape harvest, together with the soil portion underneath each single grapevine. Our results demonstrate an excellent reproducibility of the $^{87}\text{Sr}/^{86}\text{Sr}$ values of each sampling point in the two harvesting years suggesting that the Sr uptake process from the grapevine roots to the wine is time independent. Furthermore, we find a small-scale, albeit detectable, variability of $^{87}\text{Sr}/^{86}\text{Sr}$ values among the different sampling points. This variability is due to both the heterogeneity of the geological substratum of the vineyard, and the isotopic change of the leachable Sr fraction from the soil. $^{87}\text{Sr}/^{86}\text{Sr}$ values on soils are similar to the corresponding wine despite some scattering. They show a consistent trend with the Sr-isotope ratios characterizing each wine on each sampling point, corroborating that wines inherit their inorganic elements from the soil parent material on which each vineyard is embedded. The $^{87}\text{Sr}/^{86}\text{Sr}$ value can safely represent a meaningful parameter and an extremely promising isotope-geochemical tracer in the analysis procedure to guarantee the geographic origin and the production terroir of wines. To corroborate our results, we also consider other high-quality wines of the Italian territory, such as Chianti Classico, Cesanese, Aglianico del Sannio and Aglianico del Vulture for comparison.



S10.02 -3

UNEXPECTED RELATIONSHIPS BETWEEN DC13, WATER DEFICIT, AND WINE GRAPE PERFORMANCE

Costantini Edoardo A.c.^{*[1]}, Agnelli Alessandro^[1], Bucelli Pierluigi^[1], Ciambotti Aldo^[2], Ntarelli Laura^[1], Pellegrini Sergio^[1], Perria Rita^[3], Priori Simone^[1], Storchi Paolo^[3], Vignozzi Nadia^[1]

^[1]CRA ~ ABP ~ Firenze ~ Italy ^[2]CRA ~ ENO ~ Asti ~ Italy ^[3]CRA ~ VIC ~ Arezzo ~ Italy

Water nutrition is crucial for wine grape performance. Thus soil investigation aims at characterizing spatial and temporal variability of available water. A possible strategy is to integrate monitoring and proxies of water availability. The carbon isotope ratio DC13, measured in the alcohol of wine, is a promising tool to determine water stress during the vine growing season and vine performance. A research study was set up to evaluate the relationships between DC13, soil water deficit, and wine grape viticultural and oenological performance. The trial was carried out for three years in the Chianti Classico wine production district (Central Italy), on not irrigated vineyards of a premium farm. The reference variety was Sangiovese. 11 sites were chosen for vine monitoring and grape sampling. The performance parameters were sugar content, sugar accumulation rate, mean berry weight, and extractable polyphenols. DC13, stem water potential, and soil water deficit, as difference between soil water content, monitored during the veraison-yield, and the standard wilting point, were measured. DC13 resulted directly related to stem water potential and soil water deficit, and showed absence to only moderate water stress. However, the relationship with viticultural and oenological results was contrary to the expectation, that is, the performance increased when the water stress decreased. The explanation was that the viticultural husbandry was so competing for the plants (high plant density, high pruning, weak rootstock, grass cover) that the effects of water stress on grape quality were magnified. In conclusion, DC13 cannot be directly used to estimate vine performance.



S10.02 -4

REALISATION OF TERRONS IN THE LOWER HUNTER VALLEY, AUSTRALIA

Hughes Philip^[1], Mcbratney Alex^{*[1]}, Malone Brendan^[1], Minasny Budiman^[1]

^[1]The University of Sydney ~ Faculty of Agriculture, Food & Natural Resources ~ Sydney ~ Australia

The recent globalisation of the wine industry has seen the expansion of New World wines on the international market. In order to improve the profitability of the Hunter Valley, Australia as a wine growing region and tourist destination, recognition and marketing of viticulture terroirs is a worthwhile endeavour. This study sought to define terrons with the view to delineating terroirs in the Hunter Valley. A terron is a relatively new soil mapping concept that combines soil and landscape data to create continuous soil classes, which are ascribed memberships to groups based to the relative strength of their attributes. Soil-landscape attributes of important to wine-growing were derived using digital soil mapping technologies from the field observations combined with the environmental covariates. One of the most important attributes measured was marl, a lime bearing rock which is a constituent of good wine making soils. The remaining data included land class, subsoil pH, readily available water and drainage. Based on these landscape attributes, the area was grouped into classes that have similar properties using fuzzy k means algorithm. These classes were interpreted as a terron map of the Hunter Valley winemaking region. This terron map was shown to local vigneron who were asked to assess the terron map for accuracy. From this it was determined that not only had the terron map accurately predicted identifiable attributes, such as the presence of marl, but it had also correctly depicted the characteristic of individual soil taxa described in the terron model.



S10.02 -5

SOIL-PLANT WATER STATUS AND WINE QUALITY: INNOVATIVE IMPLEMENTATION IN VITICULTURE ZONING.

Bonfante Antonello^{*[3]}, Albrizio Rossella^[1], Agrillo Antonella^[2], Basile Angelo^[3], Buonomo Roberta^[3], De Mascellis Roberto^[3], Erbaggio Arturo^[4], Fragnito Fulvio^[3], Gambuti Angelita^[5], Giorio Pasquale^[3], Guida Gianpiero^[3], Langella Giuliano^[3], Mileti Antonio^[2], Manna Piero^[2], Moio Luigi^[5], Terribile Fabio^[2]

^[1]National Research Council of Italy (CNR) ~ ISAFOM ~ Ercolano ~ Italy ^[2]University of Naples Federico II ~ Department of Soil, Plant, Environmental and Animal Production Sciences ~ Portici (NA) ~ Italy ^[3]National Research Council of Italy (CNR) ~ Institute for Mediterranean Agricultural and Forestry Systems (ISAFOM) ~ Ercolano (NA) ~ Italy ^[4]freelance agronomist ~ . ~ Napoli ~ Italy ^[5]University of Naples Federico II ~ Department of food science ~ Portici (NA) ~ Italy

The ZOViSA Project (Viticultural zoning at farm scale) tests a new methodology for the viticultural zoning at farm scale integrating the classical pedological approach, the study of soil hydrological processes and the use of physically based agro-hydrological model. The project is conducted in two farms of southern Italy (Del Monte–Ponte(BN) and Quintodecimo–Mirabella Eclano (AV)) located in the Campania region and devoted to quality wines production (Aglianico and Falanghina DOC). One task of the project is to study the effects of soil-plant water status (e.g. soil water stress) on wine quality, through the use of simulation model SWAP. This latter allows estimating soil-plant water status in different crop phenological stages. Moreover, its use is fundamental to extend the approach from stand scale to farm scale, becoming also an important forecasting tool to support the farmer decision. In one site (Quintodecimo farm) the soil spatial distribution was recognized; then the experimental plots for monitoring the soil-plant water status were defined. Soil water variables (through TDR probes and tensiometers), crop development (biometric and physiological parameters) and climate variables (Temperature, radiation, rainfall, wind) were daily monitored. Afterwards, the model was calibrated and applied to estimate the crop water stress index. The results have been correlated to the crop physiological measurement (leaf gas exchange, chlorophyll-a fluorescence, leaf water potential, chlorophyll content, LAI measurement), grape bunches measurement (berry weight, sugar content, titrable acidity, etc.) and wine quality (aromatic response) in two different pedo-systems. Finally a preliminary "spatial application" of the model was carried out.



S10.02 -6

RELATIONSHIPS BETWEEN DIGITAL SOIL MAP UNITS AND CROP RESPONSE THROUGH THE NDVI ANALYSIS IN A VINEYARD REGION OF THE NE SPAIN

Bagheri Bodaghabadi Mohsen^[1], Martínez-Casasnovas José A.*^[2], Ramos M. Concepción^[2]

^[1]Shahrekord University ~ College of Agriculture ~ Shahrekord ~ Iran, Islamic Republic of ^[2]University of Lleida ~ Environment & Soil Science ~ Lleida ~ Spain

In this work, crop (vineyards) development measured by means of the Normalized Difference Vegetation Index (NDVI) from detailed remote sensing data area related to statistical significant differences of soil properties in different soil units (clusters). A detailed map of top soil properties of a 50-ha sample catchment was generated by means of digital soil mapping techniques, based on spatial interpolation methods and cluster analysis. The digital soil map was based on 40 soil samples distributed throughout the catchment. The NDVI was compute from bands 6 (red edge) and 5 (red) of the WorldView-2 satellite, with 2-m pixel resolution. The differences of the NDVI in each soil mapping unit were compared using ANOVA, which proved a significant difference of the NDVI in the soil map units ($\alpha = 0.001$). Different multiple range tests (LSD, Tukey and Duncan) were carried out to compare NDVI means in each soil map unit. The tests showed contradictory results, showing significant differences in some cases of clusters with different top soil properties and no significant differences of vine development in other cases of different top soil properties. The results are promising since they can validate the digital soil mapping process but point out the need of using additional soil properties such as soil depth or total available water retention capacity.



S10.03a - INFLUENCES OF TREE SPECIES ON FOREST SOILS

Chair Person:

Cindy Prescott, Vancouver - Canada

Tuesday 03 July 2012 from 08:30 to 10:00. Room Biancospino

S10.03a -1

INFLUENCE OF TREE SPECIES ON SOIL IN THE BOREAL FOREST: BEYOND THE DIRECT LITTER EFFECT

David Paré, Québec - Canada

S10.03a -2

C AND N IN ABOVE- AND BELOWGROUND LITTER IN STANDS OF DIFFERENT TREE SPECIES IN NORTHERN FINLAND

Heljä-Sisko Helmisaari, Helsinki - Finland

S10.03a -3

DYNAMICS OF SOIL CARBON, NITROGEN AND MICROBIAL BIOMASS DURING 20 YEARS OF SUCCESSION TOWARDS DECIDUOUS OR CONIFER CANOPY IN SUB BOREAL PLANTATIONS

Alison Munson, Québec - Canada

S10.03a -4

DIFFERENCES IN SOIL CARBON POOLS AND FLUXES IN ADJACENT STANDS OF SCOTS PINE, NORWAY SPRUCE AND SILVER BIRCH IN SW SWEDEN

Karna Hansson, Uppsala - Sweden

S10.03a -5

TREE SPECIES COMPOSITION CONTROLS SOIL C DYNAMICS IN MEDITERRANEAN MOUNTAINS FROM CENTRAL SPAIN

Eugenio Díaz-Pinés, Garmisch-Partenkirchen - Germany

S10.03a -6

NUTRIENT FLUXES AND SOIL MICROBIAL PROCESSES UNDER TREE SPECIES AFTER CONVERSION FROM NORWAY SPRUCE

Monique Carnol, Liège - Belgium



S10.03a -1

INFLUENCE OF TREE SPECIES ON SOIL IN THE BOREAL FOREST: BEYOND THE DIRECT LITTER EFFECT

Paré David^[1], Laganière Jérôme^[2], Bergeron Yves^[2], Anger Denis^[4], Chen Han^[3], Bradley Robert^[5]

^[1]Natural Resources Canada ~ Canadian forest service ~ Québec ~ Canada ^[2]Université du Québec à Montréal ~ Centre d'étude de la forêt ~ Montreal ~ Canada ^[3]Lakehead University ~ department ~ Thunder Bay ~ Canada ^[4]agriculture et agroalimentaire Canada ~ department ~ Quebec ~ Canada ^[5]Université de Sherbrooke ~ biology ~ Sherbrooke ~ Canada

It is often assumed that litter palatability is the main factor driving changes in soil processes as the abundance of deciduous to coniferous trees changes in boreal forests. However, the transformation of the soil system is affected by numerous other processes. For example, the coniferous canopy cools the soil because of high light interception, it favours bryophyte communities that further cool the soil and make it wetter. These conditions make the soil environment inhospitable to certain groups of the meso- and macro-fauna. Finally, the vertical distribution of root systems, which vary with tree species, triggers different mechanisms of soil organic matter stabilization and de-stabilization. Field and laboratory studies were set-up to distinguish the relative contribution of these mechanisms. These included observations of element fluxes in situ in natural forests with different proportion of species, reciprocal exchanges of soils between forest types as well as laboratory microcosms study where the litter decomposition rate was measured for different combinations of litter type, litter mixture and soil provenance. Non-direct litter effects were found to be important. Because they vary with external conditions, their recognition when forecasting species effect in the context of a changing environment may be important. Important microclimatic effects and weak soil organic matter stabilization observed in coniferous stands suggest that the soil carbon storage of these stands is more vulnerable to environmental changes.



S10.03a -2

C AND N IN ABOVE- AND BELOWGROUND LITTER IN STANDS OF DIFFERENT TREE SPECIES IN NORTHERN FINLAND

Helmisaari Heljä-Sisko^{*[1]}, Sah Shambhu^[1], Smolander Aino^[2]

^[1]University of Helsinki ~ Dept. of Forest Sciences ~ Helsinki ~ Finland ^[2]Finnish Forest Research Institute ~ Vantaa Research Centre ~ Vantaa ~ Finland

*The aim of our study was to determine both above- and belowground tree litter production and C and N inputs to soil in silver birch, Scots pine and Norway spruce stands. We hypothesize that 1) C and N inputs in fine root litter may be larger than the corresponding inputs in foliage litter. 2) Fine root litter differs qualitatively from the foliage litter, e.g. the C:N ratio and the share of organic compounds may differ. We determined the litter production of fine roots and foliage in a tree species experiment in northern Finland in the 70-year old stands of silver birch (*Betula pendula* Roth.), Scots pine (*Pinus sylvestris* L.) and Norway spruce (*Picea abies* (L.) Karst.) growing on originally similar site type. The annual means of leaf/needle litterfall were 1810, 1970 and 1940 kg/ha in silver birch, Scots pine and Norway spruce stands, respectively. Respective annual N inputs in foliage litter were 19, 9 and 15 kg/ha. The annual fine root litter production and respective C and N inputs of birch were smaller but those of pine and spruce as large or larger than in needle litterfall. Fine roots, however, decomposed during the first two years more slowly than foliage. Spruce litter had the smallest mass loss, and birch litter the largest. The root longevity did not differ with soil depth. We conclude that both above- and belowground litter affect soil fertility and soil C under different tree species, and should be considered in ecosystem C and N budgeting.*



S10.03a -3

DYNAMICS OF SOIL CARBON, NITROGEN AND MICROBIAL BIOMASS DURING 20 YEARS OF SUCCESSION TOWARDS DECIDUOUS OR CONIFER CANOPY IN SUB BOREAL PLANTATIONS

Munson Alison^{*[1]}, Maillard Émilie^[1], Paré David^[2]

^[1]Université Laval ~ Centre d'étude de la forêt ~ Québec ~ Canada ^[2]Ressources Naturelles Canada ~ Service canadien des forêts ~ Québec ~ Canada

*Experimental conifer plantations established in 1986 in the sub-boreal region of Ontario, Canada, have evolved to contrasting canopy dominant species under different early silvicultural treatments. In those plantations treated with herbicide to control competing vegetation, the canopy is now dominated by the planted native pine (*Pinus strobus*) or spruce (*Picea glauca*), with a dominantly moss understory. Plantations that did not receive herbicide treatment essentially succeeded to native hardwoods (dominantly *Populus tremuloides* in the canopy) and a diverse shrub and herb understory, since mortality of planted conifers was almost 100%. We measured indicators of C and N cycles during the 20 year succession of these contrasting vegetation types, at 4, 10 and 20 years. Over this period we noted shifting ratios of total Corg:NT, Cmic:Corg, Nmic:Norg and Cmic:Nmic, in both the humus and superficial (0-10 cm) mineral horizons. NT gradually decreased in the humus over 20 years, however was consistently lower under the conifer canopy; at 20 years the Corg:NT was higher under the conifer (32) compared to the deciduous canopy (27). Nmic tended to be constantly lower under the conifer canopy at all sampling years, and at 20 years, Cmic:Nmic was higher under the conifer (6.2) compared to the deciduous canopy (5.0). In the mineral soil, Nmic was also lower and under the conifer canopy (all years), while Cmic decreased over 20 years, but only under the deciduous canopy. We discuss these results in relation to changing C and N cycles as well as potential external N inputs.*



S10.03a -4

DIFFERENCES IN SOIL CARBON POOLS AND FLUXES IN ADJACENT STANDS OF SCOTS PINE, NORWAY SPRUCE AND SILVER BIRCH IN SW SWEDEN

Hansson Karna^{*[1]}, Olsson Bengt^[1], Olsson Mats^[2], Fröberg Mats^[2], Helmisarii Heljä-Sisko^[3], Johansson Ulf^[4], Kleja Dan Berggren^[2]

^[1]Swedish University of Agricultural Sciences ~ Ecology ~ Uppsala ~ Sweden ^[2]Swedish University of Agricultural Sciences ~ Soil and Environment ~ Uppsala ~ Sweden ^[3]University of Helsinki ~ Forest Sciences ~ Helsinki ~ Finland

^[4]Swedish University of Agricultural Sciences ~ Unit for Field-based Forest Research ~ Simlångsdalen ~ Sweden

*Different tree species differ in productivity, litter quality and quantity, canopy structure and nitrogen deposition. Norway spruce (*Picea abies*), Scots pine (*Pinus sylvestris*) and birch (*Betula pendula* and *B. pubescens*) are the three dominant tree species in Sweden. We compared soil C fluxes and the accumulation of soil organic carbon under adjacent Norway spruce, Scots pine and silver birch stands growing on similar soils and examined the different processes involved. This was achieved mainly through field measurements of carbon pools and fluxes in southern Sweden, combined with respiration and decomposition studies in the laboratory. Soil carbon fluxes and the accumulation of soil organic carbon were found to differ between the three species, with the strongest differences in humus layers between spruce and birch, with pine intermediate. Most carbon was stored in soils in spruce stands. Birch stands had the fastest root turnover and the highest carbon mineralisation rate. Species differences can be explained by differences in tree growth rate and litter decomposition. The three tree species differed in terms of litter quality, carbon mineralisation, DOC fluxes and fine root turnover.*



S10.03a -5

TREE SPECIES COMPOSITION CONTROLS SOIL C DYNAMICS IN MEDITERRANEAN MOUNTAINS FROM CENTRAL SPAIN

Díaz-Pinés Eugenio^{*[1]}, Montes Fernando^[2], Schindlbacher Andreas^[3], Dannenmann Michael^[1], Jandl Robert^[3], Rubio Agustín^[4]

^[1]Karlsruhe Institute of Technology ~ Institute for Meteorology and Climate Research. Atmospheric and Environmental Research ~ Garmisch-Partenkirchen ~ Germany ^[2]INIA ~ Centro de Investigaciones Forestales (CIFOR) ~ Madrid ~ Spain ^[3]Federal Research and Training Centre for Forests, Natural Hazards and Landscape ~ Directorate ~ Vienna ~ Austria ^[4]Universidad Politécnica de Madrid ~ Silviculture and Pasciculture ~ Madrid ~ Spain

Tree species composition influences the carbon cycle due to differential growth rates, quantity and quality of litterfall (both above- and belowground) and creation of different meteorological environments, among other factors. Therefore, soil C cycle is expected to vary depending on tree species composition, as well as soil C sequestration potential. Here, we present a synthesis work of tree species composition effects on soil C storage and C effluxes, focused on three ecotones between Scots pine and Pyrenean oak in Central Spain. The investigation of the stands showed a greater aboveground biomass in pine, as well as greater growth rates and, therefore, greater litterfall annual rates. Regarding soils (50 cm soil profile), pine stands stored a significant higher amount of OC than oak stands (95-140 vs. 45-70 Mg C ha⁻¹). However, differences in soil C stocks across vegetation types were mainly due to the particulate OC (> 53 µm) but not to the mineral-associated organic carbon (<53 µm). Soil lab incubations showed that the soil CO₂ efflux was much higher in soils from pine, but there were no differences neither in C decomposability, nor in temperature dependence of soil respiration, despite contrasting soil microbial communities (upon PLFA assessment technique). A precipitation simulation showed a similar response in relation to CO₂ emissions after rewetting irrespective to vegetation composition, but a huge N₂O pulse in soil from oak. We conclude that Scots pine is clearly preferable in terms of C sequestration than Pyrenean oak. References: Díaz-Pinés et al.2011. For Ecol Manag 262



S10.03a -6

NUTRIENT FLUXES AND SOIL MICROBIAL PROCESSES UNDER TREE SPECIES AFTER CONVERSION FROM NORWAY SPRUCE

Carnol Monique^[1], Bazgir Masoud^[2]

^[1]University of Liège ~ Biology, ecology, evolution/ Plant and microbial ecology ~ Liège ~ Belgium ^[2]Ilam University ~ Faculty of Agriculture, Water Resources Dep. ~ Ilam ~ Iran, Islamic Republic of

*The biogeochemical cycling in forest ecosystems is highly dependent on the interactions between plants and soil. Tree species affect element cycling through deposition in throughfall, litter composition, microbial activities in soil and rhizosphere processes. Species diversification has been suggested for maintaining forest ecosystem services and uniting provisioning and supporting services within multifunctional and sustainable forestry. However, most information on species impacts has been derived from studies performed at different sites, where the influence of cofactors cannot be accounted for. Here we synthesize results from a study performed 11 years after conversion of a Norway spruce stand (*Picea abies* (L.) KARST.) to a mixed stand composed of Norway spruce, common alder (*Alnus glutinosa* (L.) GAERTN.), european beech (*Fagus sylvatica* L.), pedunculate oak (*Quercus robur* L.), silver birch (*Betula pendula* ROTH.), goat willow (*Salix caprea* L.) and rowan (*Sorbus aucuparia* L.). As stand closure was not achieved yet, the impact of individual species could be evaluated. We measured fresh leaf element composition, element return to the soil via throughfall and litterfall (leaves, twigs, reproductive parts), forest floor chemical characteristics, microbial biomass and microbial activities (N mineralization, potential nitrification, respiration) in the forest floor under the different tree species. Our results suggested that (1) foliar element concentrations differed between species and were highest for rowan, (2) high base cation litterfall and throughfall fluxes under rowan lead to better soil quality, (3) input of acidifying cations was reduced under broadleaves, (4) potential nitrification increased under the N₂ fixing alder.*



S10.03b - INFLUENCES OF TREE SPECIES ON FOREST SOILS

Chair Person:

Lars Vesterdal, Copenhagen - Denmark

Tuesday 03 July 2012 from 10:30 to 12:00. Room Biancospino

S10.03b -1

EVALUATION OF TREE SPECIES EFFECTS ON CARBON STABILIZATION AND MICROBIAL ACTIVITY IN MINERAL FOREST SOILS

Antia Villada, Reading - United Kingdom

S10.03b -2

HUMUS HORIZONS AND HUMUS FRACTIONS IN SOILS DEVELOPED UNDER SPRUCE MONOCULTURE AND BEECH FOREST – CASE STUDY FROM THE LOWER MONTANE BELT IN THE TATRA MOUNTAINS (POLAND)

Katarzyna Wasak, Cracow - Poland

S10.03b -3

LEAF LITTER LEACHATE FLUXES UNDER SIX DIFFERENT TREE SPECIES ON A METAL CONTAMINATED SITE

Lotte Van Nevel, Ghent - Belgium

S10.03b -4

TREE SPECIES TRAITS CAUSE DIVERGENCE IN SOIL ACIDIFICATION DURING FOUR DECADES OF POST-AGRICULTURAL FOREST DEVELOPMENT

De Schrijver An, Gontrode - Belgium

S10.03b -5

CHANGES OF SOIL CHEMISTRY, WATER AND NUTRIENT FLUXES IN GERMAN FORESTS AFTER REPLACEMENT OF NORWAY SPRUCE WITH DOUGLAS FIR COMPARED TO EUROPEAN BEECH

Jörg Prietzel, Freising-Weihenstephan - Germany

S10.03b -6

DETERMINATION OF PLANT-AVAILABLE PHOSPHORUS FORMS IN SOIL UNDER CONSIDERATION OF THE INFLUENCE OF DIFFERENT TREE SPECIES

Jörg Niederberger, Freiburg - Germany



S10.03b -1

EVALUATION OF TREE SPECIES EFFECTS ON CARBON STABILIZATION AND MICROBIAL ACTIVITY IN MINERAL FOREST SOILS

Villada Antia^{*[4]}, Shaw Liz^[4], Vesterdal Lars^[2], Gundersen Per^[2], Vanguelova Elena^[3], Verhoef Anne^[4]

^[1]Soil Research Centre ~ Department of Geography and Environmental Science ~ Reading ~ United Kingdom ^[2]Danish Centre for Forest ~ Landscape and Planning ~ University of Copenhagen ~ Denmark ^[3]Centre for Forestry and Climate Change ~ Alice Holt Forest Research ~ Farnham ~ United Kingdom ^[4]Soil Research Centre ~ Department of Geography and Environmental Science ~ Reading ~ United Kingdom

Given current concerns about rising atmospheric CO₂ concentrations and their subsequent effects on global climate, it is of critical importance to identify the factors controlling soil organic C (SOC) storage. As the main C source in forest ecosystems, tree species have been shown to have an impact on the SOC accumulation rate and its vertical distribution within the soil profile. The need to evaluate the tree species impact on soil C stability is vital in informing forest planning and management strategies to maximize the long term C sequestration potential of European forests, however, the direct effect of tree species on C stabilization has not yet been reported. With the aim of understanding the tree species effect on SOC stabilization processes, chemical (water extractable and acid hydrolysable C) and physical (inter-/intra-aggregate light and organo-mineral C) fractionation schemes were applied to two contrasting soils (luvisol and podzol) where common-garden experiments (Sitka spruce, Douglas fir, Norway spruce, beech and oak) have been established since 1964 (Forest and Landscape Denmark). In addition, enzymatic assays (dehydrogenase, β -glucosidase, xylanase, phenol oxidase and peroxidase) were used to assess the tree species impact on C-related soil microbial activity. The results from this study will inform tree species selection in new afforestation projects that are already planned in most European Countries to mitigate climate change.



S10.03b -2

HUMUS HORIZONS AND HUMUS FRACTIONS IN SOILS DEVELOPED UNDER SPRUCE MONOCULTURE AND BEECH FOREST – CASE STUDY FROM THE LOWER MONTANE BELT IN THE TATRA MOUNTAINS (POLAND)

Wasak Katarzyna*^[1], Drewnik Marek^[1]

^[1] Jagiellonian University, Institute of Geography and Spatial Management ~ Department of Pedology and Soil Geography
~ Cracow ~ Poland

The aim of the study is to evaluate differences occurring in the soil humus properties between two types of forests: natural beech forest and spruce monoculture. Dominance of spruce in lower forest belt of the Tatra Mountains is the effect of forest management in this area in the past. Large-scale plantations of Norway spruce had been established on large areas of beech sites till first decades of 20th century. The objects of investigation are two profiles representing Rendzic Leptosols under spruce and beech, and two profiles formed on allocthonous deposits on carbonate bedrock which can be classified as Rendzic Leptosol – under spruce forest and Haplic Cambisol – under beech site. The soil samples were analyzed for the basic properties as well as the fractional composition of humus fractions and particular analyzes of humus acids. Organic carbon content, pH, carbonates content and active carbonates content were measured. The composition of humus acids fractions and humification index were calculated after extraction and fractionation using Duchaufour and Jacquin method. Analyzes of C NMR and chemical composition of the humus acids were done. It is shown that different tree species strongly affect features of both ectohumus and endohumus horizons. It is visible in morphology of humus horizons as well as humus fraction composition and their properties. Another factor controlling features of humus horizons is parent material. It seems to be possible to separate effects which are results of vegetation and parent material features.



S10.03b -3

LEAF LITTER LEACHATE FLUXES UNDER SIX DIFFERENT TREE SPECIES ON A METAL CONTAMINATED SITE

Van Nevel Lotte^[1], Jan Mertens^[2], Filip Tack^[3], Stefaan De Neve^[4], Kris Verheyen^[1]

^[1]Ghent University ~ Laboratory of Forestry ~ Ghent ~ Belgium ^[2]University College Ghent ~ Department of Biosciences and Landscape Architecture ~ Ghent ~ Belgium ^[3]Ghent University ~ Laboratory for Analytical Chemistry and Applied Ecochemistry ~ Ghent ~ Belgium ^[4]Ghent University ~ Department of Soil Management and Soil Care ~ Ghent ~ Belgium

*Tree species produce leaf litter with different chemical composition and degradability, and these differences might influence the composition and reactivity of the soil solution. Moreover, tree species that accumulate trace metals in their foliage, might show retarded leaf litter decomposition. The soil solution composition in turn affects the behaviour and mobility of trace metals within the soil profile. Hence, tree species choice has a meaningful influence on metal mobility in ecosystems, which emphasizes the importance of tree species selection with respect to risk control. We studied the biogeochemical effects of leaf litter decomposition on the soil solution by sampling leaf litter leachates with zero-tension lysimeters. We selected six tree species in a forest on a metal contaminated site (*Populus tremula*, *Betula pendula*, *Robinia pseudoacacia*, *Quercus* spp., *Pinus sylvestris*, *Pseudotsuga menziesii*). Apart from the characterization of the leaf litter leachates generated from in situ (contaminated) litter, not-contaminated leaf litter from the six considered tree species was brought to the study site as well. We will present our results of the tree species effects on leaf litter leachates, considering contaminated versus not-contaminated leaf litter, allowing to gain fundamental insights in the driving factors of terrestrial metal cycling.*



S10.03b -4

TREE SPECIES TRAITS CAUSE DIVERGENCE IN SOIL ACIDIFICATION DURING FOUR DECADES OF POST-AGRICULTURAL FOREST DEVELOPMENT

An De Schrijver^{*[1]}, Pieter De Frenne^[1], Jeroen Staelens^[1], Gorik Verstraeten^[1], Bart Muys^[2], Lars Vesterdal^[3], Stefaan De Neve^[4], Kris Verheyen^[1]

^[1]Ghent University ~ Laboratory of Forestry ~ Gontrode ~ Belgium ^[2]K.U.Leuven ~ Forest Ecology and Management ~ Leuven ~ Belgium ^[3]University of Copenhagen ~ Forest & Landscape Denmark ~ Copenhagen ~ Denmark ^[4]Ghent University ~ Department of Soil Management and Soil Care ~ Ghent ~ Belgium

A change in land use from agriculture to forest generally increases soil acidity. However, it remains unclear to what extent plant traits can enhance or mitigate soil acidification caused by atmospheric deposition. An in-depth understanding of tree species-specific effects on soil acidification is crucial for soil protection, particularly in view of the predicted global increases in acidifying nitrogen (N) deposition. We report soil acidification rates in a chronosequence of broadleaved deciduous forests planted on former arable land in Belgium. This region receives one of the highest loads of potentially acidifying atmospheric deposition in Europe, which allowed us to study a 'worst case scenario'. We show that less than four decades of forest development caused significant soil acidification. Atmospheric deposition drives post-agricultural forests towards more acidic conditions, but the rate of soil acidification is also determined by the tree species-specific leaf litter quality and litter decomposition rates. We propose that the intrinsic differences in leaf litter quality among tree species create fundamentally different nutrient cycles within the ecosystem, directly through the chemical composition of the litter and indirectly through its effects on the size and composition of earthworm communities. Poor leaf litter quality contributes to the absence of a burrowing earthworm community, which retards leaf litter decomposition and results in forest-floor build-up and soil acidification. Also nutrient uptake and N₂ fixation are causing soil acidification, but were found to be less important. Our results highlight the fact that tree species-specific traits significantly influence the magnitude of human pollution-induced soil acidification.



S10.03b -5

CHANGES OF SOIL CHEMISTRY, WATER AND NUTRIENT FLUXES IN GERMAN FORESTS AFTER REPLACEMENT OF NORWAY SPRUCE WITH DOUGLAS FIR COMPARED TO EUROPEAN BEECH

Prietzl Jörg^[1], Sven Bachmann^[1]

^[1]Technische Universität München ~ Ecology and Ecosystem Management ~ Freising-Weihenstephan ~ Germany

*Of the main commercial tree species in Germany, Norway spruce (*Picea abies*) is supposed to be most negatively affected by the expected climate change. European beech (*Fagus sylvatica*) and Douglas fir (*Pseudotsuga menziesii*) are considered less vulnerable; moreover, the growth potential of Douglas fir exceeds that of spruce. Thus, current forest policy and management aims to reduce the percentage of Norway spruce monocultures and to increase the percentages of Douglas fir and European beech in German forests. In our study, effects of a tree species change from Norway spruce to Douglas fir and European beech on soil chemistry, and ecosystem water and nutrient fluxes were investigated in 19 (soil) and 5 (water and nutrient fluxes) forest stands on different sites. Replacement of Norway spruce by Douglas fir or European beech resulted in decreased topsoil acidity as well as in thinner forest floor layers with more active humus forms, decreased C/N ratios, and decreased organic carbon (OC) stocks. All effects were more pronounced under European beech compared to Douglas fir. Total soil OC losses after replacement of spruce by Douglas fir (on average -7%) and European beech (on average -11%) increased with stand age. Compared to Norway spruce at the same site, seepage water fluxes were decreased under Douglas fir, and increased under European beech. At sites with increased N saturation, replacement of spruce by beech resulted in a strong decrease in seepage water NO₃-concentration, whereas no decrease or even increases were observed after replacement of spruce by Douglas fir.*



S10.03b -6

DETERMINATION OF PLANT-AVAILABLE PHOSPHORUS FORMS IN SOIL UNDER CONSIDERATION OF THE INFLUENCE OF DIFFERENT TREE SPECIES

Niederberger Jörg^[1], Bauhus Jürgen^[1], Kohler Martin^[1]

^[1]University of Freiburg ~ Institute of Silviculture ~ Freiburg ~ Germany

The results of the first German nationwide forest soil survey suggested a limited P supply for nearly 60 % of the German forest sites. However, there was no correlation between the foliar P concentrations and the total P content in soil, suggesting that total soil P is not a good indicator of P available to trees. Yet, to assess soil fertility and for example management options to utilize additional forest biomass, efficient methods are needed to determine P availability in forest soils. Here we used the Hedley fractionation method to determine the different forms of available P in a subset of samples from 62 spruce and 26 beech sites from the nationwide forest soil survey. All in all, six inorganic and four organic P forms, as well as the residual P content, were measured. However, because this sequential extraction methods is very labour-intensive, we assessed whether proxies may be measured for the soil P fractions. Therefore, in a second stage, we tested whether Hedley P fractions could be determined by means of an indirect and more inexpensive technique; the Near Infrared Spectroscopy (NIRS). First results indicate considerable differentiation in the P distribution among the various fractions for spruce and beech. The content of labile organic P, for instance, was clearly higher for spruce sites in comparison to beech sites. In contrast the content of HCl soluble P was higher for Beech sites than for Spruce sites.



S10.03c - INFLUENCES OF TREE SPECIES ON FOREST SOILS

Chair Person:

Sue Grayston, Vancouver - Canada

Tuesday 03 July 2012 from 13:30 to 15:00. Room Biancospino

S10.03c -1

THE EFFECT OF DOMINANT TREE SPECIES ON SOIL MICROBIAL COMMUNITY, SOIL FAUNA AND CARBON STORAGE

Jan Frouz, Prague - Czech Republic

S10.03c -2

MICROBIAL COMMUNITIES IN ASPEN- AND SPRUCE FOREST FLOORS OF THE BOREAL MIXEDWOOD

Sylvie Quideau, Edmonton - Canada

S10.03c -3

STRUCTURE OF THE ACTIVE MICROBIAL COMMUNITY IN CONTRASTING FOREST SOILS

Pascal Boeckx, Ghent - Belgium

S10.03c -4

EFFECTS OF CHANGES IN TREE SPECIES, LAND-USE CHANGE, AND CLIMATE CHANGE ON FOREST NITROGEN RETENTION AND LOSS.

Pamela Templer, Boston - United States

S10.03c -5

TREE SPECIES EFFECTS ON THE MYCORRHIZAL CO₂ FLUX

Oleg Menyailo, Krasnoyarsk - Russian Federation

S10.03c -6

RELATIONSHIPS BETWEEN TREE SPECIES AND CURRENT PEDOGENETIC PROCESSES

Arnaud Legout, Champenoux - France



S10.03c -1

THE EFFECT OF DOMINANT TREE SPECIES ON SOIL MICROBIAL COMMUNITY, SOIL FAUNA AND CARBON STORAGE

Frouz Jan*^[1]

^[1] Faculty of sciences, Charles University ~ Institute for Environmental studies ~ Prague ~ Czech Republic

Carbon storage in aboveground tree biomass and soil organic matter (fermentation and humus layer), microbial respiration and biomass, and in situ litter decomposition was studied in post mining sites in northwest of the Czech Republic covered by seven various types of forests: alder, lime, oak, larch, pine and spruce plantations, and unreclaimed sites dominated by aspen, birch and willow. No topsoil was applied in these sites, so carbon accumulation is was the result of in situ soil development. Carbon storage in soil organic matter varied from 4.5 ± 3.7 to 38.0 ± 7.1 $t\ ha^{-1}$ (rate of C accumulation 0.15 ± 0.05 to 1.28 ± 0.34 $t\ ha^{-1} year^{-1}$). It decreased in order: lime, alder, larch, oak, pine, spruce and unreclaimed natural regeneration sites. No correlation was found between litter input and C storage in soil. There positive correlation with litter decomposition rate and carbon storage. These were no correlation between C storage in soil and soil respiration or microbial biomass. Amount of carbon in mineral layer and total soil carbon also correlated positively with earthworm abundance and amount of earthworm casts in profile. Field and laboratory manipulation experiment support the hypothesis about significant effect of soil fauna bioturbation on carbon storage. Laboratory experiment shows that incorporation of litter in soil by earthworms result in stronger carbon storage than mechanical mixing of soil or no mixing. Results indicate that soil fauna development play important role in soil formation in post mining sites.



S10.03c -2

MICROBIAL COMMUNITIES IN ASPEN- AND SPRUCE FOREST FLOORS OF THE BOREAL MIXEDWOOD

Quideau Sylvie^[1], Kishchuk Barbara^[2], Swallow Mathew^[1], Lloret Emily^[1]

^[1]University of Alberta ~ Renewable Resources ~ Edmonton ~ Canada ^[2]Natural Resources Canada ~ Canadian Forest Service ~ Edmonton ~ Canada

The boreal mixedwood forest of western Canada is composed of a mosaic of forest types, ranging from aspen-dominated to spruce-dominated stands. Soil microbial communities, and how they respond to disturbance, are a key component of site productivity through their regulation of organic matter and nutrient cycling patterns. Phospholipid fatty acid and substrate-induced respiration analyses were used to compare the microbial biomass and microbial community structure of forest floors as a function of disturbance (harvesting, silvicultural burning) and stand type (aspen, spruce, mixedwood). Distinct differences were found among stand types using both techniques, which seemed to be strongly affected by the presence of white spruce and the composition of the understory vegetation. On the other hand, differences among stand types appeared resilient to both harvesting disturbance and silvicultural burning. Microbial community stability was maintained even when the belowground (root) and surficial litterfall inputs were manipulated during a reciprocal transfer experiment. Furthermore, laboratory incubations using ¹³C- enriched substrates as well as a moisture manipulation experiment indicated that the communities differed in their ability to metabolize substrates. Microbial community stability in the white spruce forest floor appeared to be minimally impacted by lowering moisture. Yet moisture had a profound effect on the aspen forest floor, which harbored structurally and functionally distinct microbial communities at different moisture levels. The distinct response to moisture manipulation in aspen and spruce could be a result of community adaptations to the unique abiotic environment inherent to each forest floor.



S10.03c -3

STRUCTURE OF THE ACTIVE MICROBIAL COMMUNITY IN CONTRASTING FOREST SOILS

Staelens Jeroen^[1], Bodé Samuel^[1], De Schrijver An^[2], Verheyen Kris^[2], Boeckx Pascal^{*[1]}

^[1]Ghent University ~ Laboratory of Applied Physical Chemistry (ISOFYS) ~ Ghent ~ Belgium ^[2]Ghent University ~ Laboratory of Forestry ~ Ghent ~ Belgium

*Tree species can influence the properties of forest soils by differences in litter quality, microclimate, nutrient uptake, interception of atmospheric deposition, biological soil community and soil nutrient transformation rates. Diverging soil conditions under different tree species are well known but have rarely been related to possible differences in microbial communities. Therefore, the aim of our study was to characterize the structure of the active microbial community in the soil beneath two contrasting tree species (*Quercus robur* L. and *Pinus sylvestris* L.). The experiment was performed in two pairs of adjacent equal-aged deciduous and coniferous stands growing on a well-drained sandy soil with similar stand history, located in a region with enhanced nitrogen deposition (Belgium). In the four study stands the mineral topsoil (0-10 cm) was injected with an amino acid (glycine) that was enriched in the heavy stable carbon (C) isotope. Soils were sampled 1 and 7 d after injection in order to assess the structure of the active soil microbial community. The relative importance of living functional soil microbial groups (gram-positive and gram-negative bacteria, saprophytic fungi, arbuscular mycorrhizal fungi and actinomycetes) was determined by analyzing phospholipid fatty acids (PLFAs). Determining the ¹³C content of PLFAs also allowed quantifying the microbial groups that actively assimilated the applied glycine, in contrast to more common PLFA studies that only fingerprint the living microbial groups. The results will be discussed in relation to our earlier findings on biogeochemical processes, particularly of nitrogen, in the studied forest stands.*



S10.03c -4

EFFECTS OF CHANGES IN TREE SPECIES, LAND-USE CHANGE, AND CLIMATE CHANGE ON FOREST NITROGEN RETENTION AND LOSS.

Templer Pamela*^[1]

^[1]Boston University ~ Biology ~ Boston ~ United States

Forests of the northeastern United States receive some of the highest rates of atmospheric nitrogen deposition and many watersheds are beginning to show signs of nitrogen saturation. In addition to changes in atmospheric deposition of nitrogen, other human-induced disturbances have led to dramatic shifts in forest composition of the United States over the last 100 years. Tree species composition of many forests is changing in response to introduced pests and pathogens, land-use change, and climate change. Understanding the combined effects of increased nitrogen inputs and changes in plant species composition on forest nitrogen cycling is critical to our understanding of forest biogeochemistry and nutrient budgets. Despite several decades of research on the effects of atmospheric nitrogen deposition, there is still significant uncertainty about the factors that regulate nitrogen retention and loss in forest ecosystems. We used a combination of enriched isotopic tracers (to follow specific cohorts of nitrogen inputs) and evaluation of natural abundance nitrogen and oxygen stable isotopes of nitrate (to determine sources of nitrate leached from forests). We evaluated the combined impacts of changes in tree species composition, land-use change, and climate change on nitrogen retention and loss in northern hardwood forests. Results from these studies suggest that tree species composition can be a strong regulator of forest nitrogen retention, but differences among species may change depending upon nitrogen inputs, previous land-use change, and projected changes in climate.



S10.03c -5

TREE SPECIES EFFECTS ON THE MYCORRHIZAL CO₂ FLUX

Menyailo Oleg*^[1]

^[1]Institute of Forest SB RAS ~ Biogeochemistry ~ Krasnoyarsk ~ Russian Federation ^[2]University of York ~ Biology ~ York ~ United Kingdom

Mycorrhiza plays an important role in global carbon cycle, especially, in forest soils, yet the effect of tree species on the amount and timing of C transfer through roots to mycorrhiza is largely unknown. We studied the C transport to mycorrhiza under 6 most commonly dominant in boreal forests tree species using the Siberian afforestation experiment. The CO₂ flux from mycorrhizal and non-mycorrhizal mesh collars was measured every two weeks from May until October of 2010 and 2011. The two years were different in time of snow melt, summer precipitation allowing assessing the role of mycorrhiza in inter-annual variability in CO₂ flux. During the overall dry summer of 2010, the difference in soil surface CO₂ flux between the tree species were determined mostly by difference in mycorrhizal flux, while during the wetter summer of 2011, soil heterotrophs also contributed to the difference in CO₂ flux between the tree species. The mycorrhizal CO₂ flux was not linked to soil temperature but rather to trees phenology and to photosynthetic activity. All tree species transferred more carbon to mycorrhiza during the second half of summer and in September, this is because all the carbon photosynthesized earlier is used for building the trees biomass. Seasonal variation in C transfer to mycorrhiza was much larger than hourly variation (within a day). Tree species strongly differed in C flux to mycorrhiza: more C was transferred by deciduous species than by conifers.



S10.03c -6

RELATIONSHIPS BETWEEN TREE SPECIES AND CURRENT PEDOGENETIC PROCESSES

Legout Arnaud^[1], Jaffrain Jérôme^[1], Titeux Hugues^[2], Zeller Bernhard^[1], Ranger Jacques^[1]

^[1]INRA ~ Biogéochimie des Ecosystèmes Forestiers ~ Champenoux ~ France ^[2]University of Louvain ~ Earth and Life Insitue Environmental sciences -Soil science ~ Louvain la Neuve ~ Belgium

According to global change, tree species composition will change, to more diverse stands or to highly productive monocultures. Both options will impact the current ecosystems functions. A study held in a common garden experiment set on acid soils (Morvan France) gave new insights in the impact of tree species on forest soil functions: -Net mineralization and principally nitrification depends on vegetation. Stimulation of nitrification occurred in Douglas fir, pine, beech and oak, reduction in spruce, fir and in the former broadleaved forest. - The soil solutions used as indicators showed strong species effects: o the forest-floor solutions were species dependent: DOC controlled the transfer of Al under spruce but nitrate did it under Douglas fir. o Solutions in the mineral soil revealed very different figures. Transfer of nutrient cations due to proton neutralisation, and of monomeric Al associated with excess nitrate dominated under pine, Douglas fir and secondarily under oak and spruce, while, transfert of organically bound Al and Fe dominated under broadleaved trees and fir. o Solution from limed coniferous stands showed a strong decrease in NO₃⁻ and Al. Calcium changes only occurred just below the forest soil, indicating a very conservative biological recycling of this element. Tree species oriented current soil processes: acidification by species which stimulated nitrification in a system unable to immobilize nitrates (case of Douglas fir and laricio pine), complexation by DOC under spruce or fir. Liming efficiently mitigated the deleterious effects of excess nitrification, avoiding transfer of Al towards the deep soil layers.



S11.01a - IMPACT OF CLIMATE CHANGE ON SOIL BIOCHEMICAL ACTIVITY WITH SPECIAL EMPHASIS ON SOIL RESPIRATION

Chair Persons:

Jens Leifeld, Bern - Switzerland

Carmen Trasar-Cepeda, Santiago de Compostela -Spain

Monday 02 July 2012 from 13:30 to 15:00. Room Biancospino

S11.01a -1

TEMPERATURE SENSITIVITY OF SOIL ORGANIC MATTER DECOMPOSITION IN BOREAL SOILS

Pekka Vanhala, Helsinki - Finland

S11.01a -2

TEMPERATURE SENSITIVITY OF STABLE SOIL CARBON – LESSONS LEARNED FROM LONG-TERM BARE FALLOW EXPERIMENTS

Pierre Barré, Paris - France

S11.01a -3

IN-SITU CARBON TURNOVER DYNAMICS AND THE ROLE OF THE SOIL MICROBIAL COMMUNITY THEREIN; A CLIMATE WARMING SIMULATION STUDY IN AN ALPINE ECOSYSTEM

Ika Djukic, Vienna - Austria

S11.01a -4

UNCERTAINTIES OF MODELING ECOSYSTEM RESPIRATION BASED ON SOIL TEMPERATURE – CAN THEY BE REDUCED USING MANUAL AND AUTOMATIC CHAMBER MEASUREMENTS?

Ulrike Hagemann, Müncheberg - Germany

S11.01a -5

IMPROVEMENT OF ENGINEERING PROPERTIES OF SOILS WITH BIOPOLYMER ADDITIVES

Yeliz Yukselen-Aksoy, Manisa - Turkey

S11.01a -6

DOES MICROBIAL RESPIRATION ADAPT TO CHANGES IN TEMPERATURE?

Kristiina Karhu, Exeter - United Kingdom



S11.01a -1

TEMPERATURE SENSITIVITY OF SOIL ORGANIC MATTER DECOMPOSITION IN BOREAL SOILS

Vanhala Pekka^{*[1]}, Karhu Kristiina^[2], Sonninen Eloni^[3], Tuomi Mikko^[1], Björklöf Katarina^[1], Hämäläinen Kai^[3], Fritze Hannu^[4], Liski Jari^[1]

^[2]University of Exeter ~ College of Life and Environmental Sciences ~ Exeter ~ United Kingdom ^[3]University of Helsinki ~ Finnish Museum of Natural History ~ Helsinki ~ Finland ^[4]Finnish Forest Research Institute ~ Forest Ecology ~ Vantaa ~ Finland ^[1]Finnish Environment Institute ~ Natural Environment Centre ~ Helsinki ~ Finland

Soils contain two to three times more carbon than the atmosphere or terrestrial vegetation. Therefore, slight changes in the rate of soil organic carbon (SOM) decomposition can significantly affect the atmosphere CO₂ concentration. The temperature sensitivity of decomposition of different SOM fractions was studied by using ¹³C and ¹⁴C isotopes to differentiate between SOM of different age. The quality of SOM and the functionality and composition of microbial communities formed under different climatic conditions were also studied. Transferring of soils from a colder to a warmer climate was used to assess how changing climate, litter input and soil biology will affect soil respiration and its temperature sensitivity. Our studies show how warming climate will affect the decomposition of different SOM fractions in boreal soils: the most labile C was least temperature sensitive, indicating that it is utilized irrespective of temperature. The decomposition of intermediate C was highly temperature sensitive. Oldest, centennially cycling C was again less temperature sensitive, indicating that different stabilizing mechanisms were limiting its decomposition. Because the highly temperature sensitive C forms a major part of SOM in the studied soils, these soils will lose more carbon in future than estimated earlier. SOM decomposition in boreal soils will increase more in response to warming, compared to temperate or tropical soils, also because the Q₁₀ is temperature dependent. In the northern soils the warming will occur within a lower temperature range, where Q₁₀ is higher, and a similar increase in temperature causes a higher relative increase in respiration rates.



S11.01a -2

TEMPERATURE SENSITIVITY OF STABLE SOIL CARBON – LESSONS LEARNED FROM LONG-TERM BARE FALLOW EXPERIMENTS

Romain Lefevre^[1], Barré Pierre^{*[2]}, Gérard Bardoux^[1], Bent T Christensen^[3], Cyril Girardin^[1], Sabine Houot^[4], Thomas Kätterer^[5], Folkert Van Oort^[6], Claire Chenu^[1]

^[1]BIOEMCO Laboratory ~ AgroParisTech ~ Thiverval-Grignon ~ France ^[2]Geology Laboratory ~ Ecole normale supérieure ~ Paris ~ France ^[3]University of Aarhus ~ Agroecology and Environment ~ Tjele ~ Denmark ^[4]EGC laboratory ~ AgroParisTech ~ Thiverval-Grignon ~ France ^[5]Swedish University of Agricultural Sciences ~ Soil and Environment ~ Uppsala ~ France ^[6]PESSAC Laboratory ~ INRA ~ Versailles ~ France

The impact of climate change on the stability of soil organic carbon (SOC) remains a major source of uncertainty in predicting future changes in atmospheric CO₂ levels. The sensitivity of SOC mineralization to global warming remains unsettled, with one particular issue being whether the mineralization response to temperature is the same for labile and stable SOC pools. Long-term (>25 years) bare fallow experiments (LTBF) in which the soil is kept free of any vegetation, represent a unique research platform to examine this issue as with increasing duration of the treatment, the proportion of stable SOC increases. This study employs soils from LTBF experiments situated at Askov (Denmark), Grignon (France), Versailles (France) and Ultuna (Sweden). We used archived soils sampled at the start of the experiments and after 25, 50, 80 and 52 years of bare fallow, respectively, when the soils had become enriched in stable SOC. The samples were incubated at one fixed water potential (-0.32 bars) and four different temperatures (4, 12, 30 and 35 °C). The evolution of total CO₂ and of ¹³CO₂ from the incubated soils was monitored for one year. The results indicate a higher vulnerability of SOC in LTBF soils enriched in stable C. However, we observed no relationship between the duration of the bare-fallow treatment and the temperature sensitivity of SOC. Interestingly, the quality (as determined by δ¹³C) of the mineralized SOC depended on the incubation temperature. Further modelling will allow us to determine the temperature sensitivity of kinetic pools in SOC simulation models.



S11.01a -3

IN-SITU CARBON TURNOVER DYNAMICS AND THE ROLE OF THE SOIL MICROBIAL COMMUNITY THEREIN; A CLIMATE WARMING SIMULATION STUDY IN AN ALPINE ECOSYSTEM

Djukic Ika^{*[1]}, Zehetner Franz^[1], Watzinger Andrea^[2], Horacek Micha^[2], Gerzabek Martin H.^[1]

^[1]Institute of Soil Research ~ Department of Forest and Soil Science ~ Vienna ~ Austria ^[2]Austrian Institute of Technology GmbH ~ Health & Environment Department - Environmental Resources & Technologies ~ Tulln ~ Austria

Litter decomposition represents one of the largest fluxes in the global terrestrial carbon cycle. It is therefore crucial to better understand the factors governing decomposition and their responses to changing environmental conditions. We used high-to-low elevation soil translocation to simulate the combined effects of changing climatic conditions, shifting vegetation zones and altered snow cover regimes in the Austrian Limestone Alps. Over a two-year incubation period, we studied carbon turnover dynamics and pathways of carbon during microbial decomposition of isotopically labeled maize straw. A simulated mean annual soil warming of 1.5 and 2.7°C, respectively, resulted in a significantly accelerated turnover of added maize carbon at the lower elevation sites. The more resistant carbon pool (half-life: 1-2 years) responded more strongly to experimental warming (100-190% increase in decomposition rate) compared to the labile pool (half-life: 1-2 weeks; 5-20% increase in decomposition rate). Changes in substrate quantity and quality in the course of the decomposition appeared to have less influence on the microbial community composition and its substrate utilization than the prevailing environmental conditions, to which the microbial community adapted quickly upon change. In general, microbial community composition and function significantly affected substrate decomposition rates only in the later stage of decomposition when the differentiation in substrate use among the microbial groups became more evident. Our study demonstrates that rising temperatures in alpine ecosystems will accelerate decomposition of litter carbon, especially in more resistant pools, but also lead to a rapid adaptation of the microbial communities to the new environmental conditions.



S11.01a -4

UNCERTAINTIES OF MODELING ECOSYSTEM RESPIRATION BASED ON SOIL TEMPERATURE – CAN THEY BE REDUCED USING MANUAL AND AUTOMATIC CHAMBER MEASUREMENTS?

Hagemann Ulrike^[1], Madlen Pohl^[1], Jürgen Augustin^[1]

^[1]Leibniz-Centre for Agricultural Landscape Research (ZALF) e.V. ~ Institute of Landscape Matter Dynamics ~ Müncheberg ~ Germany

A common method for estimating ecosystem respiration (Reco) relies on periodic daytime measurement campaigns using a non-flow-through non-steady-state opaque chamber system (Livingston and Hutchinson 1995) with continuous sampling (Drösler 2005). Gaps between measurement campaigns are filled by modeling Reco based on continuously logged soil temperatures using the Lloyd-Taylor model (Lloyd and Taylor 1994). This method relies on the assumption that nighttime Reco fluxes can be modeled based on measured daytime fluxes. To test this assumption and facilitate gap-filling, we have made comparative measurements near the manual measurement locations using a high-resolution automatic chamber system. Results show that the Lloyd-Taylor model parameters based on manually measured daytime Reco fluxes differed from those based on automatically measured nighttime fluxes, resulting in higher values of nighttime Reco based on daytime measurements compared to nighttime measurements. As the annual soil carbon budget of agricultural areas often fluctuates around zero (Kutsch et al. 2010), this difference may have serious implications with respect to annual estimates of Reco and determine the evaluation of the carbon source or sink functionality of these sites. We discuss possible reasons for the differences between manual daytime and automatic nighttime chamber measurements, in particular a) chamber construction, b) small-scale spatial variability of Reco, c) wind turbulence and layering effects, d) plant physiology, and e) the applicability of the Lloyd-Taylor model, and explore the effect of Reco modeling based on manual and/or automatic measurements on the annual GHG balance of corn (*Zea mays* L.) in a young moraine landscape of north-eastern Germany.



S11.01a -5

IMPROVEMENT OF ENGINEERING PROPERTIES OF SOILS WITH BIOPOLYMER ADDITIVES

Yukselen-Aksoy Yeliz*^[1], Ayhan Anil^[1]

^[1]Celal Bayar University ~ Civil Engineering ~ Manisa ~ Turkey

In the literature, the recent studies have shown that the rate use of biopolymers in geotechnical engineering increases in recent years. The xanthan gum and chitosan biopolymers are economical polymers, have been extensively used in industry and available in the nature. Therefore, these two biopolymers were selected for this study. In this study, the consistency limits, swell indexes, consolidation parameters and permeability of the samples which were prepared different concentrations of biopolymers were investigated. In general results show that, the liquid limit values of kaolin and bentonit samples increased with used biopolymer additives. The effects of biopolymers were distinctly seen on bentonite, because its higher liquid limit value than kaolin. In the presence of xanthan gum and chitosan biopolymers, increase in plastic limit values of bentonite sample distinctly higher than the kaolin sample. In the presence of of xanthan gum biopolymer, only the modified free swelling index of kaolin decreased. However, the modified free swell indexes of the kaolin and bentonite samples decreased in the presence of chitosan. According to these results, it was concluded that chitosan can be used for decreasing of swelling potentials of soils which have high swelling potential. The consolidation coefficients decreased when xanthan gum concentration increases under the same load. General results have shown that biopolymers can be used in geotechnical engineering for special purposes.



S11.01a -6

DOES MICROBIAL RESPIRATION ADAPT TO CHANGES IN TEMPERATURE?

Karhu Kristiina^[1], Hopkins David^[2], Wookey Philip^[3], Dungait Jennifer^[4], Prosser James^[5], Singh Brajesh^[6], Ågren Göran^[7], Fraser Fiona^[3], Hartley Iain^[1]

^[1]University of Exeter ~ Geography ~ Exeter ~ United Kingdom ^[2]Heriot-Watt University ~ School of Life Sciences ~ Edinburgh ~ United Kingdom ^[3]University of Stirling ~ Biological & Environmental Sciences ~ Stirling ~ United Kingdom ^[4]North Wyke Research ~ Sustainable Soils and Grassland Systems ~ Okehampton ~ United Kingdom ^[5]University of Aberdeen ~ Institute of Biological and Environmental Sciences ~ Aberdeen ~ United Kingdom ^[6]University of Western Sydney ~ Hawkesbury Institute for the Environment ~ Sydney ~ Australia ^[7]Swedish University of Agricultural Sciences ~ Department of Ecology ~ Uppsala ~ Sweden

Recent studies have produced conflicting results in terms of the effects of long-term temperature changes on the functioning of soil microbial communities. We are investigating whether adaptation of soil microbial communities to temperature generally enhances (enhancement) or reduces (thermal acclimation) the direct effects of temperature changes on decomposition rates. Previously, we developed a soil-cooling approach which involves cooling samples after respiration rates have stabilised following a prolonged pre-incubation period, and determining the potential for respiration rates to recover during extended exposure to lower temperatures. In contrast to other studies, our initial research demonstrated enhancement in Arctic soils. Here we present results from a new project which is extending the approach to temperate, Mediterranean and tropical soils. We also aim to disentangle the mechanisms behind any observed responses by characterising the composition and function of microbial communities in the cooled and control soils; microbial biomass, PLFAs, mass-specific activity, carbon-use efficiency, and the activities of enzymes involved in the break-down of labile versus more recalcitrant compounds, are all being quantified. Initial results from temperate soils generally show no clear signs of thermal acclimation, but responses were dependent on soil type and the temperature range investigated; at low temperatures further evidence for enhancement was produced. Incubation of Mediterranean and tropical soil samples is ongoing and will be completed by March, allowing responses at high soil temperatures to be elucidated. The study represents one of the most extensive investigations undertaken to date into the potential for thermal acclimation under contrasting environmental conditions.



S11.01b - IMPACT OF CLIMATE CHANGE ON SOIL BIOCHEMICAL ACTIVITY WITH SPECIAL EMPHASIS ON SOIL RESPIRATION

Chair Persons:

Carmen Trasar-Cepeda, Santiago de Compostela -Spain

Jens Leifeld, Bern - Switzerland

Monday 02 July 2012 from 15:30 to 17:00. Room Biancospino

S11.01b -1

TEMPERATURE EFFECTS ON BACTERIAL GROWTH IN SOIL AFTER NUTRIENT ADDITION, DRYING/REWETTING AND FREEZING/THAWING.

Erland Baath, Lund - Sweden

S11.01b -2

TEMPERATURE SENSITIVITY OF ENZYMES ACTIVITY IN SOIL AS DEPENDENT ON SUBSTRATE AMOUNT AND DROUGHT EFFECT

Evgenia Blagodatskaya, Pushchino - Russian Federation

S11.01b -3

SEASONAL VARIATIONS IN THE AVAILABILITY OF LABILE SUBSTRATE CONFOUND THE TEMPERATURE SENSITIVITY OF HETEROTROPHIC RESPIRATION.

Miko Kirschbaum, Palmerston North - New Zealand

S11.01b -4

ANNUAL VARIATION IN CO₂ EFFLUXES IN AFFORESTED AND AGRICULTURAL SOILS

Félix Zorita, Santiago de Compostela - Spain

S11.01b -5

CARBON CONTROLS ON SOIL RESPIRATION ACROSS A TROPICAL ELEVATION GRADIENT: EVIDENCE FROM THE ANDES

Jeanette Whitaker, Lancaster - United Kingdom

S11.01b -6

INDICATION OF SOIL AMINO SUGARS TO WARMING EFFECT ON MICROBIAL TRANSFORMATION PROCESS OF SOM IN A TEMPERATE STEPPE

Xudong Zhang, Shenyang - China



S11.01b -1

TEMPERATURE EFFECTS ON BACTERIAL GROWTH IN SOIL AFTER NUTRIENT ADDITION, DRYING/REWETTING AND FREEZING/THAWING.

Baath Erland*^[1]

^[1]Lund University ~ Microbial Ecology, Dep Biology ~ Lund ~ Sweden

Temperature has a direct effect on bacterial growth rates in soil, usually following a square-root relationship below optimum temperature, with Q10 decreasing with temperature. Temperature will, however, also affect the rate with which the bacteria will react on environmental perturbations. Adding substrate (glucose) to soil results in a lag-period before bacterial growth, measured with the leucine incorporation method, increases above that in the control soil. The lag period scaled with temperature, increasing from less than 10 h at 25-30°C, to around 2 days at 5°C, and > 5 days at 0°C. A similar temperature effect was found for the bacterial growth recovery after a drying/rewetting event. Bacterial growth increased linearly with time after rewetting, reaching the level found in a constantly moist control soil after less than 10 h at 25°C, after around 3 days at 15°C and after around 10 days at 5°C. Bacterial growth after freezing/thawing also appeared to increase linearly with time, reaching levels in a non-frozen control soil after around 2 days at 5°C. The freezing temperature affected the recovery. A temperature of -18°C resulted in lower initial growth rates after thawing, but eventually in higher growth compared to a freezing temperature of -3°C. Having in mind that one of the predicted effects of global change will be more perturbation events like drying/rewetting and freezing/thawing, the effect of temperature on the microbial response to such perturbations should be evaluated.



S11.01b -2

TEMPERATURE SENSITIVITY OF ENZYMES ACTIVITY IN SOIL AS DEPENDENT ON SUBSTRATE AMOUNT AND DROUGHT EFFECT

Blagodatskaya Evgenia*^[1], Schrumpf Marion^[2], Weber Enrico^[2], Wutzler Thomas^[2], Reichstein Markus^[2], Trumbore Susane^[2]

^[1]Institute of Physicochemical and Biological Problems in Soil Science Russian Academy of Sciences ~ Russian Academy of Sciences ~ Pushchino ~ Russian Federation ^[2]Max Planck Institute for Biogeochemistry ~ Biogeochemical Processes ~ Jena ~ Germany

The decomposition of soil organic matter (SOM) is mediated by the activity of extracellular enzymes, which, in turn, is dependent both on the amount and availability of decomposed substrates. According to Michaelis-Menten relationship, the different drivers are responsible for the temperature sensitivity of SOM decomposition at low (K_m) and high (V_{max}) substrate amounts. We tested the temperature sensitivity of the K_m and V_{max} for the set of 6 hydrolytic enzymes responsible for the different stages of decomposition of soil organics (such as starch, cellulose, hemicellulose, chitin etc.) as well as for the enzymes degrading the aromatic compounds (peroxidases and phenoloxidases). Enzyme kinetics was determined in the course of QuaSOM experiment (Max Planck Institute for Biogeochemistry Jena, Germany) where continuous ^{13}C - CO_2 -labeling was applied during vegetation of peppermint (*Mentha piperita* L.) under deficit and optimal moisture regimes. Our study revealed the group of the enzymes (α -glucosidase, xylanase, chitinase) with multiphase Michaelis-Menten kinetics. The temperature sensitivity of the enzymes activity decreased with the increasing substrate concentrations. Contrasting responses of phenol- versus peroxidases to different moisture regimes were most pronounced in the rhizosphere of peppermint. The drought effect on the enzymes activity will be linked with the partitioning of plant-originated and SOM-originated carbon in heterotrophic respiration and in microbial biomass. A mechanism of microbial adaptation to the periodical draughts consisted in much larger increase in K_m than in V_{max} as a response to increasing temperature.



S11.01b -3

SEASONAL VARIATIONS IN THE AVAILABILITY OF LABILE SUBSTRATE CONFOUND THE TEMPERATURE SENSITIVITY OF HETEROTROPHIC RESPIRATION.

Kirschbaum Miko*^[1]

^[1]Landcare Research ~ Global Change Processes ~ Palmerston North ~ New Zealand

In deriving the temperature dependence of heterotrophic respiration from empirical observations, changing substrate availability can confound any inferred inherent temperature sensitivity. This is a potential problem under any experimental or observational setting. Its potential effect for measurements under seasonally varying temperatures is investigated here in a modelling study. The CenW/ CENTURY model was run with different lignin to nitrogen ratios of fresh litter, and with litter either becoming available continuously or with litter production being restricted to autumn leaf fall. It was investigated to what extent inclusion of varying substrate supply within a realistic modelling framework modified the derived temperature sensitivity of heterotrophic respiration. It was shown that in systems with recalcitrant litter, as might be produced by conifers or eucalypts, the confounding effect of changing substrate supply is only slight. In systems with more labile litter, however, such as that produced by nutrient-rich grasslands, the confounding effect of substrate availability can be important and can substantially weaken any derived temperature sensitivity. This effect is even more pronounced in systems where litter fall is restricted to the autumn months.



S11.01b -4

ANNUAL VARIATION IN CO₂ EFFLUXES IN AFFORESTED AND AGRICULTURAL SOILS

Zorita Félix^[1], Trasar-Cepeda Carmen^[2], Leirós M. Carmen^[2], Gil-Sotres Fernando^[2]

^[1]IIAG-CSIC ~ Bioquímica del Suelo ~ Santiago de Compostela ~ Spain ^[2]USC ~ Edafología y Química Agrícola ~ Santiago de Compostela ~ Spain

In the 1990s, the European Union subsidised the afforestation of agricultural land as a means of mitigating climate change. This policy was based on the idea that afforestation would lead to accumulation of organic carbon in plant biomass and soils, thus contributing to the removal of atmospheric CO₂ (the main greenhouse gas) via the action of the soil as a C sink. As a result, large areas of agricultural land (not only marginal but good quality land) were transformed into forest land. However, the effectiveness of the policy has still not been demonstrated. In the present study, we investigated how the afforestation of agricultural soils (maize cropped soils) affects soil CO₂ effluxes. For this purpose, the daily variations in the CO₂ effluxes were monitored in forest soils and in the agricultural soils from which they were derived. The CO₂ effluxes were measured monthly in winter, and fortnightly during the rest of the year, using a portable Infra Red Gas Analyzer and a closed soil chamber. The results showed that there were no clear differences between the afforested and cropped soils, as the only time that significant differences were observed were when agricultural activities were being carried out. It was also found that when water was not limited, the CO₂ effluxes were closely related to temperature, so that the maximum emissions occurred at midday.



S11.01b -5

CARBON CONTROLS ON SOIL RESPIRATION ACROSS A TROPICAL ELEVATION GRADIENT: EVIDENCE FROM THE ANDES

Whitaker Jeanette^[1], Meir Patrick^[2], Mcnamara Niall^[1], Ostle Nick^[1], Bardgett Richard^[3]

^[1]Centre for Ecology and Hydrology ~ Shore Section ~ Lancaster ~ United Kingdom ^[2]University of Edinburgh ~ Centre for Environmental Change & Sustainability ~ Edinburgh ~ United Kingdom ^[3]Lancaster University ~ Lancaster Environment Centre ~ Lancaster ~ United Kingdom

The Tropical Andes is predicted to warm by 3-5 °C this century with unknown feedbacks to ecosystem processes. There is concern that climate change could result in significant losses of carbon from these soils through temperature driven increases in soil respiration. However, the climatic vulnerability of these large soil carbon stores is poorly understood. In this project we investigated the role of soil biological and physical properties in determining soil respiration along an elevation gradient from 200 m to 3700 m asl. With soils sampled from 14 locations along the gradient we examined variation in soil and microbial biomass C and N, and microbial diversity (using phospholipid fatty acid biomarkers). A series of carbon substrate addition experiments were conducted to determine the role of carbon quality and quantity in constraining soil respiration, using substrates of increasing complexity (from glucose to hemicellulose). Results show that soil C and N content, microbial biomass C and N and total microbial biomass all increase with altitude, with a significant decrease in soil bacterial:fungal ratios. Experimental results reveal that (a) carbon quality and quantity constrain soil respiration across the elevation gradient; and (b) soils capacity to utilise carbon substrates is strongly correlated with soil and microbial C content and microbial biomass. The implication of this work is that soil biological and chemical properties will be important determinants of CO₂ feedbacks to the atmosphere in this region as climate change progresses.

S11.01b -6

INDICATION OF SOIL AMINO SUGARS TO WARMING EFFECT ON MICROBIAL TRANSFORMATION PROCESS OF SOM IN A TEMPERATE STEPPE

Zhang Xudong^{*[1]}, He Hongbo^[1], Wang Yang^[1]

^[1]Institute of Applied Ecology, Chinese Academy of Sciences ~ State Key Laboratory of Forest and Soil Ecology ~ Shenyang ~ China

The unprecedented global warming can profoundly impact SOC cycling, but how the warming impact is attributed to the microbial transformation process of SOM is unclear. As reliable microbial residue biomarkers, amino sugars are usually used to elucidate microbial processes of C dynamics, as they are highly involved in microorganism-mediated SOC cycling. Here we present results from a 3-year field experiment to investigate the effect of asymmetric diurnal warming (control, day warming, night warming and diurnal warming) on soil amino sugar signatures and aimed to evaluate the indicative role of amino sugars to warming effect on the microbial transformation process of SOM in a temperate steppe of northern China. Our results indicated that the three warming treatments affected soil amino sugar signatures differently, i.e. fungal- and bacterial-derived residues indicated different responses of microbial communities to asymmetric diurnal warming. Interestingly, day warming had no significant effect on both bacterial muramic acid and fungal glucosamine, while night warming increased the concentrations of both amino sugars significantly. Although diurnal warming did not show any interactive effect on the two microbial residues, amino sugar concentrations were still higher compared to the control and day warming treatments. On the base of fungal to bacterial residue ratios and the proportion of microbial residue carbon to SOC, we concluded that night warming can enhance the accumulation of fungal residues and stability of soil organic matter, while day warming will resulted in more rapid transformation of soil organic matter and possible organic carbon loss in the steppe soil.



S11.02a - SOIL BIODIVERSITY AND ECOSYSTEM SERVICES

Chair Person:

Anne Winding, Aarhus - Denmark

Wednesday 04 July 2012 from 10:30 to 12:00. Room Acero

S11.02a -1

*CONNECTING SOIL BIODIVERSITY TO FUNCTIONS AND ECOSYSTEM SERVICES:
PRESENTATION OF CASE STUDIES AND OF THE EU FP7 PROJECT ECOFINDERS*

Philippe Lemanceau, Dijon - France

S11.02a -2

ECOSYSTEM SERVICES PROVIDED BY THE SOIL BIOTA

Lijbert Brussaard, Wageningen - Netherlands

S11.02a -3

*MANAGING SOIL BIODIVERSITY FOR ECOSYSTEM SERVICES: CHALLENGES AND
OPPORTUNITIES*

Mary Stromberger, Fort Collins, Colorado - United States

S11.02a -4

SHIFTING DIMENSIONS – DEFINING THE ECOLOGICAL STATUS OF SOILS

Helaina Black, Aberdeen - United Kingdom

S11.02a -5

TILLAGE-INDUCED CHANGES IN THE FUNCTIONAL DIVERSITY OF SOIL BIOTA

Christine Van Capelle, Braunschweig - Germany

S11.02a -6

A TRIAL WITH ECOSYSTEM SERVICES IN SOIL OF FOUR ARABLE FARMS

Michiel Rutgers, Bilthoven - Netherlands



S11.02a -1

**CONNECTING SOIL BIODIVERSITY TO FUNCTIONS AND ECOSYSTEM SERVICES:
PRESENTATION OF CASE STUDIES AND OF THE EU FP7 PROJECT ECOFINDERS**

Lemanceau Philippe^[1], Bailey Mark^[2], Faber Jack H.^[3], Griffiths Bryan^[4], Maron Pierre-Alain^[1], Martin Francis^[5], Mougel Christophe^[1], Philippot Laurent^[1], Pascual Unai^[6], Pelé Natasa^[7], Ranjard Lionel^[1], Winding Anne^[8]

^[1]INRA ~ UMR Agroécologie ~ Dijon ~ France ^[2]CEH ~ . ~ Wallingford ~ United Kingdom ^[3]Alterra ~ Centre for Ecosystem Studies ~ Wageningen ~ Netherlands ^[4]Teagasc ~ Environment Research Centre ~ Wexford ~ Ireland ^[5]INRA ~ UMR Interactions Arbres/Micro-Organismes ~ Nancy ~ France ^[6]University of Cambridge ~ Land Economy ~ Cambridge ~ United Kingdom ^[7]INRA Transfert ~ Europe ~ Paris ~ France ^[8]Aarhus University ~ Environmental Science ~ Roskilde ~ Denmark

Soils provide essential ecosystem services such as primary production, regulation of biogeochemical cycles and their consequences on climate, water filtration, resistance to pests and diseases, and regulation of above-ground biodiversity. These services result from functions supported by soil organisms. Their abundance, diversity and activities vary according to environmental factors and Human activities. Despite progress made over the last decade in assessing soil biodiversity, the huge reservoir of biodiversity represented by soils remains superficially explored as do the relations between soil biodiversity and functioning. This lack of knowledge is related to the small size of most organisms, their hidden location, the matrix structure of the soil and the immense variety of environmental conditions. Knowing the range of biodiversity, its contribution to soil functioning and ecosystem services, and the impact of the variety of environmental situations on both parameters is thus a critical challenge to be addressed. This knowledge is required by the European Commission for defining a policy for sustainable management of soils with a view to adopt a legally binding Soil Framework Directive. Case studies on C and N cycling will be presented to illustrate the connection between soil biodiversity and functions. Also, data demonstrating the contribution of environmental filters as drivers of microbial communities will be shown. Finally, a brief overview of the EU FP7 EcoFINDERS will show how it can provide the EC with scientific, operational and economic information on biodiversity to design and implement strategies for ensuring sustainable use of soils.



S11.02a -2

ECOSYSTEM SERVICES PROVIDED BY THE SOIL BIOTA

Brussaard Lijbert*^[1], Faber Jack H.^[2]

^[1]Wageningen University ~ Soil Quality ~ Wageningen ~ Netherlands ^[2]Alterra ~ Moleculair Ecology, Ecotoxicology and Wildlife Management ~ Wageningen ~ Netherlands

We connect the soil biota to ecosystem structure and functioning and the concept of ecosystem services, i.e. the benefits people derive from ecosystems, and to the impact of land management and environmental drivers of change upon such phenomena. Following recent developments in trait-based ecology, functional trait groups, based on organismal- and species- trait diversity, addressing multiple associations between traits and ecosystem services across different trophic levels, are proposed as more suitable than functional groups based on species diversity per se, in relating drivers of change to soil biota-mediated ecosystem functioning and services. The concept of functional trait groups will be presented as useful when we wish to extend basic understanding of ecosystem functioning to practical management for enhanced ecosystem services. From a set of studies we infer that judicious choices of tillage systems and crops/cultivars in arable agriculture, animals in livestock husbandry and grazing systems, and crops and animals in mixed farming, optimize the delivery of ecosystem goods and services and, hence, make agricultural production systems both more efficient and more robust, i.e. adaptable to changing climate variability and environmental and economic risks. The evidence, limited as it is as yet, suggests that a functional trait-based approach is promising for the design of agro-ecosystems. We will further elaborate this by putting such approach into the perspective of the management of a landscape, which is characterized by both agricultural crop and livestock diversity and 'wild' (be it planned or unplanned) biodiversity in a certain spatial configuration.



S11.02a -3

MANAGING SOIL BIODIVERSITY FOR ECOSYSTEM SERVICES: CHALLENGES AND OPPORTUNITIES

Stromberger Mary*^[1], Weir Tiffany^[2]

^[1]Colorado State University ~ Department of Soil and Crop Sciences ~ Fort Collins, Colorado ~ United States ^[2]Colorado State University ~ Horticulture and Landscape Architecture ~ Fort Collins, Colorado ~ United States

Molecular studies have generated significant findings regarding the level of microbial diversity in soil, but we have yet to learn how to effectively capitalize on this diversity to promote beneficial ecosystem services. Soils of high biodiversity are more likely to contain important ecosystem service providers (ESPs), whose presence determines a soil's potential to perform a specific function (e.g., cycle elements, bioremediate contaminants, promote plant growth, etc.) under certain environmental conditions. To benefit from this genetic potential, however, we need a much greater understanding of 1) the important ESPs within a microbial community, 2) the abiotic and biotic factors that influence community diversity and ESP abundance, species composition, and activity, and 3) the spatial and temporal distribution of ESPs and their activities. In this presentation I will discuss the challenges and opportunities of managing soil biodiversity to promote ecosystem services, with an emphasis on crop growth promotion under abiotic stress. I will outline a discover-and-manage approach to promote ecosystem services through assessment of the diversity and abundance of relevant microbial populations, including ACC deaminase positive bacteria, and identification of important abiotic and biotic factors associated with their activity in space and time (through geostatistics and development of predictive models, including decision tree analysis). Once manageable predictors of microbial communities and/or activities are identified, strategies can be developed and implemented to promote their ecosystem services.



S11.02a -4

SHIFTING DIMENSIONS – DEFINING THE ECOLOGICAL STATUS OF SOILS

Black Helaina*^[1], Cameron Clare^[1], Campbell Colin^[1], Chamberlain Paul^[2], Creamer Rachel^[3], Harris Jim^[4], Pawlett Mark^[4], Robinson Lucinda^[1], Singh Brajesh^[5], Woods Claire^[2], Ritz Karl^[4]

^[1]The James Hutton Institute ~ Ecological Science ~ Aberdeen ~ United Kingdom ^[2]CEH ~ n/a ~ Lancaster ~ United Kingdom ^[3]Teagasc ~ ... ~ Johnstown ~ Ireland ^[4]Cranfield University ~ ... ~ Cranfield ~ United Kingdom ^[5]University of Western Sydney ~ Hawkesbury Institute for the Environment ~ Richmond ~ Australia

The global soil resource is essential to the future survival of humankind and other life on the earth. It is all the more remarkable therefore that we are largely ignorant of what constitutes a healthy soil that is able to sustain the delivery of diverse ecosystem services. We must improve our limited knowledge regarding the biogeography of soil organisms which support such services to develop viable approaches that tackle the global issue of soil degradation. Using data obtained from a unique study of habitats across the UK mainland, we demonstrate, for the first time, that the integration of genotypic, phenotypic and functional measures of soil microbes and invertebrates results in characteristic configurations of soil biodiversity with respect to habitat, irrespective of geographical location. Furthermore, we identified consistent trajectories in these characteristics in a succession from extensive to intensive land use. The results provide clear evidence that multi-taxa approaches that have been globally adopted to define the status of water bodies and terrestrial habitats could be applied to soils to provide a consistent and universal system for characterizing the ecological status of soils. In developing this concept further, we propose that a multivariate approach, which incorporates functional, genotypic and phenotypic traits of soil biodiversity, could be effective in safe-guarding both the organisms and ecosystem processes which underpin soil health and ecosystem services.



S11.02a -5

TILLAGE-INDUCED CHANGES IN THE FUNCTIONAL DIVERSITY OF SOIL BIOTA

Van Capelle Christine*^[1], Schrader Stefan^[1], Brunotte Joachim^[2]

^[1]Johann Heinrich von Thünen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries (vTI) ~ Institute of Biodiversity ~ Braunschweig ~ Germany ^[2]Johann Heinrich von Thünen-Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries (vTI) ~ Institute of Agricultural Technology and Biosystems Engineering ~ Braunschweig ~ Germany

Based on the general strategy to conserve biodiversity and the ecosystem services provided by organisms, there is a need to assess the functional and structural biodiversity in arable soils considering the impact of different tillage systems. Thus, a survey on scientific literature, which has been published during the past six decades, was conducted. We concentrated on data from agroecosystems in Germany as they cover a wide range of different soils, which are representative for temperate regions. The state of knowledge was analyzed covering the impact of conventional, conservation and no-tillage management on lumbricids, collembolans, mites, enchytraeids, nematodes and microbiota. Interaction effects between tillage intensity and parameters characterizing the respective system (e.g. soil texture and crop) were considered. Besides abundance and biomass of soil organisms, species richness and individual densities of taxonomical and functional units, enzyme activities and various quotients indicating microbial-driven soil processes were included in the analysis. The integrating analysis of data sets indicates that soil biota responds specifically to tillage systems. Whereas abundances and species diversity of lumbricids significantly increased, individual density and species diversity of collembolans significantly decreased when tillage intensity was reduced. Tillage-driven impacts on lumbricids and collembolans, thereby, differed depending on soil texture, whereas those on nematodes and microbial communities varied depending on soil depth. Functional groups within certain taxa evince differing tillage-induced impacts. Linking several data sets on various indicator organisms clearly shows that the decision, which tillage system should be applied, must be taken for each individual case, considering local soil characteristics.



S11.02a -6

A TRIAL WITH ECOSYSTEM SERVICES IN SOIL OF FOUR ARABLE FARMS

Rutgers Michiel^[1], Christian Mulder^[1], Leo Posthuma^[1], Anton J. Schouten^[1], Anton M. Breure^[1], Lijbert Brussaard^[2]

^[1]National Institute for Public Health and the Environment ~ Laboratory for Ecological Risk Assessment ~ Bilthoven ~ Netherlands ^[2]Wageningen University ~ Soil Quality ~ Wageningen ~ Netherlands

A focus on ecosystem services (ES) is key towards a more sustainable management of our natural resources, besides an environmental policy on mitigating the effects of threats like soil pollution and climate change. Many ES rely significantly on the functioning of soils. Consequently, there is an urgent need for rulers and indicators of soil related ES. In the Netherlands, two decades of soil sampling in a monitoring network with the Biological Indicator of Soil Quality (BiSQ) have resulted in a substantial database of soil organisms and their habitat characteristics. Extensive additions from ecological literature have expanded the data set to become a very rich source for both fundamental and practical applications. Abiotic and biotic reference values for soils with a presumed healthy status were derived for ten soil type land use combinations. These references were considered as targets for sustainable land management, for different soil type and land use characteristics. The concept was tested at four arable farms on silt loam in the Netherlands. Overall, ten ES had a lower performance than at the reference sites. However two ES had a higher performance than the reference, i.e. climate functions and natural attenuation. Furthermore, ES were reflected in the typical soil management systems of these four farms, i.e. intensive, conventional (2x) and organic.



S11.02b - SOIL BIODIVERSITY AND ECOSYSTEM SERVICES

Chair Person:

Rachel Creamer, Teagasc - Ireland

Wednesday 04 July 2012 from 13:30 to 15:00. Room Acero

S11.02b -1

SOIL BIOINDICATORS FOR SOIL MONITORING, RISK ASSESSMENT AND SOIL CHARACTERIZATION. RESULTS FROM THE FRENCH NATIONAL "BIOINDICATORS PROGRAMME."

Guénola Pérès, Paimpont - France

S11.02b -2

RESULTS OF A COUNTRY-SCALE SURVEY ON THE EFFECTS OF AGRICULTURAL PRACTICES ON SOIL MESOFAUNA IN HUNGARY

Miklós Dombos, Budapest - Hungary

S11.02b -3

SELECTION OF INDICATORS OF SOIL BIODIVERSITY FOR A EUROPEAN MONITORING SCHEME

Bryan Griffiths, Wexford - Ireland

S11.02b -4

NEMATODES AS INDICATORS OF SOIL HEALTH AND AGRICULTURAL SUSTAINABILITY: POSSIBILITIES OF THE METHOD WHEN APPLIED AT BOTH A NATIONAL AND EUROPEAN LEVEL.

Dote Stone, Wexford - Ireland

S11.02b -5

METAPROTEOMICS OF LEAF LITTER DECOMPOSITION

Sophie Zechmeister-Boltenstern, Vienna - Austria

S11.02b -6

DENITRIFYING BACTERIAL COMMUNITY STRUCTURE AND DENITRIFICATION POTENTIAL AS AFFECTED BY SOIL PROPERTIES IN WETLANDS CREATED IN CHESAPEAKE PIEDMONT, USA

Changwoo Ahn, Fairfax, Virginia - United States

S11.02b -1

SOIL BIOINDICATORS FOR SOIL MONITORING, RISK ASSESSMENT AND SOIL CHARACTERIZATION. RESULTS FROM THE FRENCH NATIONAL "BIOINDICATORS PROGRAMME."

Pérès Guénola^{*[1]}, Antonio Bispo^[2], Cécile Grand^[2], Isabelle Gattin^[3], Mickaël Hedde^[4], Jennifer Harris-Hellal^[5], Marina Leguedard^[6], Nuria Ruiz-Camacho^[7], Aude Alaphilippe^[8], Thierry Beguiristain^[9], Francis Douay^[10], Olivier Faure^[11], Adnane Hitmi^[12], Sabine Houot^[13], Marc Legras^[3], Muriel Guernion^[1], Jean-François Vian^[14], Sébastien Conil^[15], Laurence Rougé^[1], Patrice Lepelletier^[16], Salima Taibi^[16], Jeanne-Chantal Dur^[4], Daniel Cluzeau^[1]

^[1]University Rennes 1 ~ UMR CNRS "Ecobio" 6553, Station Biologique ~ Paimpont ~ France ^[2]ADEME ~ French Environment and Energy Management Agency ~ Angers ~ France ^[3]ESITPA ~ BioSol ~ Mont Saint Aignan ~ France ^[4]INRA ~ PESSAC - UR 251 ~ Versailles-Grignon ~ France ^[5]BRGM ~ SEPI ~ Orléans ~ France ^[6]Université Victor Segalen Bordeaux ~ Laboratoire de Biogenese Membranaire ~ Bordeaux ~ France ^[7]IRD ~ UMR 211 BIOEMCO ~ Bondy ~ France ^[8]INRA Avignon ~ UERIO695 Gotheron domaine de Gotheron ~ St Marcel Les Valence ~ France ^[9]CNRS Nancy ~ LIMOS, UMR 7137 ~ Vandoeuvre-les-Nancy ~ France ^[10]Groupe ISA ~ Equipe Sols et Environnement, ~ Lille ~ France ^[11]ENS des Mines de St-Etienne ~ SPIN ~ Saint-Etienne ~ France ^[12]IUT de Clermont-Ferrand ~ Laboratoire de Physiologie et Biotechnologies Végétale ~ Aurillac ~ France ^[13]INRA Versailles-Grignon ~ UMR AgroParisTEch EGC ~ Thiverval-Grignon ~ France ^[14]ISARA-Lyon ~ UPSP "SCAB" ~ Lyon ~ France ^[15]ANDRA ~ Observatoire Pérenne de l'Environnement ~ BURE ~ France ^[16]ISTPA ~ Lamsad ~ Mont St Aignan Cedex ~ France

Considering the few numbers of bioindicators available to describe and monitor soil quality and to assess soil risk, a national research programme has been set up in France to develop such indicators. The main objectives of this "BioIndicator programme" are to (i) develop methods for measuring soil biodiversity and soil functions (ii) use soil bioindicators to monitor soil quality and (iii) identify relevant bioindicators or endpoints for soil ecological assessment. In this programme involving 70 partners, 47 biological parameters have been tested i.e. microorganisms (e.g. biomass, genetical structure, enzymatic activities), fauna (nematodes, collembola, mites, earthworms, total macrofauna, metal accumulation in snails and in small mammals) and flora (e.g. lipid biomarkers in the leaves, free amino acid content, metal accumulation). These parameters were assessed on 13 sites leading in 47 plots which differ in terms of land use and agricultural practices (e.g. pasture rotation, tillage impact, management), soil type and contamination levels and origins (PAH or metal). The strengths of Bioindicator programme, which is unique at European Union scale, are (i) to test a large number of bioindicators, in a large panel of situations, (ii) to apply standardised sampling protocols managed by only one sampling team, (iii) to manage high number of data (200.000) by using a common database thus facilitates the data analysis, (iv) to collaborate with stakerholders (Ministry, environmental agency, Regional Board for Industry, Research and Environment, farmers, agricultural agency,...). This presentation will present in details the Bioindicator programme (bioindicators, sampling procedures, database, data-mining involved) illustrated by some results.



S11.02b -2

RESULTS OF A COUNTRY-SCALE SURVEY ON THE EFFECTS OF AGRICULTURAL PRACTICES ON SOIL MESOFAUNA IN HUNGARY

Dombos Miklós^{*[1]}, Gedeon Csongor^[1], Bánszegi Oxana^[1], Szabó József^[1]

^[1]RISSAC HAS ~ Dept. of Environmental Informatics ~ Budapest ~ Hungary

Although certain elements of agricultural practices have been known as main factors of biological soil degradation for decades, data that could show degree of these degradation processes are still limited and insufficient to estimate current ecological status of soils in agricultural landscapes. We will show the results of our country-scale survey (Soil Degradation Subsystem of the National Environmental Information System; details are in Szabó and co-workers' poster) on the effects of agricultural practices on soil biological activity in Hungary. 200 evenly distributed farms from Hungary were randomly selected from the database of the Hungarian Central Statistical Office, according to their agricultural techniques. We recorded all farming activities from tillage to harvest in each farm. Composite soil sampling was carried out in each sampling site in spring 2011. More than one hundred soil physical, chemical and biological properties were measured, which are considered relevant to all soil threats. Regarding the biological properties, abundance, biomass distribution, diversity indices of the mesofauna, and microbial activity were characterized at 200 farms. Traditional soil extraction method and taxonomic analysis for description of the soil microarthropod communities and live extraction followed by image analysis using EDAPHOLOG®/Coll-Scope® systems (see. poster of Gedeon et al.) run parallel for further comparison. In our presentation we will show how the different farming practices - including different agro-environmental schemes, farming practices used in organic and conventional farming systems and the resulting physical and chemical soil degradation (e.g. soil compaction) - influenced the ecological status of arable soils in Hungary.



S11.02b -3

SELECTION OF INDICATORS OF SOIL BIODIVERSITY FOR A EUROPEAN MONITORING SCHEME

Griffiths Bryan*^[1], Creamer Rachel^[1], Stone Dorothy^[1], Rutgers Michiel^[6], Mulder Christian^[6], Sousa Paulo^[3], Römbke Jörg^[7], Gardi Ciro^[5]

^[1]Teagasc ~ Environment Research Centre ~ Wexford ~ Ireland ^[2]RIVM ~ RIVM ~ Bilthoven ~ Netherlands ^[3]IMAR ~ Universidade de Coimbra ~ Coimbra ~ Portugal ^[4]ECT Ökotoxikologie GMBH ~ ECT Ökotoxikologie GMBH ~ Flörsheim a. M ~ Germany ^[5]Joint Research Centre ~ Joint Research Centre ~ Ispra ~ Italy ^[6]National Institute for Public Health and the Environment ~ RIVM ~ Bilthoven ~ Netherlands ^[7]ECT Ökotoxikologie GMBH ~ ECT ~ Flörsheim a. M. ~ Germany

In the EU, FP7, Project 'EcoFINDERS' (Ecological function and biodiversity indicators in European soils), not only is the normal operating range for the biodiversity of soil organisms across Europe to be determined, but indicators for biodiversity are to be recommended and tested. This will include some of the most recent molecular biological methods (e.g. pyrosequencing, chip technologies) as well as the well tested conventional methods. Indicators for biodiversity were selected at a workshop in Coimbra, Portugal in November 2011 based on a logical sieve approach (Ritz et al 2009). The first section of this presentation will explore in detail the rationale, the process and the results of the indicator selection. The next step is then to deploy the chosen indicators across a range of European soil/land use/habitat scenarios given a project constraint of less than 100 sampling points. The second section of the presentation will describe the GIS/soils database approach to selecting a representative range of sites and outline the sampling regime to be undertaken. (Ritz K et. al., 2009. Ecological Indicators 6:1212)



S11.02b -4

NEMATODES AS INDICATORS OF SOIL HEALTH AND AGRICULTURAL SUSTAINABILITY: POSSIBILITIES OF THE METHOD WHEN APPLIED AT BOTH A NATIONAL AND EUROPEAN LEVEL.

Stone Dote^{*[1]}, Griffiths Bryan^[1], Creamer Rachel^[1], Sousa José P^[2], Da Conceição I. Luci P. M.^[2]

^[1]Teagasc ~ Crops Environment And Land Use Programme ~ Wexford ~ Ireland ^[2]Universidade de Coimbra ~ Dep. Ciências da Vida ~ Coimbra ~ Portugal

Soil health is an important parameter when estimating the value of a soil resource, especially with regard to agricultural productivity. Soil hosts biodiversity on a range of scales which contribute to the pool of ecological functions and services that can be provided. The FP7 project EcoFINDERS set out to explore and clarify the contribution of soil biodiversity to soil health in light of the many threats to the soil resource pool in our current culture. Soil nematode assemblages have been used as indicators of soil function due to their abundance and diverse contribution within agroecosystems (Yeates, 2003). Within the EcoFINDERS project, it was proposed that an assessment of bio-indicators as tools for determining soil health across European biomes should be carried out. Soil samples from sites across Europe were analysed for nematode abundance. Molecular methods were applied to determine species diversity. Nematode community responses were analysed to assess sensitivity to a range of different disturbances (nutrient additions, tillage, grazing). In addition, as part of the on-going national project to map soils in Ireland, nematode abundance and diversity were assessed. By comparing data ranging from land use to a detailed national scale to the European scale we will present an assessment of the potential of nematodes as indicators of biodiversity, including the practicability of methods (field sampling, extraction and molecular techniques). Yeates, G.W. (2003) Nematodes as soil indicators: functional and biodiversity aspects, *Biology and Fertility of Soils* 37:199–210



S11.02b -5

METAPROTEOMICS OF LEAF LITTER DECOMPOSITION

Zechmeister-Boltenstern Sophie*^[1], Keiblinger Katharina Maria^[1], Schneider Thomas^[2], Riedel Kathrin^[3]

^[1]BOKU – University of Natural Resources and Life Sciences ~ Department of Forest and Soil Sciences ~ Vienna ~ Austria ^[2]University of Zurich ~ Institute of Plant Biology ~ Zurich ~ Switzerland ^[3]University Greifswald ~ Institute of Microbiology ~ Greifswald ~ Germany

Since almost a decade, metaproteomics is greatly advancing our understanding of microorganisms and their geochemical environment. Most proteins have an intrinsic metabolic function and can thus be used to relate specific microbial activities to defined organisms in multispecies communities. Therefore, the identification of the microbial proteins of a given habitat together with the analysis of their phylogenetic origin and their temporal distribution is expected to provide fundamentally new insights into the role of microbial diversity in biogeochemical processes. We have tested the applicability of the metaproteomic approach in combination with PLFA and enzyme measurements in field and lab studies on beech leaf litter decomposition. Goals of our investigations were: (I) to link structure and function of microbial communities involved in leaf litter decomposition and (II) to investigate the impact of leaf litter stoichiometry and seasonality on the decomposition process. In a mesocosm experiment we also tested the effect of extreme temperatures on litter degradation and the involved microbial community. Our results revealed that resource stoichiometry, i.e. site, had a strong influence on microbial community structure whereas season and temperature extremes most prominently affected community functions. It was possible to at least qualitatively link microbial community structure using metaproteomics to the decomposition process. In addition we were able to link the contribution of major phylogenetic groups to decomposer function. We will also present findings on the application of the method to soil samples and the pros and cons of different protein extraction procedures.



S11.02b -6

DENITRIFYING BACTERIAL COMMUNITY STRUCTURE AND DENITRIFICATION POTENTIAL AS AFFECTED BY SOIL PROPERTIES IN WETLANDS CREATED IN CHESAPEAKE PIEDMONT, USA

Ahn Changwoo*^[1]

^[1]George Mason University ~ Environmental Science and Policy ~ Fairfax, Virginia ~ United States

Wetland creation is a common practice for compensatory mitigation. Unfortunately, created wetlands often fail to support biotic communities comparable to those in similar, naturally occurring wetlands. Soil parameters in created wetlands are often found not indicative of 'hydric soils' typical of natural wetlands, that support important biogeochemical functions. Denitrification is one of the key biogeochemical functions of natural wetlands and denitrifying bacteria play a significant role in it due to their ability to convert nitrate to gaseous N₂, but little has been known about the role of bacterial community composition in the process. Moreover, there are currently no specific methods and/or designs that would enhance the development of the biogeochemical function in created wetlands. The objective of this study is to investigate the influence of soil properties on denitrification potential (DP), and denitrifying bacterial community structure and diversity in created wetlands. The study was conducted in three mitigation wetlands with varying ages, all created in the Piedmont region of Virginia. A preliminary data analysis has revealed that there were significant differences in gene copy numbers of denitrifying bacterial communities between the wetland sites. T-RFLP fingerprints were related to gene copy numbers obtained by qPCR, and to DEA values overall. Further data analysis is underway. The outcome of the study will provide useful information on how soil properties influence denitrifying bacterial community composition in relation to denitrification function of created wetlands



S11.02c - SOIL BIODIVERSITY AND ECOSYSTEM SERVICES

Chair Person:

Giacomo Pietramellara, Firenze - Italy

Wednesday 04 July 2012 from 15:30 to 17:00. Room Acero

S11.02c -1

BACTERIAL DIVERSITY ASSESSMENT OF HIGHLY COMPLEX SOIL ENVIRONMENTS USING MULTI-MILLION READ GENERATING SEQUENCING TECHNOLOGIES

Sotirios Vasileiadis, Piacenza - Italy

S11.02c -2

EFFECTS OF LAND USE INTENSITY ON EUROPEAN SOIL BACTERIAL, FUNGAL AND ARCHAEAL COMMUNITIES

Bruce Thomson, Wallingford - United Kingdom

S11.02c -3

THE ROLE OF THAUMARCHAEA FOR AMMONIA OXIDATION IN SOIL

Michael Schlöter, Oberschleissheim - Germany

S11.02c -4

COMMUNITY COMPOSITION OF AMMONIA OXIDIZING ARCHAEA AND BACTERIA AS A TOOL FOR EVALUATION OF QUALITY OF AGRICULTURAL SOILS

Jiri Cuhel, Brno - Czech Republic

S11.02c -5

EROSION OF BIODIVERSITY AFFECTS THE STABILITY OF SOIL MICROBIAL COMMUNITIES

Vincent Tardy, Dijon - France

S11.02c -6

EVALUATION OF SOIL QUALITY INDICATORS IN THREE DIFFERENT COLOMBIAN TROPICAL LAND MANAGEMENT AND USES

Maria Mercedes Martínez Salgado, Santiago - Chile



S11.02c -1

BACTERIAL DIVERSITY ASSESSMENT OF HIGHLY COMPLEX SOIL ENVIRONMENTS USING MULTI-MILLION READ GENERATING SEQUENCING TECHNOLOGIES

Vasileiadis Sotirios*^[1], Puglisi Edoardo^[2], Arena Maria^[1], Cappa Fabrizio^[2], Cocconcelli Pier S.^[2], Trevisan Marco^[1]

^[1]Università Cattolica del Sacro Cuore, Faculty of Agricultural Sciences ~ Institute of Agricultural and Environmental Chemistry ~ Piacenza ~ Italy ^[2]Università Cattolica del Sacro Cuore, Faculty of Agricultural Sciences ~ Institute of Microbiology ~ Piacenza ~ Italy

Soil biogeochemistry domination by Bacteria has driven towards intensive studying of their diversity in such environments. Although the breakthrough of the small ribosomal subunit (SSU) coding gene usage as a molecular marker increased throughput in bacterial diversity studies, it was soon indicated that complex soil environment requirements superseded potentials of past sequence based SSU screening methodologies. Recent high throughput sequencing technologies provided a solution in regards with read numbers but have restrictions concerning analyzed sequence lengths. Aim of the present study was to assess the information potentials according to the multi-million read depths and the SSU single hypervariable (V) region screening limitations provided by novel sequencing technologies for soil environments. V region analysis included database exploration and in silico analysis of literature based generated data. Moreover, samples screened with the referred strategy and were derived from soils that differed in properties due to land use and management, comprised a “real-world” reference for the method application evaluation. Database and in silico analysis indicated that the overall most prominent V region for soil bacterial diversity studies was V3. Soil derived data analysis provided detailed core microbial assemblage (microbiome) comparisons between Illumina screened soils, showing management correlated differences. Resolution abilities also made possible to examine diversity drivers and ecology theory application potentials in the highly complex soil environments used in the present study. Results of this study summarize the reasons according which technologies providing multi-million read sequencing depths are expected to dominate bacterial diversity screening studies during oncoming years.



S11.02c -2

**EFFECTS OF LAND USE INTENSITY ON EUROPEAN SOIL BACTERIAL, FUNGAL AND
ARCHAEAL COMMUNITIES**

Thomson Bruce^{*[1]}, Bailey Mark^[1], Plassart Pierre^[2], Lemanceau Philippe^[2], Ranjard Lionel^[2], Griffiths Rob^[1]

^[1]Centre for Ecology & Hydrology ~ Molecular Microbial Ecology ~ Wallingford ~ United Kingdom ^[2]French National Institute for Agricultural Research (INRA) ~ UMR Microbiologie du Sol et de l'Environnement ~ Dijon ~ France

Whilst the importance of soils and their contribution to ecosystem services provision are well recognised, there is a paucity of knowledge on how particular land-use practices affect different types of soil organisms, and subsequently whether this affects soil functioning. The seventh framework programme EcoFINDERS project (Ecological Function and Biodiversity Indicators in European Soils) aims to “Decipher the links between soil biodiversity, activities, functioning and ecosystem services”. Through this project we have examined soil microbes at a number of European locations ranging from Iberian grassland to boreal forest. At each field site a gradient of land-use intensification has been established permitting investigation of the effects of different land management strategies on microbial communities across a range of climatic zones and soil types. This work focuses on how the diversity and community structure of the different microbial groups are affected at local and regional scales, and the environmental parameters responsible for the perceived differences. We specifically targeted bacteria, archaea and fungi as indicators, and present molecular data showing differential effects in response to anthropogenic and natural environmental gradients. Our results highlight the effect of land-use change on soil microbial communities across Europe and adds to the understanding of how belowground organisms are affected by above ground practices.



S11.02c -3

THE ROLE OF THAUMARCHAEA FOR AMMONIA OXIDATION IN SOIL

Schlöter Michael*^[1]

^[1]Helmholtz Zentrum München ~ Environmental Genomics ~ Oberschleissheim ~ Germany

In the last decade more and more data has been published on the abundance of selected phylogenetic groups of prokaryotes in nature, without having isolates in hand. This holds mainly true for Archaea, which are often very difficult to cultivate using classical approaches. Therefore their physiology and their role for soil health are still not clear and factors driving their activity are still identified more on correlations than on mechanistic based approaches. For example many results have been presented on ammonia oxidizing crenarchaea in different soils under contrasting environmental conditions based on abundance measurements of the amoA gene, however the role of these organisms for nitrification is still unclear and even basic knowledge on autotrophic vs. heterotrophic lifestyle is controversy discussed in literature. In the presentation data based on amplicon sequencing and analysis of metagenomic libraries will be presented to identify drivers for abundance and activity of ammonia oxidizing archaea



S11.02c -4

COMMUNITY COMPOSITION OF AMMONIA OXIDIZING ARCHAEA AND BACTERIA AS A TOOL FOR EVALUATION OF QUALITY OF AGRICULTURAL SOILS

Cuhel Jiri^[1], Maly Stanislav^[1]

^[1]Central Institute for Supervising and Testing in Agriculture ~ Microbiology and Biochemistry ~ Brno ~ Czech Republic

Genetic profiling of ammonia oxidizing bacteria (AOB) and archaea (AOA) using t-RFLP was top-ranked as bioindicator for monitoring of agricultural soils. However, there is a lack of background data of t-RFLP profiles of AO communities among wide range different soils, which is a prerequisite for routine linkage between t-RFLP profiles and soil quality. The aims of the present study were to obtain basic pattern of t-RFLP profiles of AO communities from wide range of agricultural soils at a national scale, and to determine which environmental factors are key drivers of the AO community composition. A set of 77 arable and grassland soils from the Czech Republic was sampled and t-RFLP analysis of the *amoA* gene was conducted. The PCR products were digested with *AluI* and *Bsp143I* restriction enzymes. pH, clay content and urease activity explained 17.4% of the variability of the t-RFLP data of AOA. The relationships among environmental parameters and AO diversity were tighter for AOB, with 42.7% of the variability in the t-RFLP patterns explained by pH, sand content and short-term nitrification activity (SNA). Multiple regression among the soil properties, and individual fragments was calculated. The most significant relationships were found among the AOA-*Bsp143I* – 443 bp fragment and pH, clay content and urease activity ($R^2=0.418$) and among the AOB-*AluI* – 488 bp fragment and pH and SNA ($R^2=0.625$). The Shannon diversity index showed a positive and curvilinear correlation with pH for AOA (*Bsp143I*, $R^2=0.191$) and AOB (*AluI*, $R^2=0.328$), resp.



S11.02c -5

EROSION OF BIODIVERSITY AFFECTS THE STABILITY OF SOIL MICROBIAL COMMUNITIES

Tardy Vincent^[1], Maron Pierre Alain^[1], Ranjard Lionel^[1], Leveque Jean^[2], Mathieu Olivier^[2], Lemanceau Philippe^[1]

^[1]INRA/Université de Bourgogne ~ Microbiologie du sol et de l'environnement ~ Dijon ~ France ^[2]Université de Bourgogne ~ UMR Biogésociété ~ Dijon ~ France

Anthropogenic activities have led to a significant modification/reduction of biodiversity. By observing this erosion, the understanding of the relationship between biodiversity and ecosystem functioning has emerged as a central issue in ecological and environmental sciences during the last decade. This relationship between diversity-stability-function has been extensively studied by plant ecologists, but remains largely unexplored for soil microorganisms. In this context, we studied the impact of an erosion of biodiversity on the stability of soil microbial communities (i.e. resistance and resilience) in response to two perturbations: a residual metallic stress (mercury input at 20 ppm) and a transient heat stress (50 °C for 24 hours). Microbial diversity erosion was obtained by inoculating sterile soil microcosms with different dilutions of a grassland soil suspension. The response of microbial communities (bacteria and fungi) was evaluated by following the density and the diversity, but also the kinetics of soil carbon mineralization. Our results show that the erosion of diversity affects significantly the resistance and resilience of microbial communities in terms of community dynamics (diversity and density) and functioning whatever the stress. More precisely, the kinetics of soil carbon mineralization is similar between the different levels of diversity, but the intensity of mineralization decreases with the decrease of diversity. When diversity is lower, the heat stress affects more strongly the mineralization than the metallic stress. This study highlights the ecological importance of soil microbial diversity in the ability of a soil to maintain the supply of ecosystem services in fluctuating environmental conditions.



S11.02c -6

EVALUATION OF SOIL QUALITY INDICATORS IN THREE DIFFERENT COLOMBIAN TROPICAL LAND MANAGEMENT AND USES

Gutiérrez Romero Viviana^[1], Martínez Salgado Maria Mercedes^{*[2]}

^[1]Pontificia Universidad Javeriana ~ Microbiología ~ Bogotá ~ Colombia ^[2]Universidad Técnica Federico Santa María ~ Departamento de Industrias ~ Santiago ~ Chile

In Colombia, changes in land use and inappropriate management practices are very common for intensive and extensive crops. Traditionally, physical and chemical parameters are measured to indicate about soil quality regardless a correlation with biological parameters. In the present study, we determined different biological indicators (heterotrophic microbial counts, functional microbial groups and enzyme activity) and its relationship with physical and chemical parameters at three different land uses (forest, pasture and sugar cane crop). Soil samples were taken at 10-cm during a year with 10 sampling events, using a systematic nonaligned design with a GPS receiver. Soil enzyme activities were the most sensitive indicators compared with physical and chemical soil properties, especially β -glucosidase activity that shows a relationship with dehydrogenase activity (77%), pH (70%), clay content (51%), cellulolytic counts (52%) and urease activity (50%). In addition, it was evident a high spatial variability for enzymatic activities related with soil management and use; ecosystems which have been intervened (pasture and sugar cane crop) need a high samples collected to reduce the coefficient of variation. Parameters as phosphorous solubilizing bacteria did not shown any correlation with other indicators evaluated ($p>0.05$), and it is not clear the use of dehydrogenase enzyme as soil quality indicator according to our results.



S11.03a - ECOSYSTEM SERVICES AND FUNCTIONS DRIVEN BY THE DIVERSITY OF SOIL BIOTA

Chair Person:

Guenola Peres, Rennes - France

Friday 06 July 2012 from 13:30 to 15:00. Room Acero

S11.03a -1

THE CHALLENGES OF ANALYZING SOIL ORGANISMS-DRIVEN ECOSYSTEM SERVICES - AVAILABLE TOOLS

Juan José Jiménez, Jaca - Spain

S11.03a -2

CILIATES AS BIOINDICATORS OF SOIL QUALITY: FROM BIOMARKER TO COMMUNITY STRUCTURE ANALYSIS

Antonietta La Terza, Camerino - Italy

S11.03a -3

THE IMPORTANCE OF THE SOIL MICROBIAL COMMUNITY IN REGULATING PATHOGEN DECAY

Emma Moynihan, Wexford - Ireland

S11.03a -4

MYCOTOXIN DEGRADATION BY NEMATODES AND COLLEMBOLANS IN WHEAT STRAW DEPENDING ON SOIL TEXTURE

Stefan Schrader, Braunschweig - Germany

S11.03a -5

QUANTIFYING THE CONTRIBUTION OF FREE-LIVING NEMATODES TO NITROGEN MINERALIZATION IN MINIMALLY DISTURBED SOILS

Mesfin Tsegaye Gebremikael, Gent - Belgium

S11.03a -6

ROLE OF CROP RESIDUE MULCHES AND THEIR DECOMPOSITION ON SOIL FUNCTIONS IN CONSERVATION AGRICULTURE

Akhtar Iqbal, Reims - France



S11.03a -1

THE CHALLENGES OF ANALYZING SOIL ORGANISMS-DRIVEN ECOSYSTEM SERVICES - AVAILABLE TOOLS

Jiménez Juan José^[1], Decaëns Thibaud^[2], Lavelle Patrick^[3]

^[1]IPE-CSIC ~ Biodiversity Conservation and Ecosystem Restoration ~ Jaca ~ Spain ^[2]Université de Rouen ~ Laboratoire d'Ecologie ~ Rouen ~ France ^[3]CIAT ~ Soils Unit ~ Cali ~ Colombia

Soils provide a range of unique ecosystem services such as decomposition, nutrient cycling, carbon sequestration, detoxification and maintenance of soil physico-chemical properties. These services directly or indirectly support many aboveground provisioning and enriching services. A set of proper concepts and ecological theories related to soil biodiversity and its function have been proposed to explain the large variability of soil organisms assembled in complex and diversified communities. Soil organisms act at small scales, whereas their effects may range from local (diseased plants, nutrient mineralization) to very large scales (succession, carbon sequestration, greenhouse gases). For example, most of the macro-aggregate structure of soils is formed by the activities of soil invertebrates and roots, with important consequences for carbon sequestration and water infiltration at several spatial and temporal scales. The diversity of soil organisms may matter more when only few species perform a specific function than for processes that are accounted for by many species. Human activities alter the composition of soil faunal communities, but consequences for ecosystem functioning are poorly understood. Empirical evidence on effects of species diversity on ecosystem processes does not allow generalizations, and requires more studies. The influence of soil spatial variability in shaping species assemblages of soil animal communities is also poorly understood and adds uncertainties to the analysis of ecosystem services derived by soil biological functions. Efforts are required by establishing networks of excellence between researchers among European institutions and to develop a paneuropean program on soil biodiversity and ecosystem service analysis.



S11.03a -2

CILIATES AS BIOINDICATORS OF SOIL QUALITY: FROM BIOMARKER TO COMMUNITY STRUCTURE ANALYSIS

La Terza Antonietta^{*[1]}, Kumar Santosh^[1], Bharti Daizy^[1], Marinsalti Silvia^[1], Insom Emilio^[1]

^[1]University of Camerino ~ School of Environmental Sciences ~ Camerino ~ Italy

In recent years the potential of protozoan ciliates, as valuable bioindicators of ecosystem quality has been highlighted by a large number of authors. These eukaryotic, single-celled organisms are essential component of freshwater, marine and terrestrial ecosystems. Moreover free-living ciliates, due to their amazing molecular, cellular and physiological flexibility, have been able to colonise every type of environment up to now surveyed, from deep oceans, to polar regions and every soil types. Ciliates shown many desirable characteristics as test organisms for the design of convenient and cost effective assays, from the biomarker to the population-community level, to be used for environmental assessment. Firstly, ciliates occupy the first trophic levels and consequently represent ideal early warning indicators of ecosystem deterioration. Secondly, they play key roles in the transfer of matter and energy within the microbial loop. Moreover, numerous ciliate species can be easily cultured with a short generation time and for some species (i.e. Tetrahymena, Paramecium) genomic data and various molecular tools are available. Thus, this communication aim to describe the potential of ciliates as bioindicators of soil quality and to highlight their usefulness for the development of “prognostic” assays (i.e. able to detect sub-lethal toxicant effects of soil eluates), based on the exploitation of stress gene activation responses (biomarkers and biosensors), as well as, of “diagnostic” assays (i.e. able to detect overall ecosystem impairment), based on the analysis of the community structures of ciliates in arable soils to evaluate the potential impact of different agricultural management.



S11.03a -3

THE IMPORTANCE OF THE SOIL MICROBIAL COMMUNITY IN REGULATING PATHOGEN DECAY

Moynihan Emma*^[1], Ritz Karl^[2], Tyrrel Sean^[2], Richards Karl^[1], Brennan Fiona^[1]

^[1]Teagasc ~ Crops, Environment and Land Use Research Centre ~ Wexford ~ Ireland ^[2]Cranfield University ~ Department of Environmental Science and Technology ~ Bedfordshire ~ United Kingdom

Land use can greatly influence the soil physicochemical environment. Consequently, different aspects of land use will direct the structure of the microbial community. These include the predominant management strategy, organic and mineral amendments, cropping and tillage practices. An important function of soil is the suppression of microbial pathogens introduced through land-spreading of animal manures. An experiment was conducted to determine the impact of microbial community structure associated with different land uses on pathogen survival. The phenotypic structure of the soil microbial community was determined by phospholipid fatty acid (PLFA) profiling. Soils were also characterized for a range of physico-chemical properties. These soils were inoculated with model pathogenic microorganisms, including Escherichia coli, Salmonella and Listeria species. Pathogen survival was measured over 110 days, and the death rate calculated for each case. Physico-chemical and biotic data, including principal components (PCs) derived from the PLFA profiles, were used in stepwise regression analysis to determine the predominant factor related to pathogen-specific death rates. PC scores were identified as the most significant factor in pathogen decay for all organisms tested ($p < 0.01$), with the exception of an environmentally persistent E. coli isolate. This demonstrates the importance of soil biological quality, specifically the configuration of the microbial community, in pathogen suppression, and provides a possible means to assess the inherent potential of soils to regulate pathogen survival. This may lead to the identification of management strategies which will ultimately accelerate pathogen decay, and therefore improve the safety of agricultural practice.



S11.03a -4

MYCOTOXIN DEGRADATION BY NEMATODES AND COLLEMBOLANS IN WHEAT STRAW DEPENDING ON SOIL TEXTURE

Wolfarth Friederike^[1], Schrader Stefan^{*[1]}, Oldenburg Elisabeth^[2]

^[1]Johann Heinrich von Thünen-Institute ~ Institute of Biodiversity ~ Braunschweig ~ Germany ^[2]Julius Kühn-Institute ~ Institute for Plant Protection in Field Crops and Grassland ~ Braunschweig ~ Germany

A microcosm-study ($n = 5$) under laboratory conditions was conducted to assess the interaction between soil fauna (*Aphelenchoides saprophilus*, Nematoda and *Folsomia candida*, Collembola) and the mycotoxin deoxynivalenol (DON) produced by *Fusarium* species. Our hypotheses were: (1) soil fauna is able to reduce the DON concentration in wheat straw, (2) the degradation efficiency of soil fauna is affected by different soil texture (sandy loam, silt loam, clay loam). Therefore, microcosms were filled with soil and ground wheat straw (artificially *Fusarium*-infected and DON-contaminated vs. non-infected straw). Soil fauna was introduced in different combinations: collembolans, nematodes, mixed and a control without animals. After 2 and 4 weeks, soil and straw was sampled for analyzing DON concentrations and soil fauna individuals were counted. After 2 weeks DON was reduced throughout all treatments, whereas the highest reduction was determined in the mixed treatment. After 4 weeks the degradation of DON was even higher and again the highest reduction was found in the mixed treatment. In contrast to the abundance pattern of *A. saprophilus*, *F. candida* showed an increase in the non-infected treatments after 2 and 4 weeks. The number of *A. saprophilus* increased mainly in the infected treatment. Differences in DON-concentration and abundances were found to depend on soil texture. We conclude that nematodes and collembolans are able to contribute to the degradation of the mycotoxin DON in wheat straw as an ecosystem service.



S11.03a -5

QUANTIFYING THE CONTRIBUTION OF FREE-LIVING NEMATODES TO NITROGEN MINERALIZATION IN MINIMALLY DISTURBED SOILS

Gebremikael Mesfin Tsegaye^[1], Buchan David^[1], De Neve Stefaan^[1]

^[1]Gent University ~ Soil Management ~ Gent ~ Belgium

*Free-living nematodes have been estimated to contribute 8-19% to total N mineralization in the soil. Despite abundance, diversity and complex interactions of these nematodes with soil biota, these estimations are based on theoretical food web calculations or on very simplified experiments including only selected few species and often in sterilized media. Data that include the interactions among different groups of nematodes, microbes and plants is rarely available. To address this issue we conducted an incubation experiment for 86 days with and without plants, by extracting and re-inoculating entire nematode populations into soil cores that had been defaunated using low-dose gamma irradiation which selectively kills fauna while minimally disturbing the microbial population. Three treatments were compared on soil either left bare or planted with *Lolium perenne*: control, defaunated and reinoculated (+Nem) and defaunated but not re-inoculated (-Nem). Dynamics in mineral nitrogen, microbial biomass, enzyme activities, phospholipids fatty acids (PLFA), Plant N uptake, nematode population and composition were determined after 7, 30, 45, 65, and 86 days of incubation. Nitrification and total mineral N concentration were found to be significantly higher in +Nem samples comparing to -Nem samples throughout the incubation period in bare microcosms. Significant effects on microbial biomass and enzymatic activities were also recorded. Based on these results it seems that inoculating the entire free-living nematode population increases nitrification and total mineral N concentration in bare microcosms. Data on PLFA, nematode composition and microbes-nematodes-plant interactions effects on N mineralization are currently being measured. The oral presentation includes all these findings.*



S11.03a -6

ROLE OF CROP RESIDUE MULCHES AND THEIR DECOMPOSITION ON SOIL FUNCTIONS IN CONSERVATION AGRICULTURE

Iqbal Akhtar^[1], Sohaib Aslam^[2], Francois Lafolie^[3], Pierre Benoit^[4], Stephane De Tourdonnet^[5], Patricia Garnier^[4], Eric Scopel^[6], Sylvie Recous^[1]

^[1]INRA ~ UMR FARE ~ Reims ~ France ^[2]INRA ~ UMR EGC ~ Grignon ~ France ^[3]INRA ~ UMR EMMAH ~ Avignon ~ France ^[4]INRA ~ UMR EGC ~ Grignon ~ France ^[5]Montpellier SupAgro ~ UMR Innovation ~ Montpellier ~ France ^[6]CIRAD ~ URP SCRID ~ Atananarivo ~ Madagascar

Core principle of Conservation Agriculture is to maintain soil cover by crop residue mulching or cover crops. Mulching practice affects many agroecosystem services, through water dynamics and C and N transformations (Coppens et al., 2007) and their impact on climate change, water and nutrient cycling and soil biological activity. The objectives of this work were (i) to quantify the effects of biotic (diversity of mulches and soil types) and abiotic (climatic conditions) factors on soil functions such as C stabilization, C and N mineralization and transport, GHG emission, microbial dynamics and diversity; (ii) to assess by modeling how these factors affect agroecosystem services in a range of agricultural conditions met in conservation agriculture of France, Brazil and Madagascar. An experiment was performed in controlled conditions with soil columns. The treatments varied either by the type of residue mulch (*Zea mais* + *Doliquos lablab* or *Triticum aestivum* + *Medicago sativa*), or by the type of soil (sandy or loamy soil) and by the water regime (manipulated through the intensity and frequency of rain applied to the soil columns). The *Pastis_Mulch* model (Findeling et al., 2007) tested on the measured data, was then used to simulate different scenarii, particularly different crop rotations and associations representative of the CA agrosystems (amount and quality of crop mulches), amount and distribution of rainfall (dry and wet years) and types of soil. The results allowed to rank the factors according to their positive and negative effects on the different ecosystem services involved.



S11.03b - ECOSYSTEM SERVICES AND FUNCTIONS DRIVEN BY THE DIVERSITY OF SOIL BIOTA

Chair Person:

Ciro Gardi, Ispra - Italy

Friday 06 July 2012 from 15:30 to 17:00. Room Acero

S11.03b -1

HOW DOES REDUCED TILLAGE INFLUENCE SOIL BIODIVERSITY, SOIL FUNCTIONS AND ECOSYSTEM SERVICES? THE EXAMPLE OF THE SUSTAIN PROJECT

Guénola Pérès, Paimpont - France

S11.03b -2

CHANGES IN SOIL MICROBIAL PROCESSES AND COMMUNITY STRUCTURE BY DIFFERENT LONG TERM TILLAGE SYSTEMS

Rajasekaran Murugan, Witzenhausen - Germany

S11.03b -3

DOES RIVER RESTORATION CHANGE EARTHWORM COMMUNITIES, HUMUS FORMS AND SOIL STRUCTURE IN ALLUVIAL ECOSYSTEMS?

Claire Le Bayon, Neuchâtel - Switzerland

S11.03b -4

BIOGENIC SOIL STRUCTURES: FEEDBACKS BETWEEN BIOACTIVITY AND SOIL HYDROLOGY

Loes Van Schaik, Potsdam - Germany

S11.03b -5

TRANSFORMATION AND DEGRADATION OF SOIL ORGANIC MATTER, MICROBIAL BIOMASS, POLYSACCHARIDES AND PROTEIN BY THE GEOPHAGOUS EARTHWORM METAPHIRE GUILLELMI

Jun Shan, Nanjing - China

S11.03b -6

IMPACT OF BIOCONTROL PLANTS ON BACTERIAL WILT AND NON-TARGETED SOIL MICROBIAL COMMUNITIES ON A NATURALLY INFESTED SOIL

Paula Fernandes, Lamentin - Martinique



S11.03b -1

HOW DOES REDUCED TILLAGE INFLUENCE SOIL BIODIVERSITY, SOIL FUNCTIONS AND ECOSYSTEM SERVICES? THE EXAMPLE OF THE SUSTAIN PROJECT

Pérès Guénola^{*[1]}, Daniel Cluzeau^[1], Michael Corson^[2], Lijbert Brussaard^[3], Steven Crittenden^[3], Ben Delbaere^[4], Vincent Hallaire^[2], Djilali Heddadj^[5], Gerard Korthals^[6], Safya Menasseri^[2], Thierry Morvan^[2], Martin Potthoff^[7], Stefan Schrader^[8], Myriam Pulleman^[3], Wijnand Sukkel^[6]

^[1]University Rennes 1 ~ UMR CNRS "Ecobio" 6553, Station Biologique ~ Paimpont ~ France ^[2]INRA ~ UMR SAS ~ Rennes ~ France ^[3]Wageningen University ~ Environmental Sciences ~ Wageningen ~ Netherlands ^[4]European Centre for Nature Conservation ~ ECNC ~ Tilburg ~ Netherlands ^[5]CRAB ~ Recherche appliquée - Pôle agronomie, ~ Vannes ~ France ^[6]PPO ~ Stichting Dienst Landbouwkundig Onderzoek ~ Lelystad ~ Netherlands ^[7]University of Göttingen ~ RCAE ~ Göttingen ~ Germany ^[8]VTI ~ Institute of Biodiversity ~ Braunschweig ~ Germany

In response to soil structural degradation and soil organic matter decline associated with arable crop production, alternative approaches including no tillage or reduced tillage systems have been developed. Farmers, researchers and policy makers in Europe are increasingly interested in exploring the possible benefits of these systems. Many studies worldwide have analysed the impact of tillage systems on soil functioning and crop yields; however, until now no study has aimed to give a comprehensive overview of these systems, including the impacts on soil biodiversity, chemical and physical soil properties, and ecosystem services, while integrating socio-economic sustainability. This information, as well as the selection and monitoring of soil indicators, is crucial to guide practical implementation and policies. The SUSTAIN project, performed in France and the Netherlands, proposes a novel transdisciplinary approach. The main objectives of SUSTAIN are (i) to understand how reduced-tillage systems impact the biodiversity of soil functional groups and soil functions (soil structure maintenance, organic matter and nutrient cycling, water regulation, soil filtering); (ii) to quantify the effects of reduced tillage systems on the ecosystem services (food production, greenhouse-gas mitigation); (iii) to investigate the socio-economic sustainability of reduced-tillage systems; and (iv) to develop and disseminate monitoring tools, such as soil-disturbance indicators and evaluation methods for system sustainability. SUSTAIN assembles a broad spectrum of expertise in soil biology, soil physics, soil chemistry and agronomy as well as tools for integrated soil ecosystem analysis. This expertise is combined with the economic and social evaluation of services provided by soil biodiversity.



S11.03b -2

**CHANGES IN SOIL MICROBIAL PROCESSES AND COMMUNITY STRUCTURE BY
DIFFERENT LONG TERM TILLAGE SYSTEMS**

Murugan Rajasekaran^{*[1]}, Joergensen Rainer Georg^[1], Koch Heinz-Josef^[3]

^[1]University of Kassel ~ Soil Biology and Plant Nutrition ~ Witzenhausen ~ Germany ^[2]Institute for Sugar Beet Research
~ Soil Biology and Plant Nutrition ~ Göttingen ~ Germany ^[3]Institute for Sugar Beet Research ~ - ~ Göttingen ~ Germany

The effects of different tillage systems on soil nutrients have been studied extensively. However, the linkage between different tillage intensities and microbial community structure and their relationship with ecosystem functions has not been directly investigated. In this study, we therefore investigated the long-term effects of mouldboard plough (30cm), cultivator (15cm) and no tillage on microbial activity (basal respiration), biomass (C, N and S) and microbial residues. A strong increase in the stocks of soil organic carbon, total N, P and S were found in the order cultivator > no tillage >> mouldboard plough in the soil profile (0-40cm). The mean stocks of microbial biomass C was 13 and 5% higher under cultivator treatment in comparison with mouldboard plough and no tillage, respectively. The cultivator treatment increased the mean stocks of microbial biomass N and fungal ergosterol significantly (31 and 21%, respectively) compared with no-tillage and mouldboard plough, but had no effect on the stocks of microbial biomass S. The microbial biomass C/soil organic carbon ratio was significantly higher (2.1) in the cultivator treatment and exhibited inverse relationship with the metabolic quotient. The highest ergosterol/microbial biomass C ratio (0.38%) and fungal C/bacterial C ratio (2.2) under the cultivator treatment indicate the abundance of saprotrophic fungi compared with mouldboard plough and no tillage. In summary, our results showed that the higher proportion of fungal biomass and residual C under cultivator system can provide stability in soil nutrients by increasing the role of saprotrophic fungi in soil organic matter dynamics.



S11.03b -3

DOES RIVER RESTORATION CHANGE EARTHWORM COMMUNITIES, HUMUS FORMS AND SOIL STRUCTURE IN ALLUVIAL ECOSYSTEMS?

Le Bayon Claire*^[1], Claire Guenat^[2], Coraline Sahin^[1], Nathalie Moreira^[1], Jean-Michel Gobat^[1], Géraldine Bullinger-Weber^[3]

^[1]University of Neuchâtel ~ Laboratory Soil & Vegetation ~ Neuchâtel ~ Switzerland ^[2]EPFL ~ ECOS laboratory, Station 2 ~ Lausanne ~ Switzerland ^[3]University of Lausanne ~ Biogeosciences Laboratory ~ Lausanne ~ Switzerland

Functioning as ecotons, floodplains usually provide shelter for many organisms. However, these ecosystems have been largely submitted to human pressure through the embanking of rivers. Such damages have led to river restoration projects in order to re-establish a near-natural alluvial dynamics and to recover floodplains biodiversity and naturalness. Focusing on soils, we aimed at using biological and pedological descriptors to assess the success of river restoration: i) earthworm communities, ii) humus forms and iii) soil structure and porosity. Two floodplains were compared: i) on one hand, the Emme River which presents an embanked (EE) and a restored site (ER), ii) on the other hand, the Rhine River, never embanked, which represents the near-natural reference (NR). Our main assumption was that earthworm communities, humus forms and soil parameters increase in terms of diversity, typicity and evolution along a gradient of naturalness from the embanked system to the near-natural reference. First results show that earthworm's communities tend to be quite similar in terms of abundance, species and ecological categories for ER and NR sites. Humus forms, most of them being psammofoms, seem to be better developed in the NR site compared to EE and ER sites. Soils structure and porosity appear to be greater developed after river restoration (ER) and tend to approach values of the near-natural reference. Further statistical analyses are however needed and will be performed to better highlight the effect of river restoration.



S11.03b -4

BIOGENIC SOIL STRUCTURES: FEEDBACKS BETWEEN BIOACTIVITY AND SOIL HYDROLOGY

Van Schaik Loes*^[1], Schröder Boris^[1], Zehe Erwin^[2], Eccard Jana^[3]

^[1]University of Potsdam ~ Institute of Earth and Environmental Science ~ Potsdam ~ Germany ^[2]Karlsruhe Institute of Technology ~ Institute of Water Resources and River Basin Management ~ Karlsruhe ~ Germany ^[3]University of Potsdam ~ Institut für Biochemie und Biologie ~ Potsdam ~ Germany

Bioactivity influences the hydrological processes through creation of biogenic soil structures, thereby changing infiltration and drainage patterns. At the same time, however, the species distribution also depends on soil moisture contents. Therefore including the feedbacks between bioactivity and soil hydrology is crucial for getting reliable predictions of catchment scale hydrological behavior under land use change and climate change. Different organisms are known to strongly influence soil structure through the creation of macroaggregates and macropores: most commonly earthworms, rodents, moles, and roots but also shrinkage in clay soils is an important abiotic origin of macropores. The spatial distribution of these soil organisms leads to both a variability in local soil structure and thus local infiltration patterns as well as varying degrees of connectivity of local macropore patterns at larger scales. Thus, local information on bioactivity - as the origin of macroporosity - may be used as an indicator for spatial variability of water storage and fluxes at the small scale, whereas knowledge on the spatial distribution and connectivity of the small scale macroporous networks is necessary to understand the influence of soil structure on the hydrology at larger scales. As a part of the CAOS (Catchments as Organised Systems) Project we will therefore link spatial distributions of main soil organisms to resulting spatial patterns of macropores, with the final aim to improve hydrological modeling of water storage and fluxes in the topsoil at different scales.

S11.03b -5

TRANSFORMATION AND DEGRADATION OF SOIL ORGANIC MATTER, MICROBIAL BIOMASS, POLYSACCHARIDES AND PROTEIN BY THE GEOPHAGOUS EARTHWORM *METAPHIRE GUILLELMI*

Shan Jun^{*[4]}, Ji Rong^[5]

^[1]Chinese Academy of Sciences ~ Institute of Soil Science ~ Nanjing ~ China ^[2]Nanjing University, ~ State Key Laboratory of Pollution Control and Resource Reuse, School of the Environment ~ Nanjing ~ China ^[3]State Key Laboratory of Soil and Sustainable Agriculture, Institute of Soil Science ~ Chinese Academy of Sciences ~ Nanjing ~ Christmas Island ^[4]State Key Laboratory of Soil and Sustainable Agriculture, Institute of Soil Science ~ Chinese Academy of Sciences ~ Nanjing ~ China ^[5]State Key Laboratory of Pollution Control and Resource Reuse, School of the Environment ~ Nanjing University ~ Xianlin Avenue 163, Nanjing ~ China

Soil organic matter (SOM) plays crucial role in relation to global carbon cycling, sustainable agricultural systems and the sequestration of micropollutants in soils. Earthworms are commonly the predominant soil fauna in most terrestrial ecosystem, and have significant effects on the SOM stability, soil microbial community and activity. However, the transformation of SOM by earthworms and the involved mechanisms are still obscure. In the present study, we prepared ¹⁴C-labeled SOM [either homogenously labeled or specifically labeled by ¹⁴C (in the aromatic or the proteinaceous component of humic substances)], ¹⁴C-labeled microbial biomass [fungi (*Penicillium chrysogenum*), bacteria (*Escherichia coli* and *Bacillus megaterium*)] and ¹⁴C-labeled cell components (protein, peptidoglycan and chitin), and investigate the degradation and transformation of these substrates in soil with the presence of the geophagous earthworm *Metaphire guillelmi*. Our results indicated that *M. guillelmi* can utilize the recalcitrant SOM (humic substances, HS) as their energy and nutrient sources owing to the selectively digestion of the proteinaceous components of HS. The results also showed that *M. guillelmi* not only significantly stimulated the mineralization of microbial biomass and its cell components, but also utilized them as nutrient and energy sources. Findings of this study provide the first direct evidences that earthworms could selectively digest the proteinaceous components of HS and utilize microbial biomass and its cell components as food sources, which underline the crucial role of the earthworms play on the decomposition and stabilization of SOM in soils.



S11.03b -6

IMPACT OF BIOCONTROL PLANTS ON BACTERIAL WILT AND NON-TARGETED SOIL MICROBIAL COMMUNITIES ON A NATURALLY INFESTED SOIL

Sire Diedhiou-Sall^[1], Fernandes Paula^{*[1]}, Peninna Deberdt^[1], Sonia Minatchi^[1], Regine Coranson-Beaudu^[1], Benjamin Perrin^[1], Eric Gozé^[2], Alain Ratnadass^[2], Richard P. Dick^[3]

^[1]CIRAD/PRAM ~ Persyst ~ Lamentin ~ Martinique ^[2]CIRAD ~ Persyst ~ Montpellier ~ France ^[3]Ohio State University ~ School of Environment and Natural Resources ~ Columbus ~ United States

*Bacterial wilt (BW), caused by *Ralstonia solanacearum*, is a major constraint in production of tomatoes and many other crops in tropical, subtropical regions, as well as in warm temperate regions. Because the efficacy of conventional methods to control BW is limited, there is an urgent need to develop and evaluate biologically based and environmentally safe, alternative control methods. Therefore, the objectives were to: 1) determine the potential of plants possessing biocontrol properties to control BW of tomato and affect non-targeted soil microbial community and activities; and 2) identify microbial properties as indicators of disease suppressive soils. The relative BW suppressiveness was determined for six plant species grown at two densities (*Mucuna deeringiana*, *Crotalaria spectabilis*, *Crotalaria juncea*, *Allium fistulosum*, *Raphanus sativus*, *Tagetes patula*) that were harvested, incorporated into soil and allowed to decompose for ten days. At the end of the plant growth stage, for *A. fistulosum*, *C. juncea* or *C. spectabilis*, tomato BW was dramatically reduced. BW incidence also correlated negatively with Gram-, Gram+ and Actinomycetes indicating an antagonistic effect of the microbial community against *R. solanacearum*. BW negatively correlated with soil NO₃- and plant biomass indicating that high plant biomass incorporation and high NO₃- availability may impede *R. solanacearum* pathogenicity. *A. fistulosum*, *C. juncea* and *C. spectabilis* have potential as BW biocontrol agents in rotation with tomato where this effect could be due to direct alleochemical effects of the roots (e.g. root exudates) and/or stimulation of a microbial component that suppresses tomato BW disease.*



S11.04 - ORGANIC MATTER DECOMPOSITION: DOES SOIL DIVERSITY MATTER?

Chair Persons:

Isabelle Bertrand, Reims - France

Claude Plassard, Montpellier - France

Sylvie Recous, Reims - France

Thursday 05 July 2012 from 08:30 to 10:00. Room Alloro

S11.04 -1

TRACKING THE FATE OF LITTER DERIVED CARBON: WHY DOES SOIL BIODIVERSITY MATTER?

Jennifer L. Soong, Fort Collins - United States

S11.04 -2

SOIL MICROBIAL DIVERSITY AFFECTS ORGANIC MATTER DECOMPOSITION

Karen Baumann, Thiverval-Grignon - France

S11.04 -3

THE DIVERSITY OF DECOMPOSER MICROORGANISMS IN SOILS: PICTURES REVEALED BY METAGENOME, METATRANSCRIPTOME AND METAPROTEOME ANALYSIS

Petr Baldrian, Prague - Czech Republic

S11.04 -4

FUNGAL PEROXIDASES AND SOIL ORGANIC MATTER DECOMPOSITION: ARE ECTOMYCORRHIZAL CORTINARIUS SPECIES THE KEY PLAYERS?

Inga Bödeker, Uppsala - Sweden

S11.04 -5

CHANGES IN LITTER AND ROOT QUALITY AS PREDICTOR OF SOIL BIOTA DYNAMICS ALONG A SUCCESSIONAL GRADIENT ON A TEMPERATE CHALK HILLSIDE

Gabriel Perez, Mont Saint Aignan - France

S11.04 -6

MODELING LITTER DECOMPOSITION: MICROBIAL AND LITTER BIOCHEMISTRY CONTROLS

Gwenaëlle Lashermes, Reims - France



S11.04 -1

TRACKING THE FATE OF LITTER DERIVED CARBON: WHY DOES SOIL BIODIVERSITY MATTER?

Soong Jennifer L.^{*[1]}, Nielsen Uffe N.^[1], Deneff Karolien^[1], Vandegehuchte Martijn L.^[1], Wall Diana H.^[1], Parton William^[1], Cotrufo M. Francesca^[1]

^[1]Colorado State University ~ Natural Resource Ecology Laboratory ~ Fort Collins ~ United States

*Soil fauna are commonly understood to accelerate the process of litter decomposition. It is yet unknown how different groups of soil fauna alter the decomposition process in ways that may change the relative amount of carbon (C) mineralized and lost as CO₂ vs. that stored in the soil as soil organic matter (SOM). Soil fauna may increase litter fragmentation or regulate the soil microbial community involved in decomposition, thus altering the physical and biological pathways underlying decomposition and affecting our ability to accurately model C cycling. In order to examine the importance of this soil biodiversity on decomposition, we incubated ¹³C and ¹⁵N enriched leaf litter (*Andropogon gerardii*) in a native tallgrass prairie in Kansas, USA. We applied a naphthalene treatment to manipulate soil fauna. Over the first year of decomposition, we traced the decomposing litter C, both with soil fauna and with naphthalene repellent, into CO₂ fluxes, SOM fractions, dissolved organic carbon, the microbial community using phospholipid fatty acid biomarkers (PLFA), and soil fauna (nematodes and microarthropods). Initial results indicate that although decreased soil fauna decreases the rate of litter mass loss, it may not significantly alter the relative mineralization of litter C to CO₂ vs. that stored in the soil. We find that the presence of soil fauna reduced microbial biomass, in particular the abundance of fungi and gram-negative bacteria, but soil fauna clearly increased microbial litter-C utilization.*



S11.04 -2

SOIL MICROBIAL DIVERSITY AFFECTS ORGANIC MATTER DECOMPOSITION

Baumann Karen^[1], Dignac Marie-France^[1], Maron Pierre-Alain^[2], Chabbi Abad^[1], Bardoux Gerard^[1], Steffens Markus^[3], Sarr Amadou^[2], Ranjard Lionel^[2], Mathieu Olivier^[4], Leveque Jean^[4], Rumpel Cornelia^[1]

^[1]Laboratoire de Biogéochimie et Ecologie des Milieux Continentaux ~ BIOEMCO ~ Thiverval-Grignon ~ France ^[2]INRA-Université de Bourgogne ~ UMR Microbiologie du Sol et de l'Environnement ~ Dijon ~ France ^[3]Technische Universität München, Lehrstuhl für Bodenkunde ~ Department für Ökologie und Ökosystemmanagement ~ Freising-Weihenstephan ~ Germany ^[4]Université de Bourgogne ~ UMR Biogeosciences ~ Dijon ~ France

Soil microorganisms play a pivotal role in soil organic matter (SOM) turn-over and their diversity is discussed as a key to the function of soil ecosystems. However, the extent to which SOM dynamics may be linked to changes in soil microbial diversity remains largely unknown. In our study we characterized organic matter degradation along a microbial diversity gradient in microcosms amended with ¹³C labeled wheat residues in order to assess whether organic matter decomposition is linked to soil microbial diversity. During incubation, respiration as well as the priming-effect was strongly linked to microbial diversity, with the highest values observed where diversity was greatest. After 60 days, nuclear magnetic resonance (NMR) analyses showed similar spectra for original wheat material and soil from the lowest diversity treatment indicating little degradation at low microbial diversity. A positive correlation between the alkyl/O-alkyl ratio and initial Shannon's index could be established. Soil lignin content was similar irrespective of microbial diversity. However, ¹³C compound specific analyses showed that vanillyl-lignin units were less degraded if microbial diversity was low. In contrast, soil sugar content as well as relative contents of the wheat specific sugars arabinose and xylose increased with decreasing diversity indicating that more sugars were used if microbial diversity was high. We conclude that microbial diversity alters the decomposition of the different plant litter biopolymers. Independent of their redundancy, functions of organic carbon decomposition are affected by microbial diversity.



S11.04 -3

THE DIVERSITY OF DECOMPOSER MICROORGANISMS IN SOILS: PICTURES REVEALED BY METAGENOME, METATRANSCRIPTOME AND METAPROTEOME ANALYSIS

Baldrian Petr^{*[1]}

^[1]Institute of Microbiology of the ASCR ~ Laboratory of Environmental Microbiology ~ Prague ~ Czech Republic

Decomposition of organic matter in forest soils is a complex process where both fungi and bacteria participate. The aim of this study was to explore the diversity of bacteria and fungi active in decomposition with a special emphasis on cellulose and hemicellulose hydrolysis. To achieve this, characterization of microbial community and selected decomposition-related genes was performed by pyrosequencing of soil DNA and RNA and combined with stable isotope probing and the extracellular proteome was analysed by mass spectrometry and enzyme activity (EEA). In Picea abies forest soil, summer represents a period with high input of photosynthate C via plant roots, while in winter the decomposition processes dominate. Bacterial communities (>10 000 OTUs) were dominated by Acidobacteria, Proteobacteria and Actinomycetes, while fungi (>1000 OTUs) mainly belonged to Ascomycetes and Basidiomycetes reflected the seasonal differences in decomposition. The seasons were also characterised by the differences in abundance of functional genes in the soil metagenome including the decomposition-related genes. Genes encoding for cellulase, glucuronidase and oxalate decarboxylase showed distinct association with different soil horizons indicating the presence of different fungal communities at different soil depths. The analysis of genes involved in hemicellulose and pectin decomposition also showed that the communities of their producers are highly diverse. The metaproteome analysis revealed the dominance of fungi over bacteria in the production of hydrolytic enzymes in soil.



S11.04 -4

FUNGAL PEROXIDASES AND SOIL ORGANIC MATTER DECOMPOSITION: ARE ECTOMYCORRHIZAL CORTINARIUS SPECIES THE KEY PLAYERS?

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^[1]Swedish University of Agricultural Sciences ~ Department of Forest Mycology and Pathology ~ Uppsala ~ Sweden

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Boreal forests act as a global sink of carbon due to a large accumulation of recalcitrant organic matter. Nitrogen is immobilized in organic compounds, leading to low plant nutrient availability in these ecosystems. Fungal peroxidases (ClassII) are likely to play a key role in degrading recalcitrant polyphenolic compounds of leaf litter and humus in boreal forest soils. These enzymes have mainly been studied in model "white rot" wood decomposers, but peroxidase activity is also commonly measured in humus. In soil, typical "white-rotters" are absent but, instead, ectomycorrhizal fungi predominate. It has often been reported that peroxidase activity increases under low nitrogen availability, suggesting a key role of these enzymes for fungal nitrogen mobilization. When fungi forage for nitrogen, carbon could be released as a side effect. Previously, we found that peroxidase-encoding genes are widely spread among ectomycorrhizal genomes. In particular, a group of Cortinarius species contained several peroxidase genes each. In order to investigate whether mycorrhizal peroxidase genes are actively expressed and if their regulation responds to nitrogen, we performed field trials in a subarctic birch forest and a boreal pine forest. Enzyme assays showed that Mn-peroxidase activity was twice as high on control plots compared to fertilized ones. Furthermore, we detected co-localization of high peroxidase activity and several different ectomycorrhizal Cortinarius species and could even show expression of manganese peroxidase genes by Cortinarius in forest soils. Thus, we hypothesize, that this particular genus is an ecologically important key player in decomposition of recalcitrant carbon in boreal forest ecosystems.



S11.04 -5

**CHANGES IN LITTER AND ROOT QUALITY AS PREDICTOR OF SOIL BIOTA DYNAMICS
ALONG A SUCCESSIONAL GRADIENT ON A TEMPERATE CHALK HILLSIDE**

Perez Gabriel^[1], Decaëns Thibaud^[1], Dujardin Gaylord^[1], Gangneux Christophe^[2], Gattin Isabelle^[2], Chauvat Matthieu^[1]

^[1]Laboratoire d'Ecologie ECODIV ~ UFR Sciences et Techniques, Université de Rouen ~ Mont Saint Aignan ~ France

^[2]Esitpa ~ Laboratoire BioSol ~ Mont Saint Aignan ~ France

Numerous studies have highlighted the impact of litter quality on soil inhabiting biota. It is now admitted that resources derived from roots are intimately linked to soil biota assemblages. Our study focuses on changes in both collembolan and microbial assemblages and their relationships with the biochemical composition of their trophic resources (e.g. litter and roots). Sampling was done in five plant assemblages: short grassland, tall grassland, encroached grassland, shrubland and forest. Litter and root biochemical composition were assessed by stepwise chemical digestion, allowing a quantification of four quality fractions: cell solubles, hemicellulose, cellulose and lignin. Both cell solubles and lignin contribution increased significantly during the succession. Mean abundance and rarefied richness of Collembola significantly increased from herbaceous stages to woody stages. This pattern was also observed for bacterial biomass and both hemiedaphic and euedaphic species abundance. Biochemical fractions derived from litter and root significantly explained variances of Collembola and microbial assemblage. Epedaphic species did not show any significant relationship with litter or root biochemical composition. Conversely, hemiedaphic and euedaphic group community pattern could be explained by fungal and bacterial abundances, respectively and by litter and root biochemical fractions. Our results clearly indicate that the quality of plant resources entering the soil food web could be a good predictor of soil Collembola and microbial assemblages. Further, segregation of Collembola in functional group appeared to be an interesting alternative for aboveground belowground studies. Our study provides an interesting conceptual framework to explore the relationships between above and belowground subsystems.



S11.04 -6

MODELING LITTER DECOMPOSITION: MICROBIAL AND LITTER BIOCHEMISTRY CONTROLS

Lashermes Gwenaëlle^{*[1]}, Daryl L. Moorhead^[2], Isabelle Bertrand^[1], Sylvie Recous^[1]

^[1]INRA ~ UMR614 Fractionnement des Agro-Ressources et Environnement ~ Reims ~ France ^[2]University of Toledo ~ Department of Environmental Sciences ~ Toledo ~ United States

The decomposition of plant litter is a complex ecological process and different levels of this complexity have been represented in mathematical models. Moorhead and Sinsabaugh (2006) developed the GDM (Guild Decomposition Model) that describes the decomposer community as three functional guilds, each guild associated with the decomposition of a major pool of litter constituent: soluble compounds, holocellulose or lignin. It also describes the interactions between holocellulose and lignin, manifest as mutual feedback controls on microbial activities. For the first time, GDM was tested against data using detailed observations simultaneously describing C mineralization and changes in litter biochemistry during maize root decay (Machinet et al. 2009). The theoretical parameters were tested and discrepancies between observations and simulations were analyzed to improve the model as follow: i) initial microbial activity was increased, ii) the structure of GDM was changed to route all degradation products into the soluble pool available for microbial assimilation, and iii) the control of holocellulose degradation by lignin was modified. The revised model was then successfully tested with results of an independent experiment using 16 maize root genotypes (Machinet et al. 2011). Our results showed that litter decay shifts from early limitation by microbial activity to later limitation by substrate quality. It also revealed strong controls of litter quality on initial rates of microbial activity. Differences between observations and simulations over the long-term were best explained by phenol acid contents, which contribute to structural cell-wall networks, demonstrating the importance of representing interactions between biochemical constituents in decomposition models.



S11.05 - NITROGEN TURNOVER AND GLOBAL CHANGE - INFLUENCE OF ECOSYSTEM DEVELOPMENT, CLIMATE, LAND USE AND XENOBIOTICS ON ABUNDANCE, DIVERSITY AND ACTIVITY OF SOIL MICROBIAL KEY PLAYERS

Chair Persons:

Michael Schlöter, Neuherberg - Germany

Sven Marhan, Hohenheim - Germany

Wednesday 04 July 2012 from 13:30 to 15:00. Room Mirto

S11.05 -1

EFFECTS OF MANURE-DERIVED VETERINARY ANTIBIOTICS SULFADIAZINE AND DIFLOXACIN ON MICROORGANISMS AND THE NITROGEN TURNOVER IN SOIL AND RHIZOSPHERE

Reimo Kindler, Berlin - Germany

S11.05 -2

EFFECT OF NITRIFICATION INHIBITOR DCD ON AMMONIA OXIDISERS AND DENITRIFIERS IN GRASSLAND SOIL AMENDED WITH SLURRY

Fiona Brennan, Wexford - Ireland

S11.05 -3

THE INFLUENCE OF CLIMATE CHANGE ON N-CYCLING MICROORGANISMS IN SOIL

Sven Marhan, Stuttgart - Germany

S11.05 -4

TEMPORAL EVOLUTION OF GROSS N MINERALIZATION AND NITRIFICATION RATES IN INTACT SOIL CORES IN A POPLAR PLANTATION FROM SOUTHERN GERMANY.

Eugenio Díaz-Pinés, Garmisch-Partenkirchen - Germany

S11.05 -5

GROWTH OF ECTOMYCORRHIZAL FUNGI ALONG A BOREAL FOREST NITROGEN DEPOSITION GRADIENT AND ITS EFFECT ON NITROGEN LEAKAGE

Adam Bahr, Lund - Sweden

S11.05 -6

WETLAND MANAGEMENT: MICROBIAL COMPOSITION AND STRUCTURE IN A PEATLAND SECONDARY SUCCESSION

Elisa Pellegrino, Pisa - Italy



S11.05 -1

EFFECTS OF MANURE-DERIVED VETERINARY ANTIBIOTICS SULFADIAZINE AND DIFLOXACIN ON MICROORGANISMS AND THE NITROGEN TURNOVER IN SOIL AND RHIZOSPHERE

Kindler Reimo^{*[1]}, Kleineidam Kristina^[2], Kotzerke Anja^[1], Ollivier Julian^[3], Schlöter Michael^[2], Wilke Berndt-Michael^[1]

^[1]Technische Universität Berlin ~ Department of Ecology ~ Berlin ~ Germany ^[2]Helmholtz Zentrum München ~ Research Unit for Environmental Genomics ~ Neuherberg ~ Germany ^[3]Technical University of Munich ~ Chair for Soil Ecology ~ Oberschleißheim ~ Germany

Veterinary antibiotics enter the environment via manure application and influence soil organisms and nutrient cycles. The present study gives information on the impact of antibiotics amended to soil with manure from pigs treated with sulfadiazine (SDZ) and difloxacin (DIF), respectively, on nitrogen turnover and on the functional diversity of microorganisms in bulk soil and rhizosphere. Therefore, the actual and potential nitrogen mineralization, denitrification and nitrification activity as well as the abundance of the corresponding functional microbial groups were tracked over 62 days in a mesocosm experiment under controlled moisture, temperature and light conditions. The mesocosms contained an agricultural soil (Orthic Luvisol) mixed with manure from untreated, SDZ- and DIF-treated pigs at amounts of agricultural relevance. Pre-grown maize seedlings were cultivated on the soil. Microbial analyses were performed at the beginning and in distinct intervals up to 62 days after manure addition. The microbial biomass and nitrogen turnover processes were stimulated by manure application. The presence of SDZ restricted the enhancing effect of manure. The potential nitrification showed comparable and significantly decreased activities in both soil compartments till the end of incubation while the impact on the potential denitrification was more pronounced in rhizosphere. The gene abundance was not changed. In contrast, DIF applications caused minor effects on gene abundance and no effects on activity. This can be attributed to fast adsorption of DIF. The observed effects on the soil microbial functions particularly in the rhizosphere represent a potential risk of antibiotics already effective in medically caused concentrations in manure.

S11.05 -2

**EFFECT OF NITRIFICATION INHIBITOR DCD ON AMMONIA OXIDISERS AND DENITRIFIERS
IN GRASSLAND SOIL AMENDED WITH SLURRY**

Brennan Fiona^[1], Ernfors Maria^[2], Philippot Laurent^[3], Richards Karl^[4], Bru David^[3], Laughlin Ronnie^[5], Mueller Christoph^[6], Mcgeough Karen^[5], Watson Catherine^[5], Griffiths Bryan^[4]

^[1]Teagasc/INRA ~ Environmental Research Centre ~ Wexford ~ Ireland ^[2]Teagasc/Swedish University of Agricultural Sciences ~ Environmental Research Centre ~ Wexford ~ Ireland ^[3]INRA/Université de Bourgogne ~ Soil and environmental microbiology ~ Dijon ~ France ^[4]Teagasc ~ Environmental Research Centre ~ Wexford ~ Ireland ^[5]Agri-Food and Biosciences Institute ~ Newforge Lane ~ Belfast ~ Ireland ^[6]University College Dublin/University Giessen ~ Department of Plant Ecology ~ Giessen ~ Germany

It is becoming increasingly important to reduce nitrogen (N) losses from agricultural soils. Nitrogen, in the form of nitrate (NO₃-), is highly soluble and is easily leached from soil, potentially resulting in contaminated receiving waters. NO₃- can also be sequentially reduced by microbial denitrifiers to the gaseous end products NO, N₂O and N₂. Reduction of N₂O emission from soils is of particular interest, as it is an important greenhouse gas. One solution currently being explored for the reduction of N-losses is the use of nitrification inhibitors, which temporarily inhibit ammonium oxidation. Dicyandiamide (DCD) is widely used in some countries but despite its common use, its impact on the N cycling microbial community remains unclear. We investigated the impact of DCD on the microbial community in slurry amended grassland soil. Microcosm incubations of three contrasting temperate grassland soils were conducted over a 20 day period at 15°C. Microcosms were amended with slurry with or without DCD and 15N isotopic labelling was applied to the samples, to allow the determination of several simultaneously occurring gross N transformation rates. Abundance of ammonium oxidizers and denitrifiers were quantified by targeting functional genes using qPCR. Soil mineral N (NH₄⁺, NO₃⁻) concentrations, gaseous losses (N₂, N₂O) and the 15N enrichment of these N compounds, were analysed over the time period. Post incubation, higher ammonium concentrations (0.125 instead of 0.008 NH₄⁺ mg N/g) and lower nitrate concentrations (0.125 instead of 0.256 NO₃mg N/g) were found in the DCD soils indicating nitrification inhibition, which subsequently affected N-losses.



S11.05 -3

THE INFLUENCE OF CLIMATE CHANGE ON N-CYCLING MICROORGANISMS IN SOIL

Marhan Sven^[1], Keil Daniel^[1], Regan Kathy^[1], Niehörster Julia^[1], Niklaus Pascal A.^[2], Kammann Claudia^[3], Philippot Laurent^[4], Poll Christian^[1], Kandeler Ellen^[1]

^[1]Universität Hohenheim, Institute of Soil Science and Land Evaluation ~ Soil Biology ~ Stuttgart ~ Germany ^[2]Universität Zürich ~ Institute of Environmental Sciences ~ Zürich ~ Switzerland ^[3]Justus-Liebig University Giessen ~ Department of Plant Ecology ~ Department of Plant Ecology, Justus-Liebig University Giessen, Heinrich-Buff-Ring 26, Giessen ~ Germany ^[4]INRA-University of Burgundy ~ Laboratory of Soil Microbiology and Geochemistry ~ Dijon Cedex ~ France

The relevance of climate change on nitrogen turnover processes in soils is still not completely understood. Nitrification and denitrification are important drivers of N₂O emission from soils. The influence of elevated atmospheric CO₂ concentration, elevated temperature, changed precipitation patterns and drought on N₂O emissions as well as the abundance and activity of ammonia oxidizing and denitrifying microorganisms were investigated in five different field experiments in agricultural ecosystems. Elevated atmospheric CO₂ increased the growth and nutrient uptake of crop plants leading to decreased N₂O production rates in an arable soil, whereas ammonia oxidizer and denitrifier abundances were more affected by seasonal variations in soil moisture than by elevated CO₂. In a grassland ecosystem elevated CO₂ was found to increase N₂O emissions, but the CO₂ effect was restricted to sites with increased soil moisture. Elevated soil temperature doubled N₂O emissions of an arable field although soil water content in the top soil layer was reduced in comparison to ambient temperature. Drought periods decreased the abundance of denitrifying bacteria in soil, but showed only minor effects on potential denitrification rates. Data of the different experiments will be presented to enlighten possible changes and feedbacks of the N-cycle in soils under future climate change scenarios.



S11.05 -4

TEMPORAL EVOLUTION OF GROSS N MINERALIZATION AND NITRIFICATION RATES IN INTACT SOIL CORES IN A POPLAR PLANTATION FROM SOUTHERN GERMANY.

Díaz-Pinés Eugenio^[1], Dannenmann Michael^[1], Butterbach-Bahl Klaus^[1]

^[1]Karlsruhe Institute of Technology ~ Institute for Meteorology and Climate Research. Atmospheric and Environmental Research ~ Garmisch-Partenkirchen ~ Germany

Deeper understanding of N transformation processes in the soil, including temporal dynamics is needed. To this purpose, analysis on undisturbed soil samples is a strongly desired. Here, we present results of gross N mineralization and nitrification rates in a poplar plantation (Swabian Alps, southern Germany) over one growing period. We applied the 15N pool dilution technique, in which the 15N labeled solution is homogenously applied by micro syringes in the intact soil core. This allows the estimation of the rates without disturbing the original structure of the soil. Our preliminary results show a strong dependence of N turnover processes on temperature and soil moisture status, and a predominant role of N mineralization in comparison to nitrification. Additionally, we relate the N turnover rates with results of microbial C and N, NH₄⁺ and NO₃⁻ contents in the soil solution as well as trace gas emissions (CO₂, CH₄ and N₂O) from field campaigns with automatic measurement systems. These results will contribute to the understanding the N turnover processes in the soil, and allow the improvement and further development of models to better predict future N₂O and other GHG emissions in a changing environment.



S11.05 -5

GROWTH OF ECTOMYCORRHIZAL FUNGI ALONG A BOREAL FOREST NITROGEN DEPOSITION GRADIENT AND ITS EFFECT ON NITROGEN LEAKAGE

Bahr Adam^[1], Ellström Magnus^[1], Akseleson Cecilia^[2], Wallander Håkan^[1]

^[1]Lund University ~ Microbial ecology ~ Lund ~ Sweden ^[2]Lund University ~ Physical Geography & Ecosystems Analysis ~ Lund ~ Sweden

The most common parameter related to nitrogen (N) leaching from forest ecosystems has been the C/N quota of the humus layer, plant N uptake and enhanced N mineralization, but the role of ectomycorrhizal fungi (EMF) has been less clear. Almost all boreal and temperate forest tree species live in symbiosis with EMF, the trees transfer carbon to the fungi in exchange for nutrients and water. When inorganic N is added to N deficient soils the symbiosis becomes repressed and EMF growth reduced since the fungal symbiont is less needed for the tree. This might lead to enhanced N leaching as the efficient nutrient uptake by the fine EMF mycelial network is reduced, and it has been observed that high N leaching coincided with reduced EMF mycelial growth in an oak forest N deposition experiment. To separate the effect of EMF growth from other environmental variables the project was set up, in the Swedish throughfall monitoring network, at 30 Norway spruce forest locations monitored for deposition, soil water chemistry, needle chemistry and vegetation. We analysed growth of EMF extraradical mycelium by using sand filled mesh-bags, a pore size of 50 μm allowed for penetration of EMF mycelium but prevented ingrowth of the coarser plant roots. I will present how growth of EMF correlated with the monitored environmental parameters, such as N deposition (spanning a gradient of 2 - 20 kg ha⁻¹ ya⁻¹), and if it affected the leaching of N (spanning a gradient of <0.01 - 4.83 mg l⁻¹).



S11.05 -6

**WETLAND MANAGEMENT: MICROBIAL COMPOSITION AND STRUCTURE IN A PEATLAND
SECONDARY SUCCESSION**

Pellegrino Elisa^{*[3]}, Silvestri Nicola^[4], Ciccolini Valentina^[1], Bonari Enrico^[1]

^[1]Scuola Superiore Sant'Anna ~ Institute of Life Sciences ~ Pisa ~ Italy ^[2]University of Pisa ~ Department of Agronomy and Agro-Environmental Management ~ Pisa ~ Italy ^[3]Scuola Superiore Sant'Anna ~ Institute of Life Sciences ~ Pisa ~ Italy ^[4]University of Pisa ~ Department of Agronomy and Agro-Environmental Management ~ Pisa ~ Italy

Wetlands cover about 6% of the world landscape. Within such lands, the dominant classes, bogs and fens, are highly important for the C cycle and in particular peatlands, sequestering about one-third of the terrestrial C, are critical ecosystems, which need to be largely investigated for their microbial diversity and roles. So far, more than 50% of the areas of peatlands, wetlands and riparian zones have been lost, through conversion to agricultural use. Intensive agriculture involving the drainage of peatlands has been shown to lead to major problems because of the oxidation, subsidence and severe CO₂ emissions. Several studies have been performed on secondary plant community succession and soil chemical changes after field abandonment in various habitats, whereas little is known about the accompanying belowground microbial diversity and the factors driving such shifts. In this regard, some studies have evaluated the effects of land use changes, such as forest, grassland and meadow restoration, or land abandonment on the microbial secondary composition and structure, but there is a lack of information regarding peatlands. To address this gap of knowledge, here, we investigated the community composition and structure of nitrifying and denitrifying bacteria, oxidising archaea and arbuscular mycorrhizal fungi in a peatland secondary succession, after being abandoned for 6 years, around the Massaciuccoli Lake (Tuscany, Italy). Arable cropping systems were used as controls. Diversity was determined by DNA cloning and sequencing. Phylogenetical analyses and multivariate methods using soil chemical parameters as environmental factors allowed us to highlight clear patterns of microbial secondary succession.



S11.06 - BIOGEOGRAPHY OF SOIL MICROORGANISMS - Sponsored by IUSS

Chair Persons:

Ellen Kandeler, Hohenheim - Germany

Naoise Nunan, Thiverval-Grignon - France

Wednesday 04 July 2012 from 15:30 to 17:15. Room Mirto

S11.06 -1

PRECIPITATION PATTERNS IN SEMI-ARID ECOSYSTEMS SHAPE SOIL MICROBIAL ASSEMBLAGES AND THEIR RESPONSE TO WET UP EVENTS

Mary Firestone, Berkeley, CA - United States - Invited

S11.06 -2

PORE-SCALE MICROBIAL BIOGEOGRAPHY

Claire Chenu, Paris - France

S11.06 -3

'MICROBIAL LOGISTICS' - MYCELIA AS NETWORKS FOR FUNCTIONAL DISPERSAL OF BACTERIA AND CHEMICALS IN SOIL

Lukas Yvo Wick, Leipzig - Germany

S11.06 -4

BACTERIAL BIOGEOGRAPHY IN TWO FUNCTIONALLY CONTRASTING RHIZOSPHERES - NITROGEN-FIXING MEDICAGO TRUNCATULA AND ECTOMYCORRHIZAL PINUS PINASTER

Georg Carlsson, Alnarp - Sweden

S11.06 -5

UNDERSTANDING SOIL MICROBIAL COMMUNITY SPATIAL PATTERNS AT MULTIPLE SCALES BY FOCUSING ON HABITAT PATCHES IN THE LANDSCAPE

Christopher Blackwood, Kent - United States - Invited

S11.06 -6

SPATIAL PROCESSES DRIVING SOIL MICROBIAL COMMUNITY ASSEMBLY ON A WIDE SCALE

Nicolas Chemidlin Prévost-Bouré, Dijon - France



S11.06 -7

SOIL BACTERIAL BIOGEOGRAPHY - WHERE DOES THE MAP LEAD US?

Bruce Thomson, *Wallingford - United Kingdom*



S11.06 -1

PRECIPITATION PATTERNS IN SEMI-ARID ECOSYSTEMS SHAPE SOIL MICROBIAL ASSEMBLAGES AND THEIR RESPONSE TO WET UP EVENTS

Firestone Mary^{*[1]}, Placella Sarah^[1], Osborne Catherine^[1], Barnard Romain^[1], Brodie Eoin^[2]

^[1]University of California ~ Department of Environmental Science, Policy and Management ~ Berkeley, CA ~ United States ^[2]Lawrence Berkeley National Laboratory ~ Earth Sciences Division ~ Berkeley CA ~ United States

To understand the impacts of precipitation patterns and changes in these patterns on the microbial communities and the processes they catalyze in semi-arid soils, we investigated the consequences of dry-down periods of different lengths and we followed community response to the first rainfall following a long dry period using two California annual grassland soils. Longer periods of dry-down before rainfall significantly increased the soil CO₂ efflux. DNA and RNA was extracted from soil was used to characterize the physiological status of communities during dry down and wet up. A long preceding dry period results in destruction of more bacterial and fungal cells, which may be fuelling the larger pulses of CO₂. We identified three response strategies to wet up events based on when taxa had the highest relative ribosomal quantity: rapid-responders (within 1 hour of wet-up), intermediate-responders (between 3 and 24 hours following wet-up), and delayed-responders (24 to 72 hours post wet-up). These data suggest that the large carbon dioxide pulse produced concurrently with wet-up results from the activity of different groups of metabolically active microorganisms over time. Relative ribosomal quantity of rapid-responders was as high in the prewet dry soils as at any other time, suggesting that some organisms may be poised to respond to the wet-up event in that they preserve their capacity to synthesize proteins rapidly. Microbial response patterns clustered phylogenetically, and were primarily conserved at the phylum level, with the clustering of responses largely consistent across the two soils.



S11.06 -2

PORE-SCALE MICROBIAL BIOGEOGRAPHY

Nunan Naoise^[4], Ruamps Léo^[2], Pouteau Valérie^[3], Chenu Claire^{*[5]}

^[1]Centre National de la Recherche Scientifique ~ BioEMCo ~ Paris ~ France ^[2]UPMC ~ BioEMCo ~ Paris ~ France

^[3]INRA ~ BioEMCo ~ Paris ~ France ^[4]CNRS ~ BioEMCo ~ Paris ~ France ^[5]AgroParisTech ~ BioEMCo ~ Paris ~ France

Microbial communities exist and are active in a complex 3-D physical framework which causes a variety of microenvironments to develop that are more or less suitable for microbial growth and activity. If there is a significant microbial biogeography at the pore scale in soil, then the relationship between microbial diversity and ecosystem function is likely to be affected by micro-environmental variations at the pore scale. Here, we show that there is a significant pore-scale microbial biogeography by labelling microbial communities in different pore size classes of undisturbed soil cores with ¹³C-labelled fructose. This was achieved by adding the substrate solution to the samples at different matric potentials (-100 kPa, -3.15 kPa and -1 kPa; placing the substrate in pores with maximum diameter of 0.97, 9.7 and 97 mm, respectively) and incubating the samples for two weeks. The structure of microbial communities in different pore size classes was measured by PLFA stable-isotope probing. Labelled PLFA profiles showed that microbial community structure differed significantly among pore size classes. In order to determine the origin of the biogeography (due to historical or contemporary environmental conditions), we cross-inoculated two sterilised soils at different matric potentials and incubated them for 10 months. The contribution of historical (differences related to inoculum) and contemporary events (differences related to soil and pore properties) to community structure was determined by ARISA. The results suggest that each contributed significantly to differentiation among communities.



S11.06 -3

'MICROBIAL LOGISTICS' - MYCELIA AS NETWORKS FOR FUNCTIONAL DISPERSAL OF BACTERIA AND CHEMICALS IN SOIL

Wick Lukas Yvo^{*[1]}, Furuno Shoko^[1], Foß Susan^[1], Banitz Thomas^[1], Harms Hauke^[1]

^[1]Helmholtz Centre for Environmental Research UFZ ~ Environmental Microbiology ~ Leipzig ~ Germany

The term 'logistics' (i.e. having the right thing, at the right place, at the right time) applies for the biodegradation of contaminants in soil. Degrading bacterial communities walk the tightrope of contaminant availability and suitable physical habitats for their activity; this situation is often aggravated by the concurrence of restricted bacterial mobility and retarded transfer of hydrophobic organic contaminants (HOC) in soil. In order to cope with heterogeneous environments mycelial fungi therefore have developed a unique network-based growth form. Unlike bacteria mycelia spread ubiquitously in the soil, penetrate air-water interfaces and cross over air-filled pores between the bacteria and contaminants in the vadose. In air-filled soil, enhanced homogenization of bacteria and contaminants can be achieved by bridging physical air gaps with fungal hyphae thus enabling substrate-directed mobilization of bacteria along chemical gradients. In this contribution we demonstrate the biodegradation-enhancing influence of mycelial dispersal networks on both the microbial transport and the translocation of HOC. Our data show that mycelial networks (i) act as effective dispersal networks for both undirected and targeted (chemotactic) mobilization of contaminant degrading bacteria ('fungal highways'), (ii) increase the mobility of a wide range of HOC due to their translocation in their cytoplasmic streaming ('fungal pipelines'), and thus (iii) improve the accessibility of bacteria to soil contaminants and, concomitantly, their biodegradation. Given their ubiquity and length of up to 1000 m g⁻¹ dry soil mycelial networks hence appear to play a significant role in the microbial biogeography for the ecosystem service of contaminant biodegradation in soil.



S11.06 -4

**BACTERIAL BIOGEOGRAPHY IN TWO FUNCTIONALLY CONTRASTING RHIZOSPHERES -
NITROGEN-FIXING MEDICAGO TRUNCATULA AND ECTOMYCORRHIZAL PINUS PINASTER**

Carlsson Georg^{*[1]}, Cloutier-Hurteau Benoît^[2], Blossfeld Stephan^[3], Pablo Anne-Laure^[4], Plassard Claude^[2], Hinsinger Philippe^[2]

^[1]Swedish University of Agricultural Sciences ~ Department of Agrosystems ~ Alnarp ~ Sweden ^[2]Institut National de la Recherche Agronomique ~ UMR Eco&Sols ~ Montpellier ~ France ^[3]Forschungszentrum Juelich GmbH ~ Institute for Bio- and geosciences (IBG-2), Plant Sciences ~ Jülich ~ Germany ^[4]Institut de Recherche pour le Développement ~ UMR Eco&Sols ~ Montpellier ~ France

Even though rhizospheric pH displays high variability, possible links between pH and bacterial biogeography at the rhizosphere scale remain largely unknown. The aim of this study was to document the spatial distribution of bacterial communities in relation to soil pH around roots of two functionally contrasting plants, a coniferous tree and an annual legume. *Pinus pinaster*, with and without ectomycorrhizal inoculation (*Rhizopogon roseolus*), and two *Medicago truncatula* genotypes (Jemalong 6 and DZA 315-16), inoculated with *Sinorhizobium medicae*, were cultivated in thin mini-rhizoboxes. After two months, millimetre-scale mapping of the following parameters were performed on 18 cm² zones: presence of roots, mycorrhizae and nodules; soil pH, using non-invasive planar optodes; and different taxonomic and functional (nitrifiers and denitrifiers) groups of bacteria, using Q-PCR. Rhizosphere acidity was highly heterogeneous, with lowest pH close to mycorrhizal roots of *Pinus pinaster* and nodules and dense roots of *Medicago truncatula*. Both soil pH and quantities of bacterial phyla showed highest variability in the rhizosphere of *Pinus pinaster* with mycorrhiza, followed, in order of decreasing variability, by *Medicago truncatula* DZA 315-16, *Medicago truncatula* Jemalong J6, and *Pinus pinaster* without mycorrhiza. The spatial patterns of bacterial phyla were consistently related to soil pH, with the strongest relationship in the rhizosphere of *Pinus pinaster* with mycorrhizal inoculation. This pioneering documentation of bacterial biogeography at the rhizosphere scale provides completely new insights in how mycorrhizal and nitrogen-fixing symbioses generate spatial heterogeneity in soil pH and bacterial community composition.



S11.06 -5

UNDERSTANDING SOIL MICROBIAL COMMUNITY SPATIAL PATTERNS AT MULTIPLE SCALES BY FOCUSING ON HABITAT PATCHES IN THE LANDSCAPE

Blackwood Christopher*^[1]

^[1]Kent State University ~ Department of Biological Sciences ~ Kent ~ United States

*It is well known that biogeographic patterns depend on the spatial scales investigated, although the mechanism behind this pattern, and the implications for ecosystem functions, are not necessarily clear. We have found that the effect of spatial scale on biogeographic patterns in microbial communities may arise from the different ways in which habitat patches and edges are treated at different scales. For example, we found that soil microbial communities in a well-defined habitat, the rhizosphere of *Lobelia siphilitica*, were spatially autocorrelated but independent of soil conditions on a regional scale, a pattern consistent with dispersal limitation and neutral dynamics. In contrast, microbial communities at the same sites but associated with random plant species were correlated with soil properties but were not spatially autocorrelated, and were therefore consistent with species sorting according to their ecological niches. To understand mechanisms behind contrasting patterns such as this, we have begun investigating the biogeography of microorganisms in well-defined habitat patches. In individual leaves and leaf neighborhoods in the Oi horizon, fungal community composition appears to be consistent with dispersal limitation. Scaling up from leaf neighborhoods, we found evidence for species sorting among forest types. However, the consistency of species sorting in the microbial community is dramatically reduced at forest patch edges, indicating that dispersal limitation still plays an important role. Finally, extracellular enzyme activities appear to be largely independent of variation in microbial community composition, indicating the important role of functional redundancy in microbial systems.*



S11.06 -6

SPATIAL PROCESSES DRIVING SOIL MICROBIAL COMMUNITY ASSEMBLY ON A WIDE SCALE

Chemidlin Prévost-Bouré Nicolas^[1], Dequiedt Samuel^[1], Saby Nicolas^[2], Thioulouse Jean^[3], Jolivet Claudy^[2], Lelièvre Mélanie^[1], Arrouays Dominique^[2], Ranjard Lionel^[1]

^[1]INRA ~ Microbiologie des Sols et de l'Environnement ~ Dijon ~ France ^[2]INRA ~ Infosol ~ Orléans ~ France

^[3]Université de Lyon ~ Laboratoire de Biométrie et Biologie Evolutive ~ Lyon ~ France

Soil houses a huge biodiversity involved in ecological services through microbial community assembly. However, processes driving soil microbial community assembly are still scarcely understood, particularly the relative importance of environmental heterogeneity regarding to dispersal limitations. This can be achieved through studying the determinism of taxa-area relationship (TAR, how community composition change with geographic distance), a fundamental relationship in ecology. Here, a biogeographical approach was applied on a wide scale to evaluate TAR for soil bacterial and fungal communities and to partition their spatial variations into environmental heterogeneity effects and dispersal limitations effects. Four contrasted regions, extracted from the French soil quality monitoring network, were considered: Brittany, Burgundy, Landes and South-East. The genetic structure of indigenous bacterial and fungal communities was determined by molecular fingerprinting and their TARs were evaluated. Significant TARs were observed in Brittany and South-East for both bacteria and fungi, and only for bacteria in Burgundy. The turnover rates of bacterial and fungal communities were in the same order of magnitude between regions and microbial groups despite different environmental patterns among regions. Distance-based canonical redundancy analysis was used to confront genetic data to soil physico-chemical characteristics, climatic conditions, land use and site location (a descriptor for dispersal limitations). Spatial variations of soil bacterial and fungal communities' assembly were mainly explained by environmental heterogeneity (15% to 36% of variance). Dispersal limitations explained smaller but significant amounts of variance in only two regions (ca. 3%). Among environmental factors, pH ranked first but their hierarchy changed with region and organism type.



S11.06 -7

SOIL BACTERIAL BIOGEOGRAPHY - WHERE DOES THE MAP LEAD US?

Griffiths Rob^[1], Thomson Bruce^{*[1]}

^[1]CEH ~ Microbial Ecology ~ Wallingford ~ United Kingdom

A decade ago, the notion that we could draw up predictive maps of soil bacterial biodiversity across landscapes may have seemed an ambitious and possibly unattainable objective. However, over the past 5 years a number of molecular studies have emerged documenting the predictable response of bacterial biodiversity to soil edaphic gradients, meaning that such ambitions are now a reality. Here I discuss these studies in relation to our own work in mapping the soil biodiversity across Great Britain. What do these studies mean for our overall understanding of the driving forces shaping soil bacterial communities? Is “everything everywhere” meaning we shouldn’t concern ourselves with biodiversity, or are the methodologies simply defining the broad types of taxa found in different soil biomes across environmental gradients? I argue that there is still a way to go in answering these questions, and discuss their relevance in aiding understanding of how soils function. Finally, metagenomic data is presented exploring the potential of high throughput sequencing to answer more relevant questions on both the biogeography of soil diversity and functionality.



S11.07 - BIOTIC AND ABIOTIC DRIVERS OF PRIMING EFFECTS

Chair Persons:

Evgenia Blagodatskaya, Pushchino - Russian Federation

Sébastien Fontain, Clermont-Ferrand - France

Wednesday 04 July 2012 from 15:30 to 17:00. Room Leccio

S11.07 -1

STABLE ISOTOPE LABELLING AND TRACKING TO QUANTIFY PLANT-MEDIATED PRIMING OF SOIL ORGANIC MATTER MINERALISATION

Eric Paterson, Aberdeen - United Kingdom

S11.07 -2

STOICHIOMETRIC COUPLING OF C AND N TURNOVER REVEALS RHIZOSPHERE PRIMING EFFECTS

Per Bengtson, Lund - Sweden

S11.07 -3

EFFECTS OF COMBINED TEMPERATURE AND DROUGHT TREATMENTS ON PRIMING

Thomas Wutzler, Jena - Germany

S11.07 -4

EFFECT OF PYROGENIC CARBON ADDITION ON GROSS NITROGEN MINERALIZATION AND EXTRACELLULAR ENZYME ACTIVITY

Bernardo Maestrini, Zurich - Switzerland

S11.07 -5

PRIMING EFFECTS: INTERACTIONS BETWEEN LIVING AND DEAD ORGANIC MATTER

Yakov Kuzyakov, Göttingen - Germany - Invited

S11.07 -6

DOES THE MINERALIZATION OF ERODED LAND-BORN C IN INLAND WATERS ACCELERATED BY PRIMING EFFECT?

Bertrand Guenet, Gif Sur Yvette - France



S11.07 -1

STABLE ISOTOPE LABELLING AND TRACKING TO QUANTIFY PLANT-MEDIATED PRIMING OF SOIL ORGANIC MATTER MINERALISATION

Paterson Eric^[1]

^[1]The James Hutton Institute ~ Plant-Soil Ecology ~ Aberdeen ~ United Kingdom

The impacts of labile carbon inputs from plants on soil organic matter (SOM) mineralisation (priming effects) have been long-recognised, but knowledge of the underlying mechanisms remains incomplete. Currently there is increasing appreciation that priming effects are key to soil carbon and nutrient cycles. As such priming effects are central to predicting the carbon-balance of soils in response to environmental change, and the capacity of soils to supply nutrients to support plant productivity. Stable isotope labelling of carbon inputs and isotopic partitioning of soil CO₂ efflux allows direct quantification of priming effects, whilst tracking the fate of labile C in microbial communities provides insights into microbial controls of priming processes. Through application of ¹³C-labelled exudate compounds and by continuous ¹³C-labelling of plants we have quantified priming effects as functions of C-input rates and have demonstrated that these response functions are soil-specific. Quantitative measurement of C-fluxes through microbial communities and dissolved organic carbon in these experiments has supported interpretation of priming mechanisms, suggesting that priming of SOM mineralisation is mediated by specific components of soil microbial communities. The results confirm that fluxes of C out of soil from native SOM are coupled to the supply of labile C to microbial communities and suggest that traditional pool-models based on first-order kinetics will be poorly adapted to capture C-dynamics in soils shifted from equilibrium by environmental or land use change. We suggest that quantitative and mechanistic understanding of priming processes will provide a basis for their incorporation into 'next generation' soil C-models.



S11.07 -2

STOICHIOMETRIC COUPLING OF C AND N TURNOVER REVEALS RHIZOSPHERE PRIMING EFFECTS

Bengtson Per*^[1], Grayston Sue^[2], Barker Jason^[2]

^[1]Lund University ~ Biology - Microbial Ecology ~ Lund ~ Sweden ^[2]University of British Columbia ~ Forestry, Department of Forest Sciences ~ Vancouver ~ Canada

Priming is defined as an increase in decomposition of soil organic matter (SOM) in response to input of easily available C or N. Real priming needs to be distinguished from apparent priming, as apparent priming results from an increased C and N mineralization in response to a higher turnover rate of the microbial biomass, without an accompanying increase in SOM decomposition. Failing to accurately differentiate between real and apparent priming could result in directly opposing interpretations and predictions regarding C sequestration and mineralization. We therefore designed an experiment where two alternative hypotheses were tested, namely that C input in the form of root exudates result in 1. Apparent priming, or 2. Real priming. The hypotheses were tested by estimating the rate of root exudation of seedlings grown in the lab in a ¹³C pulse-chase experiment. The decomposition of SOM at varying C exudation rates was then calculated from the microbial C and N assimilation. The microbial C and N assimilation was highly dependent on the rate of root exudation. However, direct stimulation by root exudates on microbial growth does not provide enough C to explain the increased assimilation. In fact, each mg of C exuded resulted in liberation of 6 mg available C from SOM. Our findings suggest that increased belowground C allocation in the form of root exudates results in real priming and accelerated decomposition of SOM. The estimate is supported by measurements of gross N mineralization, a proxy for SOM decomposition.



S11.07 -3

EFFECTS OF COMBINED TEMPERATURE AND DROUGHT TREATMENTS ON PRIMING

Wutzler Thomas^[1], Thiessen Stefany^[1], Reichstein Markus^[1], Gleixner Gerd^[1]

^[1]MPI-BGC Jena ~ Model-Data-Integration ~ Jena ~ Germany

Do priming effects vary with changing environmental conditions of temperature and moisture? Here we present data and models of a soil incubation study in the QUASOM project. Soil has been amended with labeled plant litter and has been incubated for 200 days at different combinations of temperature and drying/rewetting cycles. By tracking the total evolution of respired total CO₂ and CO₂ from labeled amendment we study the changes in decomposition of amendment and soil by the different treatments. Drifts of temperature sensitivity of the decomposition rate with time suggest that adaptation of the microbial decomposers is taking place. Consequences for dependence of priming on temperature and moisture will be analyzed using microbial biomass explicit SOM decomposition models.



S11.07 -4

EFFECT OF PYROGENIC CARBON ADDITION ON GROSS NITROGEN MINERALIZATION AND EXTRACELLULAR ENZYME ACTIVITY

Maestrini Bernardo*^[1], Abiven Samuel^[1], Herrmann Anke M.^[2], Nannipieri Paolo^[3], Landi Loretta^[3], Schmidt Michael W. I.^[1]

^[1]University of Zurich ~ Department of Geography ~ Zurich ~ Switzerland ^[2]Swedish University of Agricultural Sciences ~ Department of Chemistry ~ Uppsala ~ Sweden ^[3]University of Florence ~ Department of Plant, Soil and Environmental Sciences ~ Florence ~ Italy

Fire-derived, pyrogenic carbon (PyC) is produced during vegetation fires, and has been considered as relatively stable in soil. Recent studies, however, question if PyC is as stable as previously thought. Incubation studies indicated an initial rapid carbon mineralization of PyC and release as CO₂. In a field experiment, we also observed that PyC primed the mineralization of native soil organic matter at ambient levels of atmospheric nitrogen deposition, but not at doubled levels of mineral N deposition. We hypothesized that the addition of a complex, C-rich substrate like PyC can reduce the amount of nitrogen available to the soil microbial community. To cope with less available N soil microorganisms will mineralize more soil organic matter, and thus result in increased gross N and C mineralization (i.e. a priming effect). Enzymatic activity would increase according to the theories on complex substrate induced priming effect. According to this theory, substrates with low energy content would favour the growth of K strategists (responsible for the degradation of native soil organic matter), which are expected to allocate more energy to extracellular enzyme production. To test these hypotheses we incubated a mix of soil and highly ¹³C labelled PyC, and measured the PyC-induced priming effect on soil organic matter, gross N mineralization (using ¹⁵N isotope dilution technique) and, the activity of extracellular enzymes responsible for the decomposition of aromatic compounds (phenol oxidase and peroxidase) and for the depolymerization of proteins (protease and amidase). First results will be presented.



S11.07 -5

PRIMING EFFECTS: INTERACTIONS BETWEEN LIVING AND DEAD ORGANIC MATTER

Kuzyakov Yakov*^[1]

^[1]University of Göttingen ~ Department of Soil Science of Temperate Ecosystems ~ Göttingen ~ Germany

The priming effects – increase or decrease in soil organic matter turnover (measured as changes of CO₂ efflux and N mineralization) after addition of available substrates – is not an artifact of incubation studies, but is a natural process sequence in the rhizosphere and detritusphere that is induced by pulses or continuous inputs of fresh organics. Recent publications have shown that priming effect (PE) results from interactions between living (microbial biomass) and dead organic matter and commonly occurs in most plant–soil systems.. The intensity of turnover processes in such hotspots as rhizosphere and detritusphere is at least one order of magnitude higher than in the bulk soil. Various prerequisites for high-quality PE studies will be outlined: calculating the C budget; analysis of the dynamics of released CO₂ and its sources; linking C and N dynamics with microbial biomass changes and enzyme activities; evaluating apparent and real PEs; and assessing PE sources as related to soil organic matter stabilization mechanisms. Approaches for identifying priming, based on the assessment of more than two C sources in CO₂ and microbial biomass will be proposed. Future studies should evaluate directions and magnitude of PEs according to expected climate and land-use changes and the increased rhizodeposition under elevated CO₂ as well as clarifying the ecological significance of PEs. The conclusion is that PEs – the interactions between living and dead organic matter – should be incorporated in models considering microbial biomass as an active driver of C and N turnover.



S11.07 -6

**DOES THE MINERALIZATION OF ERODED LAND-BORN C IN INLAND WATERS
ACCELERATED BY PRIMING EFFECT?**

Guenet Bertrand*^[1]

^[1]CNRS ~ LSCE ~ Gif Sur Yvette ~ France

In the last decade, several studies questioned the becoming of Terrestrial Organic Matter, such as transported soils, in aquatic systems. Soil Organic Matter (SOM) is classically considered as more recalcitrant than autochthonous organic matter. However, SOM contributes largely to carbon budget of aquatic ecosystems, mainly via the incorporation of soil organic carbon by bacteria. Furthermore, whether transported SOM is a C-sink through burial in aquatic sediments or a C-source due to rapid outgassing is still strongly debated. In soil sciences, it is now well established that presence of Labile Organic Matter (LOM), such as glucose or roots exudates, can influence SOM mineralization, this phenomenon being called Priming Effect (PE). Despite the abundance of LOM (e.g. transparent exo-polymers or algal exudates) in aquatic ecosystems, occurrence of PE during SOM processing in these ecosystems has almost never been evoked. In this study, we measured how quickly Soil Organic Matter (SOM) sampled from cropland, meadow, forest and bare fallow was mineralized in shallow and agitated aquatic systems as compared to 'classical' mineralization within soil horizons. We show that the most important factor controlling the C fluxes was the ecosystem where soils were sampled. Then, aquatic conditions increase SOM mineralization by 91% due to an important increase during the first days. Glucose addition simulating fresh LOM exudation by phytoplankton, increased by 18.7% the SOM mineralization in water. The amount of CO₂ derived from SOM mineralization emitted by aquatic systems might depend upon SOM aggregates stability, modulated by the availability of LOM and nutrients.



S11.08 - PHYSICO-CHEMICAL PROCESSES GOVERNING THE FATE AND TRANSPORT OF PATHOGENS AND BIOMACROMOLECULES IN SOILS

Chair Persons:

Jacques Berthelin, Nancy - France

Michael Sander, Zurich - Switzerland

Monday 02 July 2012 from 15:30 to 17:15. Room Mirto

S11.08 -1

MATRIX EFFECTS CRITICAL TO MICROBIAL TRANSPORT IN ORGANIC WASTE-AFFECTED SOILS; IMPLICATIONS FROM MULTIPLE SCALES RESULTS

Adrian Unc, Las Cruces, New Mexico - United States

S11.08 -2

GRAIN SIZE AND WATER VELOCITY COMBINED AND SYNERGISTIC EFFECTS ON BIOCOLLOID TRANSPORT

Vasiliki Syngouna, Patras - Greece

S11.08 -3

FORCES DRIVING ADSORPTION OF TRANSGENIC INSECTICIDAL CRY PROTEINS TO ORGANIC MATTER

Michael Sander, Zurich - Switzerland

S11.08 -4

KINETICS OF INFECTIOUS PRION PROTEIN ATTACHMENT TO CHARGED MINERAL SURFACES

Kurt Jacobson, Madison - United States

S11.08 -5

DO INTERMOLECULAR INTERACTIONS AFFECT CATALYTIC ACTIVITY OF FUNGAL PHOSPHATASE IN SOLUTION AND WHEN ADSORBED ON MINERAL SURFACES

Siobhan Staunton, Montpellier - France

S11.08 -6

ARTEMISININ IN SOIL AND ITS IMPACT ON MICROBIAL GROWTH

Bjarne W. Strobel, Copenhagen - Denmark



S11.08 -7

*IMPACT OF PHYSICOCHEMICAL PROPERTIES AND MICROBIAL COMMUNITY STRUCTURE
ON THE SURVIVAL OF E. COLI O157:H7 IN EASTERN CHINA SOILS*

Jianming Xu, *Hangzhou - China*



S11.08 -1

MATRIX EFFECTS CRITICAL TO MICROBIAL TRANSPORT IN ORGANIC WASTE-AFFECTED SOILS; IMPLICATIONS FROM MULTIPLE SCALES RESULTS

Unc Adrian^{*[1]}, Harter Thomas^[2], Goss Michael J.^[3], Cook Simon^[2], Li Xunde^[4], Mahboubi Ali A.^[5], Mosaddeghi Mohammad R.^[6], Atwill Edward R.^[7]

^[1]New Mexico State University ~ Plant and Environmental Science ~ Las Cruces, New Mexico ~ United States

^[2]University of California, Davis ~ Department of Land, Air, and Water Resources ~ Davis, California ~ United States

^[3]University of Guelph ~ Kemptville Campus ~ Kemptville, Ontario ~ Canada ^[4]University of California, Davis ~ Department of Population Health and Reproduction, School of Veterinary Medicine ~ Davis, California ~ United States

^[5]Bu-Ali Sina University ~ Department of Soil Science, College of Agriculture ~ Hamadan ~ Iran, Islamic Republic of

^[6]Isfahan University of Technology ~ Department of Soil Science, College of Agriculture ~ Isfahan ~ Iran, Islamic Republic of ^[7]University of California, Davis ~ Western Institute for Food Safety and Security ~ Davis, California ~ United States

One of the more theoretical questions about the current approach to assessing the risk of transport through soil of bacteria originating in organic waste is the significance of micro- versus macro-scale parameters. Assessments at different scales and test conditions can be integrated to evaluate the level of mechanistic or stochastic detail that should be adequate to describe risk. Stochastic, black box risk analyses at large scales regularly show it is possible for risk to be linked to macro-scale parameters. Field research across soil types appears to suggest that soil parameters (e.g. matrix properties), such as soil pores size, geometry and continuity, dominate the control of transport. On the other hand, mechanistic assessments at small scales indicate the capacity of microbial cells to interact with surfaces and among each other in flocs mediated by the organic material. In the presence of organic waste materials, however, the variable charge on bacterial cells may be less critical for cell retention. Thus it is not certain that detailed mechanistic approaches are significantly useful for estimating bacterial transport under field conditions or if soil pore heterogeneity parameters, even at macro-scale, may be singly sufficient to estimate risk. We integrated results from experiments carried-out ranging from centimeter to field scales. Results suggest that 1) results inferred from a given spatial scale cannot be necessarily directly transferred across a range of spatial scales and 2) cross-scale experimental integration may be critical for the development of coherent risk assessment parameters.



S11.08 -2

**GRAIN SIZE AND WATER VELOCITY COMBINED AND SYNERGISTIC EFFECTS ON
BIOCOLLOID TRANSPORT**

Syngouna Vasiliki^[1], Chrysikopoulos Constantinos^[1]

^[1]University of Patras ~ Department of civil engineering ~ Patras ~ Greece

The main objective of this study was to evaluate the combined effects of grain size and pore water velocity on the transport in water saturated porous media of three waterborne fecal indicator organisms (Escherichia coli, MS2, and FX174) in laboratory-scale columns packed with clean quartz sand. Three different grain sizes and three pore water velocities were examined. The attachment behavior of Escherichia coli, MS2, and FX174 onto quartz sand was evaluated. The mass recoveries of the three biocolloids examined were shown to be highest for Escherichia coli and lowest for MS2. However, no obvious relationships between mass recoveries and water velocity or grain size could be established from the experimental results. The observed mean dispersivity values for each sand grain size were smaller for bacteria than coliphages, but higher for MS2 than FX174. The single collector removal and collision efficiencies were quantified using the classical colloid filtration theory. Furthermore, theoretical collision efficiencies were estimated only for E. coli by the Interaction-Force-Boundary-Layer, and Maxwell approximations. Better agreement between the experimental and Maxwell theoretical collision efficiencies were observed.



S11.08 -3

FORCES DRIVING ADSORPTION OF TRANSGENIC INSECTICIDAL CRY PROTEINS TO ORGANIC MATTER

Sander Michael^[1], Michael Madliger^[1], Jeanne E. Tomaszewski^[1], Joel A. Pedersen^[2], René P. Schwarzenbach^[1]

^[1]ETH Zurich ~ Department of Environmental Sciences, IBP ~ Zurich ~ Switzerland ^[2]University of Wisconsin ~ Departments of Soil Science and Civil & Environmental Engineering ~ Madison ~ United States

Adsorption to natural organic matter is a key process affecting the environmental activity, stability, and transport of proteins, including enzymes, pathogenic prions, and insecticidal Cry proteins expressed by transgenic Bt crops. Despite its importance, protein adsorption to organic matter has received little attention. Here, we assess the adsorption of Cry1Ab, a commercially important Cry protein, to a large set of humic and fulvic acids as a function of solution pH and ionic strength I. Adsorption was measured by two in situ surface techniques, quartz crystal microbalance with dissipation monitoring and optical waveguide lightmode spectroscopy. Cry1Ab adsorption to negatively charged HS increased with decreasing I, also at pH above the isoelectric point of Cry1Ab (IEP= 6). This I-dependence suggests patch-controlled electrostatic attraction (PCEA), by which net negatively charged Cry1Ab was oriented with positively charged surface patches towards the HS. Molecular modeling of Cry1Ab, which shows a highly non-uniform surface charge distribution, supports the PCEA adsorption mechanism. Cry1Ab adsorption to HS decreased and desorption from HS increased with increasing pH, consistent with attenuation of PCEA due to the concomitant decrease in positive surface charge. At any given pH and hence Cry1Ab charge, adsorption varied considerably between the tested HS and was found to increase with decreasing HS polarity, suggesting that adsorption also had a strong contribution from the hydrophobic effect. Cry1Ab adsorbed to a selected humic acid retained full insecticidal activity in diet incorporation bioassays, demonstrating that adsorption did not result in irreversible structural changes of the Cry1Ab.



S11.08 -4

KINETICS OF INFECTIOUS PRION PROTEIN ATTACHMENT TO CHARGED MINERAL SURFACES

Jacobson Kurt^[1], Smith Christen^[2], Pedersen Joel^[1]

^[1]University of Wisconsin - Madison ~ Department of Civil and Environmental Engineering ~ Madison ~ United States

^[2]University of Wisconsin - Madison ~ Environmental Chemistry and Technology ~ Madison ~ United States

Transmissible spongiform encephalopathies (TSEs), or prion diseases, are a family of neurodegenerative disorders caused by a pathogenic conformational isomer of the mammalian prion protein (PrP). Due to the extreme stability of these misfolded proteins, dubbed PrPTSE, their release into the environment through alimentary or urinary shedding or carcass decomposition has been implicated in the spread of TSEs in some wild and domestic animal species. Understanding the forces that govern the interactions of PrPTSE with environmental surfaces will improve our understanding of the fate of infectious prions in soil environments. Heretofore, the forces governing the attachment of PrPTSE to environmental surfaces have been poorly understood. Here, we report the results of a study examining the attachment of PrP to charged mineral surfaces under diffusion limited attachment conditions. Combining data from a diverse group of techniques, including electron microscopy, atomic force microscopy (AFM), quartz crystal microbalance with dissipation monitoring (QCM-D) and optical waveguide lightmode spectroscopy (OWLS) has allowed us to begin to form a molecular level understanding of the interactions between these types of surfaces and infectious prions. Results of these experiments show that solution pH and ionic strength strongly influence the rate and extent of prion attachment to charged mineral surfaces, consistent with a dominant role for electrostatic interactions and protein aggregation state in PrPTSE attachment.

S11.08 -5

DO INTERMOLECULAR INTERACTIONS AFFECT CATALYTIC ACTIVITY OF FUNGAL PHOSPHATASE IN SOLUTION AND WHEN ADSORBED ON MINERAL SURFACES

Kedi Brice^[1], Duadin Gabrielle^[1], Sei Joseph^[2], Staunton Siobhan^{*[1]}, Quiquampoix Hervé^[1]

^[1]INRA ~ Eco&Sols ~ Montpellier ~ France ^[2]Univ Cocody ~ Lab Chimie Minérale ~ Abidjan ~ Côte d'Ivoire ^[3]Univ Cocody ~ Dept Chimie Minérale ~ Abidjan ~ Côte d'Ivoire

We have compared the catalytical activity of fungal phosphatase in solution and after adsorption on either kaolinite or montmorillonite as a function of purity and fractionation of raw extracts. Most measurements were made over a range of pH values (3 – 6). Protein containing solutions were purified using an Amicon filter and fractionated in a fast-flow chromatograph with a hydrophobic column. Catalytic activity was well preserved in the adsorbed state. Removal of low molecular weight impurities by diafiltration had no effect on the pH- dependence of activity in solution, nor on affinity for mineral surfaces nor the preservation of catalytic activity in the adsorbed form. The presence of proteins or protein-like molecules, concentrated in the fraction not retained on the hydrophobic column competed with phosphatases for adsorption, leading to decreased affinity for the mineral surfaces but had no effect on activity after adsorption. Protein-like substances were absent from fractions eluted from the hydrophobic columns. Phosphatase in these samples showed enhanced activity after adsorption. Comparison with the effect of adding another protein to these samples, and the concentration effect of phosphatases leads us to suggest that enhanced activity is due to dimerisation on the mineral surface. Dimerisation is prevented when nearest neighbours are not phosphatases..



S11.08 -6

ARTEMISININ IN SOIL AND ITS IMPACT ON MICROBIAL GROWTH

Herrmann Sarah^[1], Jessing Karina K.^[1], Kandeler Ellen^[2], Jorgensen Niels O.g.^[3], Strobel Bjarne W.^{*[1]}

^[1]University of Copenhagen ~ Dept. of Basic Sciences and Environment ~ Copenhagen ~ Denmark ^[2]University of Hohenheim ~ Institute of Soil Science and Land Evaluation ~ Stuttgart ~ Germany ^[3]University of Copenhagen ~ Dept. Agriculture and Ecology ~ Copenhagen ~ Denmark

The power of Artemisia annua L. to counter the pandemic disease malaria has been increasingly acknowledged in the last century, as this herb is the only source of the anti-malarial drug artemisinin. A. annua cultivation has expanded and the impact to soil and water organisms is presented. Artemisinin in leaves and distribution in soil was monitored underneath source plants. The effect on bacterial growth in an A. annua plantation was compared to an intercrop by using the 3H-Leucine incorporation and agar-plate counts. Artemisinin was found more than 2 m from the plant and up to a soil depth of 90 cm with a maximum concentration of 449 µg/kg. Soil-artemisinin concentration changed during the growing season with max leave content 0.019±0.002% and 0.035±0.001% of leave DW at 2 and 18 weeks, resp. Bacterial growth was reduced by 44% in the soil under A. annua plantation compared to control soil, in soil planted with the intercrop the reduction accounted for only 21%. Agar plate counts suggested effects on bacterial community composition and revealed also that the bacterial community is able to adapt to continuous artemisinin input. Artemisinin is leaching and potentially appears in groundwater and surface waters. A high artemisinin input to soil during growing season could impair bacterial growth and community composition and thus, humble soil quality. A large-scale cultivation of A. annua should implement alternative management strategies like intercropping and distances to vulnerable surface waters.



S11.08 -7

IMPACT OF PHYSICOCHEMICAL PROPERTIES AND MICROBIAL COMMUNITY STRUCTURE ON THE SURVIVAL OF *E. COLI* O157:H7 IN EASTERN CHINA SOILS

Wang Haizhen^[1], Xu Jianming^{*[1]}

^[1]Zhejiang University ~ Institute of Soil and Water Resources and Environmental Science, Zhejiang Provincial Key Laboratory of Subtropical Soil and Plant Nutrition ~ Hangzhou ~ China

In the present study, survival of E. coli O157:H7 in 14 soils collected from different geographic zones of eastern China was investigated. Bacterial, archaea, and fungi community structures from these soils were investigated using 454 pyrosequencing technique. The phospholipid fatty acids (PLFAs) in soil bacteria were identified by GC fitted with a MIDI Sherlocks microbial identification system. The survival experiments were conducted at 21±1 °C with a soil moisture content of 40% water holding capacity, and the initial cell concentration was about 10⁶ CFU/g soil. Survival data were modeled using Weibull model, and the calculated time points (td) when the cell concentration went below the detection limit (100 CFU/g soil) were correlated to the soil properties. E. coli O157:H7 survival time in days (td) was between 1.4-26 days. The longer survival of E. coli O157:H7 was observed in northeastern Chinese soils than in southeastern Chinese soils. Results showed that td was positively correlated with soil assimilable organic carbon (AOC), silt content, microbial biomass carbon (MBC), and the abundance of Actinobacteria and bacterial PLFAs, but negatively with the abundance of fungal PLFAs. The abundance of archaea had no significant effect on E. coli O157:H7 survival. Stepwise multiple regression analysis revealed that the survival of E. coli O157 was significantly enhanced by soil AOC and Actinobacteria, and significantly suppressed by clay content. Overall, the survival of E. coli O157:H7 in soils was mainly controlled by AOC, soil texture, and the interactions between indigenous microbial communities and the introduced pathogen.



S11.09a - UNDERSTANDING MINERAL-ORGANIC-MICROBIAL INTERACTIONS IN SOILS AND THE CONSEQUENCES FOR BIOLOGICAL AND BIOCHEMICAL ACTIVITY AND THE EFFICIENCY OF ROCK FLOUR AMENDMENTS

Chair Persons:

Siobhan Staunton, Montpellier - France

David Manning, Newcastle - United Kingdom

Thursday 05 July 2012 from 08:30 to 10:00. Room Leccio

S11.09a -1

INTERACTIONS OF SOIL ENZYMES IN SOIL AS REVEALED BY PROTEIN-DRIVEN DESORPTION

Flavio Fornasier, Gorizia - Italy

S11.09a -2

CHARACTERIZATION OF HYDROLYSABLE ORGANIC PHOSPHORUS IN SOIL SUSPENSIONS AND SOIL WATER EXTRACTS USING ENZYME ADDITIONS

Kathrin E. Annaheim, Lindau - Switzerland

S11.09a -3

STABILIZATION OF ORGANIC N IN RECALCITRANT POOLS: A 15N LITTER LABELLING EXPERIMENT

Carolin Bimüller, Freising-Weihenstephan - Germany

S11.09a -4

NANOSIMS IMAGING OF SOIL MICROAGGREGATES: A WINDOW ON THE PROCESSES RULING N DYNAMICS IN SOILS.

Laurent Remusat, Paris - France

S11.09a -5

BACTERIAL COMMUNITY IN ARTIFICIAL SOILS STRUCTURED BY MINERAL COMPOSITION AND CHARCOAL RESPONDED TO PHENANTHRENE

Doreen Babin, Braunschweig - Germany



S11.09a -1

INTERACTIONS OF SOIL ENZYMES IN SOIL AS REVEALED BY PROTEIN-DRIVEN DESORPTION

Fornasier Flavio^[1], Quiquampoix Hervé^[2]

^[1]Consiglio per la Ricerca e la Sperimentazione in Agricoltura ~ RPS-Gorizia Unit ~ Gorizia ~ Italy ^[2]Institut National pour la Recherche Agronomique ~ UMR Eco&sols ~ Montpellier ~ France

Interactions among soil and soil enzymes are important because adsorption phenomena have a deep influence on enzymes catalytic activity. However little knowledge is available about the nature of interactions of a given enzyme in a specific soil. To elucidate this we performed a series of extractions using different amounts of desorbing protein. Six soils were used and five enzymatic activities were measured: arylsulfatase, beta-glucosidase, leucine-aminopeptidase, acetate-esterase, alkaline phospho-monoesterase. Increasing desorbing protein amount increased extraction yield, but the response was very different for each enzyme. Different minimal amounts of desorption protein were necessary to detect enzymatic activities in the extract, depending on the soil and enzymatic activity. Dose-response effect was either linear or curvilinear and was both soil- and enzyme-specific. As a consequence, a plateau was reached only in some cases, even though the amount of protein used was up to about 30% of soil by weight. These results highlight that: i- a significant part of soil enzymes can be easily desorbed and; ii- interactions of different soil enzymes in a specific soil can be unveiled with this simple approach.



S11.09a -2

**CHARACTERIZATION OF HYDROLYSABLE ORGANIC PHOSPHORUS IN SOIL
SUSPENSIONS AND SOIL WATER EXTRACTS USING ENZYME ADDITIONS**

Annaheim Kathrin E.*^[1], Rufener Christina^[1], Frossard Emmanuel^[1], Bünemann Else K.^[1]

^[1]ETH ~ Institute of Agricultural Sciences ~ Lindau ~ Switzerland

Soil organic phosphorus (P) has to be enzymatically hydrolysed to orthophosphate before it can be taken up by plants. Potentially hydrolysable organic P can be measured by addition of phosphohydrolases to soil suspensions and extracts, followed by colorimetric measurement of released orthophosphate. The objectives of this study were (i) to characterize the substrate specificity of commercially available enzyme preparations using model substrates, (ii) and to measure the release of orthophosphate from soil water suspensions and extracts in order to characterize the availability of organic P in presence or absence of solid particles. Two Swiss grassland soils with high organic P and low orthophosphate concentrations were treated with seven different enzyme preparations, including acid and alkaline phosphomonoesterases, phytases and a nuclease. Based on the substrate specificity, P released from simple monoesters, inositol-hexakisphosphate and DNA could be distinguished. In all cases, more orthophosphate was released from soil suspensions than from filtered extracts. Hydrolysable organic P compounds in suspension ranged in the order DNA > inositol-hexakisphosphate > simple monoesters for one soil and simple monoesters > inositol-hexakisphosphate > DNA for the other soil. For the first soil, this contrasts with the typically low proportions of DNA and the dominance of simple and multiple monoesters in alkaline soil extracts as determined by ³¹P NMR. Thus, the addition of enzymes to soil suspensions can be a useful tool to characterize bioavailable organic P, and the comparison of suspensions and extracts helps to locate the hydrolysable substrate.



S11.09a -3

STABILIZATION OF ORGANIC N IN RECALCITRANT POOLS: A 15N LITTER LABELLING EXPERIMENT

Bimüller Carolin*^[1], Naumann Pascale S.^[1], Buegger Franz^[2], Dannenmann Michael^[3], Zeller Bernd^[4], Gasche Rainer^[3], Papen Hans^[3], Kögel-Knabner Ingrid^[1]

^[1]TU München ~ Lehrstuhl für Bodenkunde ~ Freising-Weihenstephan ~ Germany ^[2]Helmholtz Zentrum München ~ Institut für Bodenökologie ~ Neuherberg ~ Germany ^[3]Karlsruhe Institute of Technology ~ Institute of Meteorology and Climate Research - Atmospheric Environmental Research ~ Garmisch-Partenkirchen ~ Germany ^[4]Centre de Nancy ~ INRA ~ CHAMPENOUX ~ France

The mineralisation of soil organic matter is the main source for plant-available nitrogen in forest soils and is dependent on litter composition, its depolymerisation rate and the soil type. To trace and to quantify the fate of nitrogen in different soil pools through litter decomposition, 15N labelled litter was deposited on the soil of three 2 m x 2 m plots after removing fresh non-decomposed litter in April 2008. The studied site is characterized as a Rendzic Leptosol in a beech forest (Fagus sylvatica) with humus type mull near Tuttlingen (Swabian Jura, Germany). The isotopic nitrogen composition of the bulk soil and the soil fractions were monitored the following three years through several harvests of the litter and the Ah horizon (0-10 cm). A combined density and particle-size fractionation with sodium polytungstate and ultrasonic dispersion allowed the separation of the free light fraction, occluded organic matter and organo-mineral associations. Subsequently, light and heavy soil fractions, bulk soil and litter samples were measured for 15N concentration. Measurements of 15N concentration showed a first increase in the free light fractions after 140 days and a time-delayed recovery in the occluded light fractions, indicating a slow aggregate turnover. Furthermore, the observed results indicate a quick transfer of 15N-enriched compounds from litter to the clay fractions, where the enrichments per soil unit exceeded the concentrations of the light fractions already after 140 days. The high concentrations of 15N in the clay fractions revealed a dominant role of organo-mineral associations for the stabilization of nitrogen.



S11.09a -4

NANOSIMS IMAGING OF SOIL MICROAGGREGATES: A WINDOW ON THE PROCESSES RULING N DYNAMICS IN SOILS.

Remusat Laurent^[1], Derrien Delphine^[2], Hatton Pierre-Joseph^[2], Zeller Bernd^[2]

^[1]Museum National d'Histoire Naturelle ~ LMCM ~ Paris ~ France ^[2]INRA ~ Biogéochimie des Ecosystèmes Forestiers ~ Champenoux ~ France

Soil organic matter represents the major source of nitrogen in natural ecosystems: plant productivity strongly depends on the rate of nitrogen release by decaying litter and microbial recycling, two processes governed by interactions within the soil matrix. ¹⁵N labelling combined with Isotope Ratio Mass Spectrometry has been very useful to assess the fate of litter-derived nitrogen over time and its uptake by plants. The complimentary use of nano-scale secondary ion mass spectrometry (NanoSIMS), by tracking isotopic label at the micron scale, shed new lights on the influence of organomineral interactions on N dynamics. We present results from the NanoSIMS imaging of ¹⁵N labelled soil microaggregates recovered from short and long term incubations. We studied a soil incubated for eight hours with ¹³C¹⁵N glycine. Images indicate a fast utilization of the soluble glycine by microbes revealed by the spatial decoupling of ¹³C and ¹⁵N locations in organic matter attached to soil particles. The distribution of the label is not correlated with the particles typology, and is likely driven by the location of microbes in the soil matrix. We also imaged some soil particles collected from a decadal incubation of ¹⁵N labelled litter. The label derived from the litter was found as submicron sized clusters. Though these clusters are likely not preserved vegetal debris, they contain OM that has not been heavily reprocessed by microbes because an intense recycling would have diluted and spread the isotopic signal. Here, association of OM with a complex mineral structure may have hampered microbial activity.



S11.09a -5

BACTERIAL COMMUNITY IN ARTIFICIAL SOILS STRUCTURED BY MINERAL COMPOSITION AND CHARCOAL RESPONDED TO PHENANTHRENE

Babin Doreen*^[1], Ding Guo-Chun^[1], Pronk Geertje Johanna^[2], Heuer Holger^[1], Heister Katja^[2], Kögel-Knabner Ingrid^[2], Smalla Kornelia^[1]

^[1]Julius Kühn-Institut, Federal Research Centre for Cultivated Plants ~ Institute for Epidemiology and Pathogen Diagnostics ~ Braunschweig ~ Germany ^[2]Technische Universität München ~ Lehrstuhl für Bodenkunde ~ München ~ Germany

In soil, organic, inorganic and biological constituents are contacting each other and forming biogeochemical interfaces upon which important processes for the ecosystem act. This study tries to gain insights into the highly diverse, complex microbial communities in soil. Since the comparison of microbial communities from natural soils is problematic, different artificial soils with a known mineral composition were used. To each artificial soil the same microbial community extracted from a natural Cambisol and autoclaved manure as organic matter was added. They were incubated under constant environmental conditions up to 18 months. The influence of mineral composition and charcoal on the establishment of microbial communities was studied. Total community DNA was extracted and the 16S rRNA gene and ITS amplicons for Bacteria or Fungi, respectively, were used in DGGE. The DGGE data showed that soil minerals and charcoal influence microbial community structure in short and long term. Pyrosequencing of day 90 samples confirmed a striking effect of charcoal on the bacterial community and several discriminative taxa were identified between the artificial soils. Furthermore, the response of microbial communities at biogeochemical interfaces to phenanthrene was explored. Therefore, one-year old artificial soil samples were spiked with phenanthrene (2 g/kg) and incubated for another 70 days. Cultivation and DGGE showed a strong response of Bacteria, Actinobacteria, Alphaproteobacteria and Betaproteobacteria to phenanthrene spiking whereas no effect was seen for Fungi.

In conclusion, it was shown that mineral composition, charcoal and phenanthrene are important factors shaping the composition of microbial communities established in artificial soils.

S11.09b - UNDERSTANDING MINERAL-ORGANIC-MICROBIAL INTERACTIONS IN SOILS AND THE CONSEQUENCES FOR BIOLOGICAL AND BIOCHEMICAL ACTIVITY AND THE EFFICIENCY OF ROCK FLOUR AMENDMENTS

Chair Persons:

David Manning, Newcastle - United Kingdom

Siobhan Staunton, Montpellier - France

Thursday 05 July 2012 from 10:30 to 12:00. Room Leccio

S11.09b -1

ENZYMATIC OXIDATION OF CARBON INPUTS AS AFFECTED BY METAL-ORGANIC COMPLEXATION

Maria Hernandez-Soriano, Raleigh - United States

S11.09b -2

TO WHAT EXTENT CLAY MINERALS AFFECT SOIL AGGREGATION? A QUANTITATIVE APPROACH BASED ON X-RAY PATTERNS MODELLING

Oihane Fernandez-Ugalde, Paris - France

S11.09b -3

ROCK FLOUR FERTILIZATION: NEW PERSPECTIVES FOR AN ANCIENT TECHNIQUE.

David Manning, Newcastle - United Kingdom

S11.09b -4

V.M. GOLDSCHMIDT AND COLLABORATORS - UNKNOWN ROCK POWDER PIONEERS – A REVIEW

Michael Heim, Aas - Norway

S11.09b -5

DECREASING CO₂ EMISSION IN AGRICULTURE BY USING ROCK FLOUR AS AN ALTERNATIVE FOR AGRICULTURAL LIME AND POTASSIUM FERTILISERS

Rene Rietra, Wageningen - Netherlands

S11.09b -6

K-SILICATE MINERALS AS A SOURCE OF K FOR LEEKS (ALLIUM PORRUM) IN SANDY SOIL

Safiya Mohammed Othoman, Newcastle upon Tyne - United Kingdom



S11.09b -1

ENZYMATIC OXIDATION OF CARBON INPUTS AS AFFECTED BY METAL-ORGANIC COMPLEXATION

Hernandez-Soriano Maria*^[1]

^[1]NORTH CAROLINA STATE UNIVERSITY ~ SOIL SCIENCE ~ Raleigh ~ United States

Soil respiration constitutes a major source for carbon dioxide release to the atmosphere, but metal-organic complexation may delay soil microbial activity. Phenolic compounds, e.g. gallic acid (GA), are ubiquitous in soil, originated from natural or anthropogenic inputs of organic carbon (OC), and therefore a common substrate for microbial degradation. Aqueous solutions of gallic acid (GA) (0.050 mM) were added with increasing concentrations of FeCl₃•6H₂O (0–0.4 mM). UV-visible spectrometry demonstrated the complexation of Fe(III) by gallic acid and fluorescence emission spectra were collected to characterize the formation of such GA-Fe complexes. Spectral attenuation (quenching) determined by excitation-emission matrix fluorescence spectroscopy confirmed the formation of metal-organo complexes. The spectrometric analysis demonstrated the formation of complexes of Fe(III) with gallic acid by Fe binding to the phenolic groups, but moreover provided information on the types of metal-organic complexes, which depended on Fe(III) concentration. The formation of metal-organo complexes was related to the alteration of the enzymatic oxidation rate of GA by the enzyme tyrosinase (L-DOPA was used as a control), determined by spectrophotometric measurement at 300 nm. Overall, structural changes to the gallic acid molecule due to metal complexation inhibited its enzymatic oxidation. Similar processes might inhibit degradation of soil organic matter.



S11.09b -2

TO WHAT EXTENT CLAY MINERALS AFFECT SOIL AGGREGATION? A QUANTITATIVE APPROACH BASED ON X-RAY PATTERNS MODELLING

Fernandez-Ugalde Oihane^[1], Barré Pierre^[1], Hubert Fabien^[2], Virto Iñigo^[3], Chenu Claire^[4], Ferrage Eric^[2], Caner Laurent^[2]

^[1]Ecole Normale Supérieure ~ Laboratoire de Géologie ~ Paris ~ France ^[2]Université de Poitiers ~ Hydrasa Laboratory ~ Poitiers ~ France ^[3]Universidad Pública de Navarra ~ Ciencias del Medio Natural ~ Pamplona ~ Spain ^[4]AgroParisTech ~ BIOEMCO Laboratory ~ Thiverval-Grignon ~ France

Aggregation is a key process for soil functioning as it influences C storage, vulnerability to erosion and water holding capacity. If the influence of soil C content or tillage on aggregation has been documented, little is known about the role of soil mineralogy. The aim of this study is to determine quantitatively if different clay-size minerals of a temperate soil contribute differently to aggregation and if their contribution is modulated by soil management. We compared aggregate-size distribution and C content of mouldboard-ploughing (tilled yearly), minimum-tillage (tilled every 4 years) and grassland in the 0-5 cm from a long-term trial in a silt loam soil in Versailles (France). For each size-class, fraction <2 µm was separated for identification and quantification of minerals by modelling X-ray diffractograms using the Sybilla software. C content was lower in the mouldboard-ploughing treatment than in the two others. The proportion of large-macroaggregates (500-5000 µm) was greater in minimum-tillage and grassland; while microaggregates (50-250 µm) showed greater proportions in mouldboard-ploughing. In the three treatments, microaggregates had the greatest amount of clay, with preferential accumulation of smectite. In grassland, clays from all aggregated fractions showed more smectite than free-clay fraction. The results indicate that swelling clays contributed particularly to the microaggregates dynamics. Their contribution to aggregation was lower for bigger aggregate sizes where the influence of organic matter and fungal hyphae was preponderant. Moreover, it was observed that cultivation reduced selection of swelling clays in aggregates which makes them more vulnerable to erosion and alters their physico-chemical functions.



S11.09b -3

ROCK FLOUR FERTILIZATION: NEW PERSPECTIVES FOR AN ANCIENT TECHNIQUE.

Manning David*^[1], Bergsma Huig^[2], Bleken Marina^[3]

^[1]Newcastle University ~ Civil Engineering & Geosciences ~ Newcastle upon Tyne ~ United Kingdom ^[2]ARCADIS Nederland BV ~ Geochemistry ~ Apeldoorn ~ Netherlands ^[3]Norwegian University of Life Sciences ~ Plant & Environmental Sciences ~ Ås ~ Norway

In October 2011 world population reached 7 billion. Agricultural production is under increasing pressure, and valuable cropland is suffering increased soil degradation. Solid solutions are needed and cannot be found by improvement of existing cropping techniques alone. To achieve sustainable progress we have to broaden our understanding of soil fertility, combining and reevaluating several disciplines of soil science. Soil mineralogy is fundamental when it comes to soil fertility. Soil minerals are the backbones of agriculture providing nutrients, shelter for various soil life forms, preserving organic matter, and reducing atmospheric CO₂ levels. High crop production and large scale application of fertilizer and soil conditioners have made us think of soil minerals as an inert substrate rather than particles that can be exhausted. Loss of mineral function relates to problems including rapidly disappearing (sub)tropical forests, loss of soil organic matter and nutrient deficiencies in moderate climate zones. Rock flour fertilization represents a viable option to encounter these problems. Rock forming minerals can protect, replace and improve soil mineralogy. Considered so far mainly for nutrient delivery, other merits will prove to be as valuable in the years to come. Rock flour should be regarded as a supplemental instead of a competing technique. However, before introducing it as a tool for soil restoration, more insight is needed regarding the overall response of soil performance to different types of rock flour.



S11.09b -4

V.M. GOLDSCHMIDT AND COLLABORATORS - UNKNOWN ROCK POWDER PIONEERS – A REVIEW

Heim Michael*^[1], Bleken Marina Azzaroli^[1]

^[1]Norwegian University of Life Sciences ~ Dept of plant and environmental sciences ~ Aas ~ Norway

Experiments with Norwegian rock powder started during WW1, in consequence of K-fertilizer shortage, under the lead of renowned geochemist V.M. Goldschmidt. Theory and chemical tests indicated that, under northern climatic conditions, biotite-mica and not as generally accepted K-feldspar was the principal primary source of K to plants (Goldschmidt and Johnsen 1922). To test this, the most extended Norwegian 'rocks for crops' experiments ever – concerning geological materials used, soil types, geographical distribution and duration – were done from 1922 to 1935, in collaboration with the Agricultural College of Norway (Cranner 1922, Solberg 1928, Retvedt 1938). Fundamental to these investigations was Goldschmidt's selection and mineralogical control of applied rock powders, and their duration (up to 9 years) to document long time effects, important aspects often missing in later experiments. These outstanding field experiments with K-bearing rock powders, showed that under northern conditions: 1)Biotite and phlogopite (Mg-biotite) gave highest yields, occasionally exceeding those of soluble fertilizer (KCl), especially in long time experiments. K-feldspar and muscovite (sericite) had little effect, 2)Rock powders showed best effects in peat soil, low effects in clay soils 3)A long-lasting effect, reducing the need for frequent application was observed. Fine grained fractions reacted fast, coarse ones slower but longer and 4)Surficial application of biotite/phlogopite had good effect on perennial crops like grass etc The results published locally and in Norwegian, have remained largely unknown. The aim of this review is to make these ground-breaking investigations known internationally, critically considering their relevance almost 100 years after their initiation by Goldschmidt.



S11.09b -5

DECREASING CO₂ EMISSION IN AGRICULTURE BY USING ROCK FLOUR AS AN ALTERNATIVE FOR AGRICULTURAL LIME AND POTASSIUM FERTILISERS

Rietra Rene*^[1]

^[1]Wageningen University and Research Centre ~ Alterra, Soil Science ~ Wageningen ~ Netherlands

Rock flours are natural resources that have been used since a long time as plant nutrient sources and soil conditioners. Although rock flour clearly has positive effects on the soil pH the efficiently compared to lime is not well known, and a significant effect on plant growth has only been shown for a limited type of rock flours that can deliver potassium. The application of basic rock flours has received new attention as it has potential to remediate CO₂ emission from agriculture. Rock flour has the potential to be an alternative for agricultural lime, which according to IPCC causes CO₂ emissions and it has potential to deliver potassium with low energy (CO₂) costs. I will present results from a field trial with grass where we have added various rates of olivine to a soil and a rock flour, and compared this to using conventional fertilisation with kieserite and lime. Olivine is used here as a model for basic silicates. During two years the effects on soil and grass have been determined. Besides using rock flour as an alternative for agricultural lime it has been suggested that rock flours such as olivine might be used to bind CO₂ from the air (Krijgsman and Schuiling, 2006; Köhler et al, 2010), although experimental proof for this is lacking. Therefore I will present the experimental results of using olivine in lysimeters during two years, and its effect on bicarbonate concentrations in the leachate.



S11.09b -6

K-SILICATE MINERALS AS A SOURCE OF K FOR LEEKS (*ALLIUM PORRUM*) IN SANDY SOIL

Mohammed Othoman Safiya^{*[1]}, Manning David^[2], Gray Neil^[2], Brandt Kirsten^[1]

^[1]Newcastle University ~ Agriculture, Food & Rural Development ~ Newcastle upon Tyne ~ United Kingdom ^[2]Newcastle University ~ Civil Engineering & Geosciences ~ Newcastle upon Tyne ~ United Kingdom

*Potassium is one of the most important plant nutrients in agriculture; it is essential for plant growth, required in large amounts, rapidly lost from agricultural soils, and sources are limited. The potential value of K silicate minerals as a novel source of K was assessed using leek (*Allium porrum* var. Oarsman F1). Leek seedlings were grown with 3 plants per 1 kg pot artificial soil under controlled climate conditions and controlled appropriate soil water potential. Potassium chloride (63% K₂O equivalent) was used as a positive control, and silicate mineral sources of K were feldspar (microcline; 11% K₂O) and biotite (9% K₂O), with application rates 138 – 550 mg K/kg soil. Soil physical and chemical characteristics were analysed. Crop growth was assessed by measurement of plant neck diameter as well as fresh and dry mass. Leek growth rates (increase in neck diameter) for an application of 550 mg K/kg soil were: K-free control: 0.11 mm/week, microcline 0.19 mm/week, biotite 0.42 mm/week and KCl 0.49 mm/week. These results reflect the expected slow release of K from microcline, demonstrating its potential as a long-term source of K. Biotite appears to be as effective as KCl as source of K, due to its high cation exchange capacity. Together with other experiments using natural soil and/or other K-sources and doses, the study showed that measurement of leek neck diameter is an excellent indicator of K-dependent growth, due to an almost linear increase for 6 weeks or more in all treatments.*

W11.01 - THROUGH EYE OF THE NEEDLE: THE SOIL MICROBIAL BIOMASS CONCEPT FROM NUTRIENT CYCLING TO GLOBAL WARMING - Dedicated to the memory of Professor David Jenkinson

Chair Persons:

Maria de Nobili, Udine - Italy

Phil Brookes, Rothamsted - United Kingdom

Emmanuel Frossard, Zurich - Switzerland

Tuesday 03 July 2012 from 15:30 to 17:30. Room Alloro

W11.01 -1

DAVID JENKINSON AND THE SOIL MICROBIAL BIOMASS

Philip Brookes, Harpenden - United Kingdom

W11.01 -2

SOIL PROTEOMICS: A TOOL FOR LOOKING THROUGH THE EYE OF THE NEEDLE IN THE HAYSTACK?

Giancarlo Renella, Florence - Italy

W11.01 -3

MICROBIAL BIOMASS AND GREENHOUSE GAS EMISSION IN TROPICAL PEAT SOIL

Kazuyuki Inubushi, Matsudo - Japan

W11.01 -4

MICROBIAL CONTROL ON STABILITY OF SOIL ORGANIC MATTER UNDER DROUGHT

Evgenia Blagodatskaya, Pushchino - Russian Federation

W11.01 -5

MINERALIZATION-IMMOBILIZATION OF SULFUR IN A SOIL DURING DECOMPOSITION OF CROP RESIDUES VARYING BY THEIR BIOCHEMICAL QUALITY AND S CONTENT

Sylvie Recous, Reims - France

W11.01 -6

PHOSPHORUS, CARBON AND NITROGEN INTERACTIONS IN TROPICAL GRASSLANDS ON HIGHLY WEATHERED SOILS

Astrid Oberson, Lindau - Switzerland



W11.01 -7

C:N:P STOICHIOMETRY OF THE SOIL MICROBIAL BIOMASS IN A GRAZED GRASSLAND SITE UNDER EXPERIMENTAL P LIMITATION OR EXCESS

Bryan Griffiths, Wexford - Ireland

W11.01 -1

DAVID JENKINSON AND THE SOIL MICROBIAL BIOMASS

Brookes Philip*^[1], Powlson David^[1]

^[1]Rothamsted Research ~ Sustainable Soils and Grassland Systems ~ Harpenden ~ United Kingdom

Professor David Jenkinson's pioneering idea of studying the soil microorganisms as a single unit, or black box, has massively influenced soil science, as the number of related papers, published worldwide, has shown. The original method based upon CHCl₃ fumigation, and published with David Powlson in 1976, was a bioassay. It stood the test of time until 1985, when the first of a number of fumigation based procedures, with Phil Brookes, converted the original method to a chemically based procedure (Fumigation Extraction) which had many advantages. The biomass methods were much more than simply procedures to characterize soils. They opened up many new research areas and are used all over the world in research into carbon and nutrient dynamics, mathematical modeling, microbial survival, soil quality and much more.



W11.01 -2

SOIL PROTEOMICS: A TOOL FOR LOOKING THROUGH THE EYE OF THE NEEDLE IN THE HAYSTACK?

Renella Giancarlo^{*[1]}, Giagnoni Laura^[2], Arenella Mariarita^[3], Landi Loretta^[4], Nannipieri Paolo^[5]

^[1]University of Florence ~ Department of Plant Soil and Environmental Sciences ~ Florence ~ Italy ^[2]University of Florence ~ Department of Plant Soil and Environmental Sciences ~ Florence ~ Italy ^[3]University of Florence ~ Department of Plant Soil and Environmental Sciences ~ Florence ~ Italy ^[4]University of Florence ~ Department of Plant Soil and Environmental Sciences ~ Florence ~ Italy ^[5]University of Florence ~ Department of Plant Soil and Environmental Sciences ~ Florence ~ Italy

Definition of the soil microbial biomass (SMB) concept has allowed great progresses in the study of the soil organic matter (SOM) turnover, and allowed to identifying and quantifying the microbial the C, N, P and S pools. Among the most relevant advances brought by the SMB concept there is the fact that microbial C, N, P and S pools, which represents 1-4% of the total organic pools, play a relevant ecological role because undergo faster biogeochemical cycles than the non cellular soil OM and the SMB acts as both source and sink of nutrients for plants. The SMB seen as black box containing interactive microbial species has been successfully applied in soil agro-ecology as early indicator of soil pollution ecological changes, and modelling of SOM dynamic. The fast development of the so called 'omic' approaches allowed the identification of a large number of species and the study of gene expression of selected soil microbial species. Among them, soil proteomics aims at identifying proteins expressed in the soil microbial communities with key ecological functions, through the study of the protein expression profile of living organisms. Soil proteomics has been mainly studied by non-soil scientists such as molecular microbiologists and protein chemists, and consequently the illuminating concept that the microbial biomass only contains at most 4% of soil total N has been neglected, drawing probably misleading conclusions. As proteins theoretically account for 50% of SMB, advances in soil proteomics may shed new light on the protein turnover and N stabilization in soils



W11.01 -3

MICROBIAL BIOMASS AND GREENHOUSE GAS EMISSION IN TROPICAL PEAT SOIL

Inubushi Kazuyuki^{*[1]}, Arai Hironori^[2], Hadi Abdul^[3], Darung Untung^[4], Limin Suwido^[6], Hatano Ryusuke^[7]

^[1]Chiba University ~ Graduate School of Horticulture ~ Matsudo ~ Japan ^[2]Chiba University ~ Graduate School of Horticulture ~ Matsudo ~ Japan ^[3]Lambung Mangkurat University ~ Faculty of Agriculture ~ Banjarbaru ~ Indonesia ^[4]University of Palangka Raya ~ Faculty of Agriculture ~ Palangka Raya ~ Indonesia ^[5]University of Palangka Raya ~ Faculty of Agriculture ~ Palangka Raya ~ Indonesia ^[6]University of Palangka Raya ~ Faculty of Agriculture ~ Palangka Raya ~ Indonesia ^[7]Hokkaido University ~ Graduate School of Agriculture ~ Sapporo ~ Japan

Huge amount of greenhouse gases such as carbon dioxide (CO₂) and nitrous oxide (N₂O) has been emitted in tropical peat soil. Microbial biomass is one of the important factors to understand CO₂ and N₂O emission which is derived from microbial reactions. However, interrelationship between greenhouse gas emission and microbial biomass is not clear. This study was conducted to quantify the microbial biomass in tropical peat soil and clarify the interrelationship among microbial biomass, CO₂ and N₂O emission. Field observation was carried out near Palangka Raya in Central Kalimantan, Indonesia from July 2009 to March 2011. CO₂ and N₂O fluxes were measured using the closed chamber method. Soil samples were collected to determine soil properties including SOC (soluble organic carbon) content. Fumigation-extraction method was applied to measure microbial biomass carbon (MBC) and microbial biomass nitrogen (MBN). MBC and MBC/SOC ratio showed positive linear relationships with CO₂ flux in the forest land ($r=0.74^{**}$, and $r=0.93^{**}$, respectively; ** : $P<0.01$), but not in the cropland. However, it was found that CO₂ flux in cropland was correlated with precipitation and high N₂O flux ($r=0.90^{**}$, and $r=0.81^{**}$). MBC/MBN ratio also showed significant positive relationships with CO₂ flux in natural forest ($r=0.92^{**}$) and burned forest ($r=0.76^{*}$; * : $P<0.05$). These results indicated that CO₂ emitting process may be different in forest area and cropland. C/N ratio of microbial biomass may influence CO₂ emission in forest area. However, CO₂ emission in cropland is controlled by different factors such as precipitation which will enhance N₂O emission.



W11.01 -4

MICROBIAL CONTROL ON STABILITY OF SOIL ORGANIC MATTER UNDER DROUGHT

Blagodatskaya Evgenia*^[1], Schrumpf Marion^[2], Weber Enrico^[2], Wutzler Thomas^[2], Gleixner Gerd^[2], Reichstein Markus^[2], Trumbore Susane^[2]

^[1]Russian Academy of Sciences ~ Institute of Physicochemical and Biological Problems in Soil Science ~ Pushchino ~ Russian Federation ^[2]Max Planck Institute for Biogeochemistry ~ Biogeochemical Processes ~ Jena ~ Germany

*Extending drought periods as a consequence of global warming affect both the amount and the activity of heterotrophic microorganisms in soil. The studies of drought effect on the decomposition of soil organic matter (SOM) which is microbially mediated still show controversial results mainly due to separated research approaches which do not consider the soil – plant system as a whole. We would like to discuss the results obtained within the QuaSOM experiment (Max Planck Institute for Biogeochemistry Jena, Germany) where continuous ¹³C- CO₂-labeling was applied during vegetation of peppermint (*Mentha piperita* L.) under deficit and optimal moisture regimes. The partitioning of plant-originated and SOM-originated carbon in heterotrophic respiration and in microbial biomass will be related to the changes in the microbial growth parameters and enzymes kinetics. The drought effect on temperature sensitivity of the enzymes responsible for the decomposition of SOM-compounds of different availability will be compared in the rhizosphere of peppermint versus bulk soil. The effect of vegetation on cycling of organic matter in soil will be considered for the contrasting moisture regimes. The changes in carbon sequestration potential due to priming effects caused by repeated drying – rewetting events will be evaluated for the short term time scale.*



W11.01 -5

MINERALIZATION-IMMOBILIZATION OF SULFUR IN A SOIL DURING DECOMPOSITION OF CROP RESIDUES VARYING BY THEIR BIOCHEMICAL QUALITY AND S CONTENT

Recous Sylvie^{*[1]}, Hamid Niknahad-Gharmakher^[2], Séverine Piutti^[3], Jean-Marie Machet^[4], Emile Benizri^[5]

^[1]INRA ~ UMR 614 Fractionnement des Agroressources et Environnement ~ Reims ~ France ^[2]Gorgan University of Agricultural Sciences and Natural Resources ~ Rangeland management Department ~ Gorgan ~ Iran, Islamic Republic of ^[3]INPL-ENSAIA ~ Laboratoire Agronomie et Environnement ~ Vandoeuvre-lès-Nancy ~ France ^[4]INRA ~ Unité Agro-Impact ~ Laon ~ France ^[5]INPL-ENSAIA ~ Laboratoire Sols et Environnement ~ Vandoeuvre-lès-Nancy ~ France

Sulfur (S) is an essential element for plants and animals. Because elements combine in soil organic matter, the C and S cycles are interdependent. The recycling and decomposition of plant residues can be an important source of available sulfate in soils, compared to the soil available S, which requires prediction for adequate sulfur management in agricultural soils. The aims of our study was to investigate (i) the effect of soil sulfate availability on crop residue decomposition and associated S mineralization and (ii) the relationships between plant residue quality (both plant biochemistry and S content) and S and C mineralization. Therefore in a first soil incubation experiment we examined the effect of initial soil sulfate content on decomposition by adding sulfate at two different concentrations in a presence of a single rate of rapeseed straw addition in a loamy soil. Then in a second experiment, we used four other residues of different biochemical compositions and S contents (wheat straw, tall fescue, mustard and beech leaves) to assess the relationship between S mineralization and plant residue composition. Net C and S mineralization were measured continuously during a 175-day incubation at 20°C and gross S mineralization and immobilization were quantified using ³⁵S soil labeling applied as pulses during incubation. The data obtained allowed to quantify S fluxes during plant residues decomposition, to discuss the relationships between kinetics of gross and net S mineralization, C dynamics, residues quality and their decomposition, and between net S mineralization and the C/S of plant residues.



W11.01 -6

PHOSPHORUS, CARBON AND NITROGEN INTERACTIONS IN TROPICAL GRASSLANDS ON HIGHLY WEATHERED SOILS

Oberson Astrid*^[1], Maike Nesper^[1], Django Hegglin^[1], Steve Fonte^[2], Idupulapati M. Rao^[2], Bertha Ramirez^[3], Jaime Veilasquez^[3], Else Bünemann^[1], Emmanuel Frossard^[1]

^[1]ETH Zurich ~ Institute of Agricultural Sciences, Group of Plant Nutrition ~ Lindau ~ Switzerland ^[2]Centro Internacional de Agricultura Tropical (CIAT) ~ Soil Ecology ~ Cali ~ Colombia ^[3]Universidad de la Amazonia ~ Agroforestry ~ Florencia ~ Colombia

The highly weathered pasture soils of the deforested areas of tropical South America usually have low phosphorus (P) contents which can strongly limit soil functions associated with the cycling of carbon (C) and nitrogen (N). Although the importance of P deficiency in pasture degradation has been recognized, knowledge on stoichiometry of C, N and P along pathways of nutrient cycles of pastures with different botanical composition and productivity is limited. We realized a case study on farms in Colombia. Our objectives were to determine whether: i) P availability is lower in degraded than productive pastures; ii) introduction of legumes increases P availability through enhanced biological P cycling; iii) pasture types affect C:N:P ratios in nutrient pools of the soil-plant system. We included nine farms, with degraded grass alone (GD), productive grass-alone (GA) and productive grass-legume pastures (GL) on each. Results showed that plant biomass production, litter deposition, soil organic P and basal soil respiration were significantly lower in GD than GA and GL. Total C, N, P and microbial P tended to be lower in soils of GD, and GD soils had less large macro-aggregates (>2000 µm) but more small macro- (250-2000 µm) and micro-aggregates (53-250 µm) than GA. Legume biomass had significantly higher N concentration and tended to have higher P concentration than grasses. This work highlights the importance of biological P cycling for sustainable pastoral systems. Analyses currently in progress will improve our understanding of the interactions of P with C and N in these systems.



W11.01 -7

C:N:P STOICHIOMETRY OF THE SOIL MICROBIAL BIOMASS IN A GRAZED GRASSLAND SITE UNDER EXPERIMENTAL P LIMITATION OR EXCESS

Griffiths Bryan^{*[1]}, Bonkowski Michael^[2], Spilles Annette^[2]

^[1]Teagasc ~ Environment Research Centre ~ Wexford ~ Ireland ^[2]University of Cologne ~ Cologne Biocenter ~ Köln ~ Germany

On a global-scale, the C:N:P ratio of soil and the soil microbial biomass tend to be constrained, with the suggestion that differences in soil microbial biomass element ratios could provide an insight into nutrient limitation in terrestrial ecosystems. Previous work on cut, rather than grazed, grassland showed clearly that both microbial biomass P and the biomass C:P were sensitive to long-term fertiliser regimes. Given the changing inputs of inorganic nutrients to many grassland soils we wanted to determine whether the stoichiometry of the soil microbial biomass could be affected by an unbalanced nutrient supply and if we could experimentally show nutrient limitation of the soil microbial biomass. We sampled plots from a long term grazing trial instigated in 1968 in which phosphorus has been applied annually at 0 (P0), 15 (P15) and 30 (P30) kg ha⁻¹, with a split in 1999 to reduce P applications to the high-P plots and increase P to the low-P plots. Increasing fertiliser P increased microbial biomass C, N and P, and the C:P ratio but did not significantly affect the biomass C:N ratio. Substrate induced respiration indicated differential nutrient limitation, with the 0 P treatment having the smallest slopes and respiratory quotient. Multi-variate analysis grouped the treatments as: [0-0]; [15-15/15-5]; [0-30/30-0]; [30-30]. Analysis of the nematode and microbial community structure revealed a shift in the bacterial: fungal ratio which might explain the observed differences in microbial biomass C:N:P.



S12.01 - PEDOLOGICAL PROCESSES AND SOIL POLLUTION

Chair Person:

Claudio Zucca, Sassari - Italy

Friday 06 July 2012 from 08:30 to 10:00. Room Olmo

S12.01 -1

TRANSITION METAL STABLE ISOTOPE SYSTEMS IN SOIL SCIENCE

Moritz Bigalke, Bern - Switzerland

S12.01 -2

EARTHWORM BIOTURBATION INFLUENCE ON METALS BIOACCESSIBILITY AND BIODISPONIBILITY IN POLLUTED SOILS

Yann Foucault, Castanet-Tolosan - France

S12.01 -3

TRACE METAL CONTENTS IN AGRICULTURAL TOPSOILS AND SUBSOILS OF THE ISLAND OF RAB, CROATIA

Helena Bakic, Zagreb - Croatia

S12.01 -4

NUTRIENT AND POLLUTANT STATUS IN ARABLE SOILS IN THE PERI-URBAN REGION OF BEIJING

Marco Roelcke, Braunschweig - Germany

S12.01 -5

SOIL POLLUTION MEASUREMENTS IN THE QUIRRA AREA, SARDINIA ISLAND (ITALY)

Massimo Zucchetti, Torino - Italy



S12.01 -1

TRANSITION METAL STABLE ISOTOPE SYSTEMS IN SOIL SCIENCE

Bigalke Moritz^{*[1]}, Wilcke Wolfgang^[1]

^[1]Geographic Institute University of Bern ~ Soil Science Group ~ Bern ~ Switzerland

Further to the established use of traditional stable isotope systems like those of H, C, N, O or S, application of a new group of non-traditional “heavy” stable isotope systems starts to develop. Although some non-traditional isotope systems have been investigated by thermal ionization mass spectrometry (TIMS) since the 1950s, the development of multicollector inductively-coupled mass spectrometry (MC-ICP-MS) about 20 years ago rendered new isotope systems accessible and shortened analysis time. In Soil Science, transition metal isotope systems have been successfully used to investigate into the fate and sources of metals in soils. Because of small but analytically accessible fractionations, the analysis of stable metal isotopes gives important information about the fate of metals during differentiation of soils, transport processes in soil and uptake of metals by organisms. A particularly promising field is elucidating the behavior of redox-sensitive metals in water-influenced soils and sediments because of pronounced isotope fractionation during redox reactions. Moreover, different isotope compositions of pollution sources and soils and the strong isotope fractionation of elements with low boiling points during metal production enable identification of metal pollution sources. Stable isotopes offer new insights into the behavior of transition metals in soils and sediments, which are inaccessible with other analytical methods. They integrate information over long time scales and are therefore especially useful to elucidate long-term processes. In the proposed presentation I will give an overview about analytical techniques and applications of stable transition metal isotopes in Soil Science, focusing on strength and weaknesses of this approach.



S12.01 -2

EARTHWORM BIOTURBATION INFLUENCE ON METALS BIOACCESSIBILITY AND BIODISPONIBILITY IN POLLUTED SOILS

Thibaut Leveque^[1], Yvan Capowiez^[2], Eva Schreck^[1], Foucault Yann^{*[1]}, Cecile Grand^[3], Graziella Rojorakotomanana^[1], Camille Dumat^[1]

^[1]EcoLab (Laboratoire d'écologie fonctionnelle) ~ 31326 ~ Castanet-Tolosan ~ France ^[2]INRA ~ 84914 ~ Avignon ~ France ^[3]ADEME ~ 49004 ~ Angers ~ France

? Metal-enriched atmospheric fine and ultra-fine particulate matters (PM) are currently rejected in environment increasing significantly ecosystem pollution by metals. Few data are currently available concerning metals impact on environment and human health. In the context of Reach reglementation, the study of pollutant fate and impact on the biosphere is required, as well as the developpement of new tools for sanitary risk assessment. Earthworm is a key organism to assess soil quality. By its bioturbation activities, earthworm could modify metal bioaccessibility and bioavailability in soils (in relation with their compartimentations and their speciations). In this context, several experiments are performed to: - Estimate the difference of metals bioaccessibility between polluted soils influence by bioturbation or not. - Determine earthworm influence on metal speciation by studying ingested soils and casts. - Asses ecotoxicology impact of metal from atmospheric PM on earthworms. ? Different polluted soils (historically polluted and spiked soils), PM and two species of earthworms : *L. terrestris* (ecologically relevant) and *E. fetida* (international standard for ecotoxicology tests) will be used for experiments in laboratory or in field. For the different soils before and after bioturbation : i) the metal bioaccessibility will be determined in vitro by the UBM test; ii) metal phytoavailability will be assessed by the study of plant uptake; iii) microscopic (MEB-EDS) and spectrometric (Raman, XRF et Exafs) techniques will be used to determine potential changes in metal speciation (cast study); iv) general parameter like survival, biomasse changes, cast production and burrowing activities will be studied to assess the ecotoxicity of metals.



S12.01 -3

TRACE METAL CONTENTS IN AGRICULTURAL TOPSOILS AND SUBSOILS OF THE ISLAND OF RAB, CROATIA

Bakic Helena^[1], Romic Marija^[1], Jokovic Lucija^[2]

^[1]Faculty of Agriculture ~ Department of Soil Amelioration ~ Zagreb ~ Croatia ^[2]Vrelo d.o.o. ~ Water - Collection, purification, distribution, appliances ~ Rab ~ Croatia

The Island of Rab, located in the northern part of the Adriatic Sea, is part of the Kvarner island group. The complex pedological structure of the island is caused by a great variability of its karst underground. In relation to this, geochemical characteristics and soil types largely determine the yield quality. Owing to intensive agricultural production in such environments, due to geological and climatic conditions and anthropogenic influence, trace metals can readily be transferred to soil solution, and leached to groundwater, vegetation and ultimately humans. Other sources of trace metals, including natural weathering processes, can also contribute to the presence of trace metals in soil. This can pose a threat to water sources, which are located in the central flysch zone, a large potential water source for agriculture and drinking water. To assess the current situation of soils a multi-element geochemical survey was conducted. Following a 500 m and 1 km square grid, 42 topsoil and 31 subsoil samples were collected. Soil properties and 16 soil element contents were determined in order to (i) characterize agricultural soils, (ii) analyze the relationship between trace metal contents and soil properties, and (iii) identify lithogenic and anthropogenic sources contributing to trace metal content in soils, by using univariate and multivariate statistics, and by producing interpolation maps. The trace metal contents do not exceed the threshold values established by Croatian government regulation, with the exception of copper. A high chromium, nickel and cadmium concentration in spots seems to be of lithogenic origin.



S12.01 -4

NUTRIENT AND POLLUTANT STATUS IN ARABLE SOILS IN THE PERI-URBAN REGION OF BEIJING

Roelcke Marco^{*[1]}, Heimann Lisa^[1], Ostermann Anne^[2], Hou Yong^[3], Ma Wenqi^[3], Xue Qiaoyun^[4], Lin Xianyang^[4], Welp Gerd^[2], Amelung Wulf^[2], Nieder Rolf^[1]

^[1]Technische Universität Braunschweig ~ Institute of Geoecology ~ Braunschweig ~ Germany ^[2]University of Bonn ~ Institute of Crop Science and Resource Conservation (INRES) - Soil Science ~ Bonn ~ Germany ^[3]Agricultural University of Hebei (AUH) ~ College of Resources and Environmental Science ~ Baoding ~ China ^[4]Zhejiang University ~ College of Environmental and Resource Sciences ~ Hangzhou ~ China

China's land-use and agricultural production are undergoing rapid changes, especially in the peri-urban areas. In the Shunyi District of Beijing multiple cropping systems are accompanied by an industrialized animal production with very high livestock densities of 15 livestock units ha⁻¹, as well as high nitrogen (N) deposition rates. For the determination of the soil nutrient and pollutant status, a joint Chinese and German soil screening covering 2 soil types (Eutric Cambisols, Luvic Cambisols) and 5 typical double or multiple cropping systems (winter wheat-summer maize, spring maize-Chinese cabbage, vegetables, orchards, poplar plantations) was carried out in Shunyi from 2009 to 2011. Soils were sampled on 26 selected plots in 0-200 cm in 6 depth increments, and analyzed for total and mineral (or plant available) macronutrients (N, P, K, S) contents, soil organic matter, DOC and DON, as well as heavy metals and antibiotics. Results over three years (six consecutive cropping seasons) showed a very high accumulation of mineral N, available P and K in soil. These nutrient contents far exceeding crop-specific demand are prone to leaching and to gaseous losses to the environment. For several of the heavy metals analyzed (Cu, Zn, Cd), the "natural background value" (Chinese standards) and in some cases also the "precaution value" (German Directive) were exceeded. A screening for several substances of the antibiotic classes of Sulfonamides and Tetracyclines detected a widespread top-soil contamination. Recommendations for a reduction of the current nutrient and pollutant loads, taking into account environmental, economical and farmers' behavioral aspects will be given.



S12.01 -5

SOIL POLLUTION MEASUREMENTS IN THE QUIRRA AREA, SARDINIA ISLAND (ITALY)

Zucchetti Massimo*^[1]

^[1] Politecnico di Torino ~ DENER ~ Torino ~ Italy

Quirra is a village located in the Italian Sardinia Island, close to a big military polygon, PISQ = "Poligono sperimentale di addestramento interforze del Salto Quirra" ("Salto di Quirra Polygon" and firing range), where ballistic missiles and weapons are tested. The PISQ is used – since at least fifty years – for missiles and weapons testing. Many environmental pollutants have supposedly been released due to PISQ activities. Being a well-known air force rocket range, where new rocket propulsion systems – for both military and civil use – are tested, airborne release of toxic and teratogenic chemical substances is a quite probable effect of these tests. Also, test explosions of bombs and weapons may have had similar results, with environmental contamination with dioxins, heavy metals and other toxic chemicals. Recent environmental assessments and measurements have been performed in the PISQ area, after the Italian justice has asked to determine the origin of the Quirra syndrome. In particular: - Measurement of radioactive pollution in environmental matrices, like soil, mushrooms, lichens, seaweeds, and many others - Assessment of the presence of heavy metals and other chemical pollutants in soil and other selected matrices around PISQ The paper shows the results of those recent measurements and draws some conclusions on the causes of environmental pollution in the Quirra area.



S12.02 - EMERGING ORGANIC POLLUTANTS - FROM THE WASTEWATER TREATMENT FACILITY TO THE AGRICULTURAL FIELD

Chair Persons:

Uri Mingelgrin, Bet Dagan - Israel

Zev Gerstl, Bet Dagan - Israel

Wednesday 04 July 2012 from 15:30 to 17:00. Room Olmo

S12.02 -1

FATE OF RECALCITRANT PHARMACEUTICAL COMPOUNDS IN SOILS IRRIGATED WITH RECLAIMED WASTEWATER: TRANSPORT AND PLANT UPTAKE

Benny Chefetz, Rehovot - Israel - Invited

S12.02 -2

ADSORPTION OF WEAK ORGANIC ACID ANIONS TO BLACK CARBON: PROTON EXCHANGE-ENABLED ADSORPTION AND ELEVATION OF THE PKA ON THE SURFACE

Joseph Pignatello, New Haven, Connecticut - United States

S12.02 -3

PLANT AND SOIL BACTERIA RESPONSE TO SULFADIAZINE EXPOSURE

Lucia Michelini, Padova - Italy

S12.02 -4

UPTAKE AND TRANSFORMATION OF EMERGING POLLUTANTS IN SOIL BY PLANTS USED FOR FOOD AND FEED PRODUCTION

Thorsten Reemtsma, Leiozig - Germany

S12.02 -5

SORPTION AND ACCUMULATION OF HUMAN PHARMACEUTICALS IN WASTEWATER IRRIGATED FIELDS IN THE MEZQUITAL VALLEY, MEXICO

Philipp Dalkmann, Bonn - Germany

S12.02 -6

OCCURRENCE AND SORPTION OF FLUOROQUINOLONE ANTIBIOTICS IN BRAZILIAN SOILS

Jussara Borges Regitano, Piracicaba - Brazil



S12.02 -1

FATE OF RECALCITRANT PHARMACEUTICAL COMPOUNDS IN SOILS IRRIGATED WITH RECLAIMED WASTEWATER: TRANSPORT AND PLANT UPTAKE

Chefetz Benny^[1], Borgman Oshri^[1], Mualem Tamar^[1], Harush Daniella^[1], Shenker Moshe^[1]

^[1]Hebrew University ~ Soil and Water Sci. ~ Rehovot ~ Israel

In this study we investigated the behavior (transport, sorption-desorption and plant uptake) of pharmaceutical compounds (PCs) in agricultural soils. All the studied PCs were detected in reclaimed wastewater used for crop irrigation. The PCs, carbamazepine and diclofenac were significantly retarded in soil samples rich with soil organic matter (SOM) and/or amended with composted biosolids. Our data suggest that most of the studied PCs can be classified as slow-mobile compounds in SOM-rich soil layers; however when these compounds pass this layer and/or introduced into SOM-poor soils, their mobility increases significantly. In regards to the chemistry of the solution, it is concluded that the main factor affecting the mobility of PCs is the pH of the solution and not the DOM concentration. A greenhouse experiment using fresh water and reclaimed wastewater spiked, or not, with persistent PC, carbamazepine, at typical concentration in effluents revealed that it can be taken up and bioaccumulated from its indigenous concentration in reclaimed wastewater. The bioaccumulation factor for the fruits was significantly lower than the value calculated for the leaves. Our experimental data suggest that uptake of carbamazepine can be considered passive uptake governed by water mass flow. This study emphasizes the potential uptake of active pharmaceutical compounds by crops in organic-matter-poor soils irrigated with reclaimed wastewater and highlights the potential risks associated with this agricultural practice.



S12.02 -2

ADSORPTION OF WEAK ORGANIC ACID ANIONS TO BLACK CARBON: PROTON EXCHANGE-ENABLED ADSORPTION AND ELEVATION OF THE PKA ON THE SURFACE

Pignatello Joseph^{*[1]}, Ni Jinzhi^[2], Teixido Marc^[3]

^[1]Connecticut Agricultural Experiment Station ~ Environmental Sciences ~ New Haven, Connecticut ~ United States

^[2]Fujian Normal University ~ College of Geographical Sciences, ~ Fuzhou ~ China ^[3]University of Barcelona ~ Departament de Química Analítica ~ Barcelona ~ Spain

Adsorption of ionogenic organic compounds to black carbon is poorly understood. We examined adsorption of two aromatic carboxylic acid allelochemicals, cinnamic and coumaric (pKa 4.4), and a sulfonamide antibiotic, sulfamethazine (pKa of sulfonamide group, 7.2) to a wood charcoal (biochar, Eucalyptus, 600 °C). Starting at a pH where acid dissociation in solution is complete, adsorption led to release of hydroxide due to proton exchange ($A^- + H_2O = AH + OH^-$). After correction for biochar buffering, hydroxide release was stoichiometric at $pH = pK_a + 3$ (carboxylic acids) or $pH = pK_a + 2$ (sulfamethazine), becoming less so as the pH rose with continued loading. The proton exchange step is thermodynamically unfavorable ($\Delta G^0 = +55$ kJ/mol for the carboxylates and +42 kJ/mol for sulfonamidate) and not fully compensated by the increase in hydrophobicity (-10 to -17 kJ/mole). Adsorption is thus enabled by formation of a charge-assisted H-bond, (-)CAHB, between AH and a surface carboxylate or phenolate group, depicted as (A...H...O-surf)-. Classified as a 'low-barrier' H-bond, the (-)CAHB between groups having similar pKa values is exceptionally strong because the proton is shared nearly equally, giving the bond high covalent character. The (-)CAHB contributes about -50 to -56 kJ/mol to adsorption free energy which, together with the hydrophobic effect, overcomes the proton exchange penalty. The proton exchange/(-)CAHB pathway, in effect, increases the pKa of the acid on the surface relative to bulk solution. It appears applicable to other weak acids, including humic substances, on carbonaceous materials.



S12.02 -3

PLANT AND SOIL BACTERIA RESPONSE TO SULFADIAZINE EXPOSURE

Michelini Lucia^{*[1]}, Reichel Rüdiger^[2], Ghisi Rossella^[1], Thiele-bruhn Sören^[2]

^[1]University of Padova ~ Department of Agricultural Biotechnology ~ Padova ~ Italy ^[2]University of Trier ~ Department of Soil Science ~ Trier ~ Germany

Agricultural soils are often contaminated with pharmaceutical antibiotics, used for the treatment of livestock. Existing publications show the persistence and effectiveness of pharmaceutical antibiotics in soil. Consequently antibiotics might be transferred to food plants, thus entering the human food chain. However, reports on the uptake in and effects on plants are rather scarce. In the study presented, uptake of the sulfonamide sulfadiazine (SDZ) by *Salix fragilis* L. and *Zea maize* L. plants grown for 40 days in soil with 10 and 200 mg kg⁻¹ SDZ was investigated. Plant uptake was determined by accelerated solvent extraction and LC-MS/MS detection in roots, leaves, rhizosphere and bulk soil samples. Phytotoxic effects were recorded during the experimental period through biometric measurements. Furthermore, SDZ effects on the rhizosphere microbial community structure was analyzed. Bioconcentration factors revealed higher accumulation potential for *Salix fragilis* L. than *Zea maize* L. plants, which might be used for phytoremediation purposes. Also, SDZ was transferred from roots to stems and leaves, while the formation of SDZ metabolites was subordinate. While 200 mg SDZ kg⁻¹ caused serious damages in the stem and leaf development of willows and the death of several maize plants. On the contrary, both plant species widely tolerated SDZ at concentrations up to 10 mg kg⁻¹, although some minor effects and especially alterations of the root morphology were evident. The latter was paralleled by strong influences even of the lower antibiotic dose on the microbial community structure in the rhizosphere, identified by PCR- DGGE of 16S rDNA profiles.



S12.02 -4

UPTAKE AND TRANSFORMATION OF EMERGING POLLUTANTS IN SOIL BY PLANTS USED FOR FOOD AND FEED PRODUCTION

Reemtsma Thorsten^{*[1]}, Macherius Andre^[1], Moeder Monika^[1]

^[1]Helmholtz Centre for Environmental Research ~ Department of Analytical Chemistry ~ Leipzig ~ Germany

*Sewage sludge is frequently applied to agricultural land as fertilizer and with it poorly degradable moderately polar and non-polar organic contaminants are transferred to the soil/water/plant system. Depending on the physico-chemical properties and the biological stability a part of these contaminants may be taken up by agricultural plants growing on sludge amended soil and may, thus, enter the food chain. Within plants, such contaminants may be distributed, deposited and transformed into metabolites of unknown properties. Besides the processes in soil also those in plants may determine a contaminants fate and the risk associated with the practice of fertilization with sewage sludge. We have investigated the uptake of selected organic compounds by a variety of agricultural plants growing in spiked soil: polycyclic musk compounds, the UV filter octocrylene, the antibacterial agent triclosan and the plastic additive N-butyl benzolsulfonamide. To investigate uptake and translocation of the considered substances, the mature plants were separated into root peel, root core, and analysed separately using a modified QuEChERS procedure and GC-MS analysis. The results indicated an inverse correlation between the bioconcentration factors and the soils' organic matter content. The translocation of the xenobiotics from root peel into root core and the aerial parts of the plants was confirmed. Additionally, triclosan exposure studies with *Daucus carota* cell suspensions indicate that triclosan is conjugated rather than degraded in the plants. Uptake by and transformation in plants may require further consideration and closer investigation for an adequate risk assessment of sludge disposal on agricultural land.*

S12.02 -5

SORPTION AND ACCUMULATION OF HUMAN PHARMACEUTICALS IN WASTEWATER IRRIGATED FIELDS IN THE MEZQUITAL VALLEY, MEXICO

Dalkmann Philipp^[4], Willaschek Elisha^[4], Siebe Christina^[2], Amelung Wulf^[4], Siemens Jan^[4]

^[1]University of Bonn ~ INRES - Soil Science ~ Bonn ~ Germany ^[2]National Autonomous University of Mexico ~ Institute of Geology ~ Mexico City ~ Mexico ^[3]University of Bonn ~ 1Institute of Crop Science and Resource Conservation – Division Soil Science ~ Bonn ~ Germany ^[4]University of Bonn ~ Institute of Crop Science and Resource Conservation – Division Soil Science ~ Bonn ~ Germany

Due to population growth and urbanization, arable fields are increasingly irrigated with untreated wastewater worldwide. Environmental and health risks, such as proliferation and formation of antibiotic resistances, caused by pharmaceutical residues are profoundly affected by the compounds' binding and accumulation in soils. The Mezquital Valley north of Mexico City is the largest wastewater irrigation area facing these risks worldwide. We investigated the accumulation and sorption of the antibiotics ciprofloxacin, sulfamethoxazole, trimethoprim, clarithromycin, and the anticonvulsant carbamazepine in soils with different duration of wastewater irrigation (0-100 years). In contrast to our expectation no accumulation of extractable ciprofloxacin and clarithromycin was detected. However, sulfamethoxazole and carbamazepine concentrations in the soils increased until a steady state of about 40 respectively 55 $\mu\text{g kg}^{-1}$ soil was reached after approximately 15 years of irrigation. The accumulation of organic matter in wastewater-irrigated soils did not increase sorption of sulfamethoxazole. (De)sorption experiments indicate that a saturation of the soils sorption capacity at least partly explains reduced sorption in irrigated soils (Freundlich KF: 0.83-1.15 $\text{mg}^{(1-N)} \text{L}^{(N)} \text{kg}^{-1}$; N: 0.68-0.75) compared to non-irrigated soil (KF: $1.85 \pm 0.09 \text{ mg}^{(1-N)} \text{L}^{(N)} \text{kg}^{-1}$, N: 0.69 ± 0.03). Sorption of ciprofloxacin was always strong irrespective the soil organic matter content and the duration of wastewater irrigation (KF: 15.72-22.25 $\text{mg}^{(1-N)} \text{L}^{(N)} \text{kg}^{-1}$, N 0.67-0.76). Strong sorption counteracts an accumulation of extractable ciprofloxacin in soil. Intermediate sorption leads to an accumulation of sulfamethoxazole and carbamezepine in soil until an equilibrium between input with wastewater and dissipation is reached. Historical records of inputs allow an estimation of dissipation rates.



S12.02 -6

OCCURRENCE AND SORPTION OF FLUOROQUINOLONE ANTIBIOTICS IN BRAZILIAN SOILS

Leal Rafael Marques Pereira^[1], Figueira Rafael Fernandes^[1], Tornisielo Valdemar Luiz^[1], Regitano Jussara Borges^{*[3]}

^[1]USP ~ Ecotoxicology ~ Piracicaba ~ Brazil ^[2]USP - ESALQ ~ Soil Science ~ Piracicaba ~ Brazil ^[3]USP ~ Soil Science ~ Piracicaba ~ Brazil

The occurrence, behavior and potential negative impacts of antibiotics in Brazilian soils are still largely ignored. This work evaluated the occurrence of four fluoroquinolone compounds (norfloxacin, ciprofloxacin, danofloxacin and enrofloxacin) in eleven soils regularly fertilized with poultry litter, as well as their sorption behavior in other twelve soils with contrasting physical, chemical and mineralogical properties. The compounds were analyzed by HPLC, using fluorescence detector, and sorption was evaluated in a single concentration (90 mg kg⁻¹), following OECD guidelines. Enrofloxacin was the only fluoroquinolone detected (27% of the soils, average concentration of 18.7 µg kg⁻¹). This concentration is compatible with those found in previous works on European soils. Low levels may be related to a fast degradation in tropical conditions (higher temperatures) and/or with intrinsic difficulties with extraction due to their very high sorption potential. Sorption to soils was highly variable, but very high for all compounds. K_d (L kg⁻¹) ranged from 544 to 124,880 (average = 24,800) for enrofloxacin, from 848 to 127,466 (average = 25,900) for danofloxacin, from 727 to 261,147 (average = 37,100) for ciprofloxacin, and from 1000 to 156,927 (average K_d = 30,700) for norfloxacin. These sorption values were much higher than those found for temperate conditions (K_d range from 260 to 5012 L kg⁻¹), which suggest that in tropical conditions sorption of fluoroquinolones is even higher. Statistical analyses showed that cation exchange capacity and clay content were the main factors influencing sorption behavior.



S12.03 - BIOGEOCHEMISTRY OF CONTAMINANTS IN WETLAND AND RIVER FLOODPLAIN SOILS

Chair Persons:

Ruben Kretzschmar, Zurich - Switzerland

Christian Mikutta, Zurich - Switzerland

Friday 06 July 2012 from 13:30 to 15:00. Room Alloro

S12.03 -1

TEMPORAL AND SPATIAL VARIATION OF IRON AND PHOSPHORUS STATUS IN A WETLAND SOIL

Ole K. Borggaard, Frederiksberg - Denmark

S12.03 -2

INTERACTION BETWEEN SALINITY AND HEAVY-METAL POLLUTION ON TAMARIX GALLICA, A POTENTIAL CANDIDATE FOR PHYTOREMEDIATION OF MEDITERRANEAN COASTAL POLLUTED SOILS

Renée Abou Jaoudé, Viterbo - Italy

S12.03 -3

DYNAMIC OF HEAVY METALS AND ARSENIC IN FLOODPLAIN SOILS – RESULTS OF FIELD AND LYSIMETER EXPERIMENTS

Holger Rupp, Falkenberg - Germany

S12.03 -4

MOBILITY OF ARSENIC IN IRRIGATED RICE SYSTEMS ON FLOODPLAIN SOILS

Steve Mcgrath, Harpenden - United Kingdom

S12.03 -5

CHARACTERISATION OF THE TRANSFER AND BIODEGRADATION OF CHLOROACETAMIDE HERBICIDES IN LAB-SCALE WETLANDS

Elodie Maillard, Strasbourg - France

S12.03 -6

TERNARY COMPLEX FORMATION BETWEEN ARSENATE AND FERRIC IRON COMPLEXES OF HUMIC SUBSTANCES

Christian Mikutta, Zurich - Switzerland



S12.03 -1

TEMPORAL AND SPATIAL VARIATION OF IRON AND PHOSPHORUS STATUS IN A WETLAND SOIL

Borggaard Ole K. ^{*[1]}

^[1]University of Copenhagen ~ Basic Sciences and Environment ~ Frederiksberg ~ Denmark

Wetland soils may act as sinks for phosphorus (P) from agricultural soils and fluvial sediments. However, the sorption of P is sensitive to the redox conditions in the soil, especially to the degree of iron (Fe) reduction. When soils become flooded and anoxic, FeIII is reduced and P sorption decreases, but the relationship between Fe and P solubility under variable field conditions is not very clear. A grid of 4 x 5 sampling points at a distance of 15 m was laid out next to the Odense River, Denmark and the redox conditions were monitored from late March until early June. The degree of Fe reduction (FeII/FeIII), which includes soluble and sorbed FeII and total non-silicate Fe (FeIII); the distribution coefficient (Kd) for FeII varied between 75 and 315 L kg⁻¹. The highest average degree of Fe reduction was measured at the beginning of April (76%) and it decreased to 36% within only nine weeks. Not only the temporal, but also the spatial variability was high. The mean coefficient of variation varied between 32% and 96% in the different sampling rounds. The temporal and spatial variation of Fe and P solution concentrations was even higher. When the degree of Fe reduction was highest, P in solution was 24 µM and it decreased by a factor six under the most oxic conditions. Hence, to assess the abilities of a wetland soil to retain P, it is mandatory to have a high sampling resolution over longer periods of time.



S12.03 -2

INTERACTION BETWEEN SALINITY AND HEAVY-METAL POLLUTION ON TAMARIX GALLICA, A POTENTIAL CANDIDATE FOR PHYTOREMEDIATION OF MEDITERRANEAN COASTAL POLLUTED SOILS

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Tamarix are salt-extruding species naturally distributed in coastal areas and salt marshes, and they are often the only woody species growing under such extreme conditions. Recently, it has been demonstrated that *Tamarix* spp. extrude cadmium from their salt glands, suggesting a potential use of these plants for phytoextraction purposes. In order to test the interaction between water salinity and heavy-metal pollution, cuttings of *Tamarix gallica* L. were planted in pots containing heavy-metal polluted soils collected in the surrounding of a former lead industry of Marseille littoral. After three months, saline solutions (0, 100, 200 and 400 mM) were used for irrigation. The impact of the treatments on leaf functionality was evaluated by measuring leaf gas exchanges, chlorophyll fluorescence and, chlorophyll, phenols, flavonoids and anthocyanins contents. Moreover, SEM observations coupled to EDXS analysis were used to determine elements (Na, Cl, and metals such as Pb, As and Al) presence and location on the leaf surface and in the leaf and root tissues. Soils and plants (aerial and root parts) were analysed by ICP-AES and GF-AAS to determine the elemental contents. Higher photosynthetic rates were measured in *Tamarix gallica* grown in heavy-metal polluted soils under 100 mM, compared to non-saline or higher saline conditions. On the other hand, heavy-metals reduced stomatal conductance, but not under moderate salinity (100 mM). The presence of Al on the root surface was observed in plants grown in polluted soils especially under non-saline conditions, because salinity enhanced Al extrusion through salt glands.



S12.03 -3

DYNAMIC OF HEAVY METALS AND ARSENIC IN FLOODPLAIN SOILS – RESULTS OF FIELD AND LYSIMETER EXPERIMENTS

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Floodplains along great rivers have to buffer considerable loads of pollutants. Tolerable concentrations of heavy metals and arsenic in soil and soil solution are here often exceeded. Therefore, approaches for management and remediation of highly contaminated floodplain areas are urgently needed. Detailed processes knowledge of heavy metal dynamics in frequently flooded soils is a basic requirement. Hence, the release and immobilization of heavy metals and arsenic in floodplain soil was studied. Investigations were carried out at lysimeter and field scale under realistic conditions. Soil monoliths (diameter 30 cm, height 70 cm) were gathered for lysimeter studies. The lysimeters and field sites were furnished with comparable measuring instrumentation. Groundwater level inside lysimeters is adjustable. The seasonal groundwater fluctuation and also periods of rapid alternating water levels was simulated. A soil-hydrological measurement facility was established in the floodplain to monitor parameters determine metals mobility (EH, temperature, soil moisture, pH) and to gather soil solution via suction cups. The studies in both scales proved a significant influence of water level, redox and pH on heavy metals and arsenic concentration in soil solution. Furthermore, the simulation of midterm flooding and drought (each 3 month, respectively) and short-term water level alteration (each 6 weeks, respectively) showed comparable patterns of metal mobilization and immobilization. It can be concluded that studies in both scales are a valuable tool to come to a comprehensive understanding of processes determining the behaviour of heavy metals in arsenic in floodplain soils.



S12.03 -4

MOBILITY OF ARSENIC IN IRRIGATED RICE SYSTEMS ON FLOODPLAIN SOILS

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Inorganic arsenic is a non-threshold carcinogen and rice is a major source of this to human populations who depend on rice in their diet. In the dry season, rice is cultivated by irrigation with water pumped from shallow tube wells in many lowland areas in Asia. Such water can contain large concentrations of arsenic, which is then deposited in the paddy fields. Incubations studies with a number of soils from Bangladesh, China and the UK showed that the arsenite species (AsIII), which is taken up by rice roots via the silicon uptake pathway, is mobilised under the reducing conditions in flooded soils. Bangladeshi soils, which were contaminated by As in irrigation water, had greater potential As(III) mobilisation than other soils. We also used 73As to determine the chemically labile in soils (E value) and phytoavailable pools (L value in rice). E values ranged from 6-21% of the total As. A simple phosphate extract of soils was better than soil E values for predicting the potential mobilisation of As into pore water. In four out of five soils, the L value of rice was similar to the E value, and this increased in flooded versus aerobic treatments. We interpret this as being due to the reductive dissolution of Fe oxides/hydroxides which releases sorbed As into solution and exposes more As in the solid phase for exchange. Soil management strategies for mitigation of As accumulation by rice will be discussed.



S12.03 -5

CHARACTERISATION OF THE TRANSFER AND BIODEGRADATION OF CHLOROACETAMIDE HERBICIDES IN LAB-SCALE WETLANDS

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Chloroacetamide herbicides are extensively used in the U.S. and in Europe in a variety of crops, including maize, sugar beet or sunflower. Biodegradation is a major attenuation process of chloroacetamides in water and soil ecosystems. which can be enantioselective, and thus change the enantiomeric signatures of chiral chloroacetamides. However, knowledge on the transfer and biodegradation of chloroacetamides in wetlands in relation with biogeochemical conditions and changes in the enantiomeric signatures is scarce. Here, we examine the transfer and in situ biodegradation of metolachlor, alachlor and acetochlor in lab-scale wetlands by combining hydrochemical and biomolecular approaches with enantiomeric and compound-specific isotope analysis (CSIA). Changes in hydrochemical conditions are evaluated using redox-sensitive species. Oxygen concentrations ranged from 6.8 ± 0.8 mg L⁻¹ to 0.7 ± 1.3 mg L⁻¹, respectively, at the inlet and outlet of the wetlands. Changes in the herbicides, their enantiomeric signatures and their degradation products are quantified over the flow path and over time. CSIA methods are developed for assessing the in situ biodegradation with respect to the biogeochemical changes in the wetlands. In parallel, the structures of microbial communities in wetland pore water samples are characterized based on T-RFLP analyses of 16S rRNA genes. Based on a multiple-method approach, the results underscore the linkage between the microbial communities, changes of hydrochemical conditions and degradation of chloroacetamide herbicides in wetlands.

S12.03 -6

TERNARY COMPLEX FORMATION BETWEEN ARSENATE AND FERRIC IRON COMPLEXES OF HUMIC SUBSTANCES

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Formation of ternary complexes between arsenic (As) oxyanions and ferric iron (Fe) complexes of humic substances (HS) is often hypothesized to represent a major mechanism for As-HS interactions under oxic conditions. To investigate the molecular-scale interaction between arsenate, As(V), and HS in the presence of Fe(III), we reacted fulvic and humic acids with Fe(III) and equilibrated the Fe(III)-HS complexes formed with As(V) at pH 7 (molar Fe/As ~10). The local coordination environments of As and Fe were subsequently studied by means of X-ray absorption spectroscopy. Our results show that 4.5-12.5 $\mu\text{mol As(V)/g HS}$ (25-70% of total As) was associated with Fe(III). At least 70% of this As pool was bound to Fe(III)-HS complexes via inner-sphere complexation. Results obtained from shell fits of As K-edge extended X-ray absorption fine structure (EXAFS) spectra were consistent with a monodentate binuclear and monodentate mononuclear complex stabilized by H-bonds ($R_{\text{As-Fe}} = 3.30 \text{ \AA}$). The analysis of Fe K-edge EXAFS spectra revealed that Fe in Fe(III)-HS complexes was predominantly present as oligomeric Fe(III) clusters at neutral pH. Shell-fit results complied with a structural motif in which three corner-sharing $\text{Fe}(\text{O},\text{OH})_6$ octahedra linked by a single $\mu_3\text{-O}$ bridge form a planar Fe trimer. In these complexes, the average Fe-C and Fe-Fe bond distances were 2.95 \AA and 3.47 \AA , respectively. Our study provides spectroscopic evidence for ternary complex formation between As(V) and Fe(III)-HS complexes, suggesting that this binding mechanism is of fundamental importance for the cycling of oxyanions such as As(V) in oxic soils and sediments.

S12.04a - BIOREMEDIATION OF SOILS AND SEDIMENTS CONTAMINATED WITH ORGANIC CHEMICALS: ASSESSING AND OVERCOMING CHEMICAL AND MICROBIOLOGICAL CONSTRAINTS

Chair Persons:

Edoardo Puglisi, Piacenza - Italy

Lorenz Adrian, Leipzig - Germany

Friday 06 July 2012 from 13:30 to 15:00. Room Leccio

S12.04a -1

PRINCIPLES AND APPROACHES FOR BIOREMEDIATION OF PCB-CONTAMINATED SOILS: A CASE STUDY

Martin-Laurent Fabrice, Dijon - France

S12.04a -2

DECONTAMINATION AND FUNCTIONAL RECLAMATION OF DREDGED BRACKISH SEDIMENTS

Serena Doni, Pisa - Italy

S12.04a -3

ENRICHMENT OF HEXACHLOROBENZENE AND 1,3,5-TRICHLOROBENZENE TRANSFORMING BACTERIA FROM RIVER SEDIMENTS IN VIETNAM AND GERMANY

Hoa Duan Tran, Leipzig - Germany

S12.04a -4

MULTIPLE PRE-EXPOSURE OF A SOIL MICROBIAL COMMUNITY TO ORGANIC CONTAMINANTS DOES NOT ENHANCE SOIL MICROBIAL COMMUNITY FUNCTIONAL RESPONSE

Deborah Shuhui Lin, Perth - Australia

S12.04a -5

DECONTAMINATION OF A POLYCHLORINATED BIPHENYLS-POLLUTED SOIL BY PHYTOREMEDIATION-ASSISTED BIOAUGMENTATION

Thierry Lebeau, Nantes - France



S12.04a -6

*IN SITU LONG-TERM EVOLUTION OF FUNGAL ABUNDANCE AND COMMUNITY STRUCTURE
IN A POLYCYCLIC AROMATIC HYDROCARBON AND HEAVY METAL CONTAMINATED SOIL:
EFFECTS OF PLANT COVER AND THERMAL DESORPTION TREATMENT*

Cécile Thion-Caupert, Nancy - France



S12.04a -1

PRINCIPLES AND APPROACHES FOR BIOREMEDIATION OF PCB-CONTAMINATED SOILS: A CASE STUDY

Ines Petric^[2], Dubravka Hrsak^[2], David Bru^[1], Nikolina Udikovic-Kolic^[2], Fabrice Martin-Laurent^{*[1]}

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Widespread use of polychlorinated biphenyls (PCBs), recalcitrant and toxic compounds, yielded in the contamination of the environment. In Croatia, warfare activities in the 90s led to heavy PCBs contamination of several sites. Remediation of PCBs contaminated sites is essential to restore environmental quality. In this context, we report the principal steps that yielded in the implementation of PCB bioremediation assay. The first step was to isolate seed culture able to transform PCBs from the contaminated site in Zadar (Croatia). A mixed bacterial community (TSZ7), enriched using biphenyl as the only carbon source, showed high capacities to degrade a wide range of PCBs (56-60% degradation of the PCBs in liquid culture). Strain Z6, identified as *Rhodococcus* sp., was found as the active PCB-degrading member of the mixed community. Intermediary metabolites were identified using GC-MS analysis and single PCB congeners (2,4,4'- and 2,2',5,5'- chlorobiphenyl). The second step was to select natural compounds such as carvone, tested as inducers of PCB degrading pathway, and soya lecithin, tested to enhance PCB bioavailability. The third step was to develop and monitor a small-scale bioremediation assay. Both biostimulation and bioaugmentation (inoculation with TSZ7 or *Rhodococcus* sp. Z6) strategies were tested, leading to the reduction of significant amount of PCBs. The last step was to address the impact of bioremediation on the global indigenous microbial community and on the PCB-degrading functional community. These results gave new insights into processes following bioremediation practices and therefore could help to promote implementation of the bioremediation in restoration of PCB-contaminated sites.



S12.04a -2

DECONTAMINATION AND FUNCTIONAL RECLAMATION OF DREDGED BRACKISH SEDIMENTS

Doni Serena^[1], Macci Cristina^[1], Peruzzi Eleonora^[1], Bianchi Veronica^[2], Iannelli Renato^[2], Ceccanti Brunello^[1], Masciandaro Grazia^[1]

^[1]CNR ~ ISE ~ Pisa ~ Italy ^[2]University of Pisa ~ Department of Civil Engineering ~ Pisa ~ Italy

*The continuous stream of sediment dredged from harbors and channels to provide shipping traffic efficiency is a considerable and ongoing problem worldwide recognized. In this study (European Project AGRIPORT) phytoremediation has been considered as a sustainable reclamation technology for bringing slightly polluted brackish sediments into productive use. The experimentation has been carried out in containers of about 1 m³ filled with contaminated (heavy metals and hydrocarbons) brackish sediments. The fine particles granulometric composition made necessary a bio-physical pre-conditioning of sediments by mixing them with an agronomic structured soil (30% v/v). Moreover, a high quality compost was mixed with the sediment-soil matrix at surface level (40t/ha) with the aim of favouring the initial adaptation of the selected vegetal species. Different plant treatments were chosen: i) *Paspalum vaginatum*, ii) *Phragmites australis*, iii) *Spartium junceum* + *Paspalum vaginatum*, iv) *Nerium oleander*+ *Paspalum vaginatum*, v) *Tamarix gallica*+ *Paspalum vaginatum*, and vi) No plants used as control. After one year from the beginning of the experimentation all the plant species were still in healthy condition and well developed. During the time, increasing values of nitrate were generally observed in the planted sediments, suggesting an improvement of the chemico-physical conditions for microorganisms and plants. The stimulation of the microbial activity in the planted sediment with respect to control has been confirmed by the increase of the dehydrogenase activity. Concerning the organic and inorganic contaminant concentrations, decreased values were detected, despite the short period passed, indicating the efficiency and success of this technology for brackish sediments reclamation.*



S12.04a -3

**ENRICHMENT OF HEXACHLOROBENZENE AND 1,3,5-TRICHLOROBENZENE
TRANSFORMING BACTERIA FROM RIVER SEDIMENTS IN VIETNAM AND GERMANY**

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Hexachlorobenzene is one of the most persistent environmental pollutant and is listed as one of the 12 persistent organic pollutants in the UN Stockholm Convention. Another chlorinated organic compound which also devotes attention is 1,3,5-trichlorobenzene because this congener is persistent under aerobic and anaerobic conditions and is one major product of HCB degradation under anaerobic conditions. Here we show that hexachlorobenzene and 1,3,5-trichlorobenzene were dechlorinated by mixed cultures enriched from sediments in Vietnam and Germany. The final end-products from hexachlorobenzene were 1,3,5-trichlorobenzene, 1,2-, 1,3- and 1,4-dichlorobenzene and monochlorobenzene. In different enrichments 1,3,5-trichlorobenzene was reductively dechlorinated to 1,3-dichlorobenzene and monochlorobenzene. The pathways remained stable over seven transfers. The same dechlorination patterns were reproduced when the inoculum of a culture was exposed to oxygen until the used redox indicator (resazurin) indicated a redox potential above zero. However, the pathways changed significantly when cultures were amended with 5 mg/l vancomycin. This indicated that the bacteria in our cultures which were in charge of the reductive dechlorination of hexachlorobenzene and 1,3,5-trichlorobenzene did not belong to the Dehalococcoides spp, which are very sensitive to oxygen and resistant to vancomycin. Isolation and identification of bacteria removing singly flanked and isolated chlorine substituents is essential to further understand the biochemical reasons for the reaction specificity of different enzymes. At the same time, chlorobenzenes can be considered as a chemical model also for more complex aromatic pollutants such as dioxins or PCBs.



S12.04a -4

MULTIPLE PRE-EXPOSURE OF A SOIL MICROBIAL COMMUNITY TO ORGANIC CONTAMINANTS DOES NOT ENHANCE SOIL MICROBIAL COMMUNITY FUNCTIONAL RESPONSE

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The significant increase in the rate of microbial degradation of xenobiotics in soil following a previous pollution event has been well documented. However, the microbial community functional response by which this phenomenon occurs has yet to be understood. We aimed to determine if multiple small exposures will enable the soil microbial community to adapt functionally to utilise hydrocarbon substrates more efficiently in subsequent exposure events, and if pre-exposure of the soil microbial community to 2-methylnaphthalene will selectively enhance microbial community functional response to utilise 2-methylnaphthalene or other related polyaromatic substrates. We exposed a soil sample from a site in Exmouth, Western Australia to either a single large dose, or several small multiple pre-exposures of diesel or 2-methylnaphthalene, along with a non-polluted control. A modified Community Level Physiological Profiling (CLPP) method was used to study respiration response of the different soil treatments to a range of volatile hydrocarbon substrates. The resulting CO₂ production profiles were examined by multivariate analysis. Pre-exposure to diesel did not select for specific substrates, but returned microbial community function to control levels. Pre-exposure of the soil community to small doses of 2-methylnaphthalene did not help recover microbial activity to control levels, nor did it selectively enhance microbial community functional response to utilise 2-methylnaphthalene or other aromatic substrates. Although there has been no observable difference in microbial community functional response in our study, it will be valuable to use stable isotope probing to determine specific groups of microbes that might contribute to pollutant degradation.



S12.04a -5

DECONTAMINATION OF A POLYCHLORINATED BIPHENYLS-POLLUTED SOIL BY PHYTOREMEDIATION-ASSISTED BIOAUGMENTATION

Camille Secher^[1], Marc Lollier^[1], Karine Jezequel^[1], Jean-Yves Cornu^[2], Lebeau Thierry^{*[3]}

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Although forbidden for more than 30 years, several environments in contact with polychlorinated biphenyls (PCBs) are still contaminated and even polluted. Low-cost biological processes like bioremediation can be implemented *in situ* and allow maintaining the physicochemical and biological properties of soils to be cleaned-up. Nonetheless, such a technique must be improved and controlled accurately. Associating soil bioaugmentation by a PCB-degrading bacteria with plants used as exudates suppliers is supposed to be relevant in stabilizing the *in situ* degrading activity. Our study aims at assessing the efficiency of phytoremediation-assisted bioaugmentation on a highly PCB-polluted soil (100 mg kg⁻¹). A previous *in vitro* study consisted in a screening of several PCB-degrading bacteria - inducer couples in liquid medium spiked with the seven indicator PCBs (Secher et al., submitted). *Burkholderia xenovorans* LB400 without inducer showed the best efficiency, i.e. 97% of all PCBs were removed in three weeks against 55% for the non inoculated control (dissipation). Among other plant species (*Medicago sativa*, *Brassica napus*, *Trifolium pratense*, *Lolium perenne*), *Festuca arundinacea* was selected based on its root hair development. The performance of this plant-bacteria couple was assessed in soil pots during a 12-week incubation under controlled conditions. Bioaugmented pots (9 10¹⁰ UFC g⁻¹soil), planted pots (30 seedlings per pot) and the combination of both were compared. *B. xenovorans* was monitored by qPCR (Norini et al., submitted) and its effect on the soil microflora by assessing the total bacterial population and the structure of the bacterial community by PCR-TTGE. PCB degradation was measured by GC-MS.

S12.04a -6

**IN SITU LONG-TERM EVOLUTION OF FUNGAL ABUNDANCE AND COMMUNITY STRUCTURE
IN A POLYCYCLIC AROMATIC HYDROCARBON AND HEAVY METAL CONTAMINATED SOIL:
EFFECTS OF PLANT COVER AND THERMAL DESORPTION TREATMENT**

Thion-Caupert Cécile^{*[1]}, Aurélie Cébron^[1], Thierry Beguiristain^[1], Corinne Leyval^[1]

^[1]LIMOS Nancy University ~ Faculty of Sciences ~ Nancy ~ France

Due to human activities, large volumes of soils are multipolluted by heavy metals and organic pollutants, such as polycyclic aromatic hydrocarbons, thus representing a key concern for remediation. Fungal communities in polluted environments are poorly documented, although fungi can contribute to pollutant biodegradation. A field experiment, with a multidisciplinary approach, involving microbiological, biological, chemical, ecotoxicological and pedological aspects, was set up to monitor the long-term fate and environmental impact of the organic and metallic contaminants of an industrially polluted soil (~1800 mg PAHs/kg). This 5-year field trial comprised four treatments in four replicate lysimetric plots: bare soil, soil planted with alfalfa, soil spontaneously colonized by indigenous plants, and thermally treated soil (~150 mg PAHs/kg) planted with alfalfa. Twice a year (in spring and autumn), the fungal abundance and the structure and the diversity of the fungal community were evaluated by real-time PCR and Temporal Temperature Gradient Electrophoresis (TTGE), respectively, targeting 18S rRNA genes. Our results show that the vegetal cover increased the fungal abundance and was the main driver for community structuring. The positive effect of plants on fungal density and diversity could represent a significant advantage in natural attenuation processes that rely on microbial biomass and activities. Nevertheless, the high level of pollution allowed only a small number of species, mostly Ascomycetes, to be maintained after five years. This study offered the interesting opportunity to monitor and model the structuring of the fungal community in a polluted soil and the re-colonization of a thermal desorption treated soil.

S12.04b - BIOREMEDIATION OF SOILS AND SEDIMENTS CONTAMINATED WITH ORGANIC CHEMICALS: ASSESSING AND OVERCOMING CHEMICAL AND MICROBIOLOGICAL CONSTRAINTS

Chair Persons:

Edoardo Puglisi, Piacenza - Italy

Lorenz Adrian, Leipzig - Germany

Friday 06 July 2012 from 15:30 to 17:30. Room Leccio

S12.04b -1

CHARACTERISATION OF POTENTIAL FOR NATURAL ATTENUATION WITHOUT GROUNDWATER MONITORING WELLS? – A NEW DIRECT PUSH PROBE

Christian Schurig, Leipzig - Germany

S12.04b -2

INSIGHTS INTO THE GENOME OF A XENOBIOTIC DEGRADING BACTERIUM

Edoardo Puglisi, Piacenza - Italy

S12.04b -3

ARE ENZYMES USEFUL TOOLS IN BIOREMEDIATION PROCESSES?

Maria A. Rao, Portici - Italy

S12.04b -4

ASSESSMENT OF PAH AND MHC CONTAMINATED SOILS BASED ON BIOAVAILABILITY

Konstantin Terytze, Berlin - Germany

S12.04b -5

HIGHWAYS VERSUS PIPELINES – CONTRIBUTIONS OF TWO FUNGAL TRANSPORT MECHANISMS TO EFFICIENT BIOREMEDIATION

Thomas Banitz, Leipzig - Germany

S12.04b -6

BRINGING (BIO)ACCESSIBILITY EXTRACTIONS TO THE NEXT LEVEL - COMBINING MOBILISATION MEDIUM AND INFINITE ABSORPTION SINK

Varvara Gouliarmou, Roskilde - Denmark



S12.04b -7

EFFECT OF STRONG SORPTION ON BIODEGRADATION AND VOLATILIZATION OF PCBS

Upal Ghosh, Baltimore - United States

S12.04b -8

BIODEGRADATION OF AN AGED DIESEL CONTAMINATION: EFFECTS OF SOIL MATRIX TYPE, CONTAMINANT CONCENTRATION, AND BIOAVAILABILITY

Nora B. Sutton, Wageningen - Netherlands



S12.04b -1

CHARACTERISATION OF POTENTIAL FOR NATURAL ATTENUATION WITHOUT GROUNDWATER MONITORING WELLS? – A NEW DIRECT PUSH PROBE

Schurig Christian^{*[1]}, Miltner Anja^[1], Zschornack Ludwig^[2], Kaestner Matthias^[1]

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Due to the large number of contaminated field sites in Europe, monitored natural attenuation frequently is the only financially feasible site remediation option. One of the few methods providing evidence of natural attenuation, which are accepted by authorities, is the recently developed in situ microcosm approach (BACTRAP®). Until now, the in situ microcosms were only applicable in aquifers equipped with groundwater wells. To overcome these limitations, a new Direct-Push BACTRAP-probe was developed on basis of the Geoprobe® infrastructure. This allows extending the approach to field sites without monitoring wells and measuring microbial activity in the vadose zone above the aquifer. Both Classical and Direct-Push BACTRAPs were incubated in the centre and at the fringe of the BTEX plume at the ModelPROBE reference site Zeitz (Germany). During microbial degradation of the ¹³C labelled substrate, the ¹³C label was incorporated into bacterial biomass, which was determined by phospholipid fatty acid (PLFA) analysis, and provided the evidence for in situ natural attenuation. In addition, the bacterial communities on classical and Direct-Push microcosms and soil were compared by analysing PLFA patterns. Based on this it could be demonstrated that DP-BACTRAPs showed a higher abundance and enrichment of microbial signature fatty acids compared to conventional BACTRAPs. Also the microbial community on DP-BACTRAPs was more related to soil microbial community. Concluding, Direct-Push based BACTRAPs offer a promising and cost efficient way for monitoring natural attenuation or remediation success at field sites currently inaccessible by the BACTRAP technique.



S12.04b -2

INSIGHTS INTO THE GENOME OF A XENOBIOTIC DEGRADING BACTERIUM

Puglisi Edoardo^{*[1]}, Cappa Fabrizio^[1], Spiewak Dominka^[1], Arena Maria^[2], Trevisan Marco^[2], Cocconcilli Pier Sandro^[1]

^[1]Università Cattolica del Sacro Cuore ~ Istituto di Microbiologia ~ Piacenza ~ Italy ^[2]Università Cattolica del Sacro Cuore ~ Istituto di Chimica Agraria ed Ambientale ~ Piacenza ~ Italy

Pseudomans spp. UC7153 is a strain recently isolated from the Madaccio ice glacier in the Italian alps. Chemical and microbiological analyses have shown the ability of this strain to degrade phenanthrene and other xenobiotics, with good efficiencies at temperature low to 4 °C. Given the potential interest of applying degrading strains for the bioremediation of cold environments, a full genomic sequencing of the strain was then carried out. Genomic DNA was extracted fragmented, and sequenced with an Illumina Hiseq 1000 at 100 bp in paired end mode. 80 millions of fragments in paired ends were produced and filtered to remove low quality sequences, adapters and duplicated sequences. 123 contigs were assembled, covering a total genomic size of 67 Mbp. A first functional annotation of *Pseudomans* spp. UC7153 identified 6221 genes, which have been screened for functional genes of environmental interest, such as genes for xenobiotics degradation and adaptation to cold conditions. Several oxygenases have been identified, as well as dehalogenases potentially involved in the degradation of chlorinated compounds and genes coding for trace elements resistance. Genomic information is being further analysed and coupled to biodegradation experiments in order to improve the understanding of the environmental behaviour of this promising xenobiotic degrading bacterium.



S12.04b -3

ARE ENZYMES USEFUL TOOLS IN BIOREMEDIATION PROCESSES?

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The answer to the title question cannot be that affirmative. In bioremediation processes enzymes may play important and different roles at least in three cases: -as main responsible (either isolated or cell-bound molecules) of the transformation and/or degradation of compounds polluting the environment. The possibility of a pollutant to enter in complex metabolic pathways is very often due to the presence of a specific enzyme that performs the first, peculiar, chemical reaction, essential to render the pollutant susceptible of subsequent enzymatic transformations. -as reliable and sensitive tools to detect and measure the amount and concentration of the pollutant and/or its transformation products during the process. Several analytical assays very often utilize specific enzymatic reactions capable to detect and transform even minimal amounts of compounds -as reliable, easy and sensitive indicators of the quality and health status of the environment subjected to the bioremediation process. Enzymatic activities are easy to measure and rapidly respond to changes in soil caused by natural or anthropogenic factors and The present paper will briefly examine general concepts about the statements previously reported. Examples supporting and confirming the positive response to the title question will be illustrated.



S12.04b -4

ASSESSMENT OF PAH AND MHC CONTAMINATED SOILS BASED ON BIOAVAILABILITY

Terytze Konstantin*^[1], Ines Vogel^[1], Robert Wagner^[1], Rene Schatten^[1], Kerstin Hund-Rinke^[2], Kerstin Derz^[2], Werner Kördel^[2], Cornelia Bernhardt^[2], David Brian Kaiser^[1], Wolfgang Rotard^[4], Karin Friede^[1]

^[1]Freie Universität Berlin ~ Earth Sciences, Geoecology ~ Berlin ~ Germany ^[2]Fraunhofer Institut für Molekularbiologie und Angewandte Oekologie (IME) ~ - ~ Schmallenberg ~ Germany ^[3]Technische Universität Berlin ~ Department of Environmental Technology/Environmental Chemistry ~ Berlin ~ Germany ^[4]Technische Universität Berlin ~ Environmental Technology/Environmental Chemistry ~ Berlin ~ Germany

Assessment of contaminated sites up to now is based on variable protection goals, whereby total contents and in part mobile contents are considered. Due to interactions of pollutants in soil and bound residues total contents do not reflect the actual true risk. In contrast an investigation based on availability/bioavailability of contaminants would enable a harmonization of the protection-goal-based evaluation and a closer-to-reality risk assessment for the individual location. The final direction of the joint research project BioRefine was to create assessment methods and scales for contaminants in soil based on bioavailability and to show possibilities of coast optimization. For the determination of bioavailable parts of contamination chemical analyses as well as toxicological and ecotoxicological methods were tested also considering a comparison between conventional methods according to German soil protection legislation and integration of bioavailability. While aged PAH proved to have only a low potential biological component, MHC demonstrated high resorption availability and toxic impact on soil organisms. These different results emphasize the necessity of the implementation of bioavailability in the risk assessment of contaminated sites helping to give a more real prognosis of danger. Most of the examined contaminated soils proved to have a far lower hazard potential than total contents suggest. This way extensive soil remediation procedures proved to be no more essential but diverse utilization tends to be possible. A guideline for local authorities, advisor and planning agencies was generated to facilitate decision processes for contaminated soils taking bioavailability of organic contaminants into account.



S12.04b -5

HIGHWAYS VERSUS PIPELINES – CONTRIBUTIONS OF TWO FUNGAL TRANSPORT MECHANISMS TO EFFICIENT BIOREMEDIATION

Banitz Thomas^[1], Karin Johst^[1], Lukas Y. Wick^[2], Karin Frank^[1]

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Based on experimental studies, two fungus-mediated transport mechanisms have been suggested to facilitate the bacterial degradation of organic soil contaminants: bacteria may use liquid films around fungal hyphae for quick dispersal ('fungal highways'), and fungi may take up and translocate contaminants through their mycelial network ('fungal pipelines'). Both mechanisms promise to enhance the bioavailability of pollutants to degrading bacteria. However, a comparative study of their respective efficiency in increasing biodegradation performance, and its dependence on environmental conditions, has hitherto not been conducted. Taking advantage of a microbial model, we therefore investigate bacterial degradation performance in response to networks that either act as bacterial dispersal vectors ('highways') or as contaminant translocation vectors ('pipelines') or as a combination of both. We analyse biodegradation improvements compared to the situation without networks, and systematically test a variety of spatially homogeneous and heterogeneous environmental scenarios. Our results suggest that each mechanism can improve biodegradation performance. The degree of improvement, however, may vary distinctly depending on the environmental conditions, and may also be negligible under certain conditions, particularly for networks acting as 'pipelines' only. In many cases, highest biodegradation improvements emerge from the combination of both mechanisms. We therefore conclude that 'fungal highways' as well as 'fungal pipelines' should be considered for developing novel bioremediation strategies based on fungus-mediated transport. Further experimental studies should focus on detection and appropriate stimulation of the two mechanisms in typical bacteria-fungi associations in contaminated soils.



S12.04b -6

BRINGING (BIO)ACCESSIBILITY EXTRACTIONS TO THE NEXT LEVEL - COMBINING MOBILISATION MEDIUM AND INFINITE ABSORPTION SINK

Gouliarmou Varvara^{*[1]}, Mayer Philipp^[1], Collins Chris^[2], Loibner Andres P.^[3], Vasilieva Victoriya^[3]

^[1]Aarhus University ~ Department of environmental science ~ Roskilde ~ Denmark ^[2]Reading University ~ Soil Research center ~ Reading ~ United Kingdom ^[3]IFA Tulln ~ Agrobiotechnology ~ Tulln ~ Austria

Soil bioaccessibility extraction techniques are generally simple dissolution experiments, where the transferred compound to the medium are measured and considered to be bioaccessible. However, such techniques can lead to an underestimation of bioaccessibility, since they do not account for the consumption of contaminants by either degradation or absorption. It is therefore crucial to develop practical bioaccessibility extraction approaches that combine both mobilisation and consumption processes. The mobilisation medium can be chosen to either maximize desorption without attacking the matrix or even to simulate the relevant organism conditions. A sorbent can act as an infinite diffusion sink for continuously removing the mobilized contaminants from the medium. Initially, we combined cyclodextrin extraction with a polymer of poly(dimethylsiloxane) and activated carbon which lead to the contaminant trap method. This contaminant trap is a practical and simple approach for the isolation and quantification of the desorption resistant contaminants in soils, its main limitation being that it is not possible to back extract from the polymer. The next step was to find a polymer material and format that can act as infinite sink and allow simple back extraction. Silicone rods were chosen, which are already used in silicone rod extraction and passive sampling. This resulted in a better and more relevant bioaccessibility extraction approach and simplified the analytical procedures. The silicone rods were applied to both cyclodextrin solutions and artificial digestive fluids, using PAHs as model compounds. Validation experiments with spiked cyclodextrin and digestive fluids confirmed an efficient trapping of PAHs by the silicone rod.



S12.04b -7

EFFECT OF STRONG SORPTION ON BIODEGRADATION AND VOLATILIZATION OF PCBS

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Abstract One of the challenges in implementing biodegradation of semivolatile organic compounds like PCBs in the open soil/sediment environment is the need for reducing losses from volatilization or leaching during the long times required for biodegradation for these slowly degrading compounds. Our recent work has demonstrated that strong sorbent amendments like activated carbon can greatly reduce the bioavailability of PCBs in soil and sediment environments and reduce volatilization and leaching. While reduction in the availability of PCBs is beneficial for human and ecosystem exposure, the effect of bioavailability reduction on aerobic and anaerobic biodegradation is unknown. The present study evaluated loss of PCBs from field collected sediments through aerobic biotransformation and volatilization with and without activated carbon amendment. In the sediment without activated carbon amendment, incubation for 1 year in aerobic environment resulted in the mass of di, tri, and tetrachlorobiphenyls in the system to decrease by 79, 58, and 13 % respectively compared to day 0. For the activated carbon treated mesocosms the total mass of di, tri, and tetrachlorobiphenyls decreased by 60, 65, and 42 % respectively compared to day 0. The present study showed that addition of activated carbon as an amendment for stabilization of PCB contaminated sediment can greatly reduce volatilization loss of the lower chlorinated PCB homologs. Activated carbon addition also lowers bioavailability of PCBs for aerobic microbial transformation, however, our results indicate that slow aerobic biodegradation of lower chlorinated PCBs continue in the presence of activated carbon in sediments.



S12.04b -8

BIODEGRADATION OF AN AGED DIESEL CONTAMINATION: EFFECTS OF SOIL MATRIX TYPE, CONTAMINANT CONCENTRATION, AND BIOAVAILABILITY

Sutton Nora B.*^[1], Langenhoff Alette^[2], Van Gaans Pauline^[2], Grotenhuis Tim^[1], Rijnaarts Huub^[1]

^[1]Wageningen University ~ Environmental Technology ~ Wageningen ~ Netherlands ^[2]Deltares ~ Subsurface and Groundwater ~ Utrecht ~ Netherlands

In situ bioremediation, either stimulated or natural attenuation, is generally considered a cost effective, minimally invasive treatment with little damage to soil function. However, even under ideal environmental conditions, bioavailability of the compound can significantly impede remediation efficiency in terms of treatment time and absolute residual concentrations. This research examines the dynamic interplay between soil matrix type, contaminant concentration, and bioavailability of a complex diesel contamination in order to identify when complete biodegradation can be achieved. To this end, biodegradation is stimulated in laboratory experiments with field collected diesel contaminated samples from different soil types (anthropogenic fill, peat, clay, and sand) and with varying degrees of contamination (high, low, or clean). Experiments last for 100 days; nutrients and oxygen are supplied and temperature is maintained at 30 °C. Absolute total petroleum hydrocarbons (TPH) concentrations as well as the bioavailable fraction are measured prior to and following biological treatment in all contaminated samples. Oxygen consumption and carbon dioxide production are measured in all batches. Results indicate that significant TPH biodegradation is possible in all contaminated samples, with removal efficiencies reaching 100% for TPH concentrations below 3 g/kg. Notably higher respiration rates in contaminated samples, as compared to clean samples, indicate the importance of full oxic conditions as a requirement for successful field treatments. In some cases, residual TPH concentrations may be above intervention values, while the remaining pool of TPH is not bioavailable and composed of higher carbon number components (>C₂₄). This indicates that bioavailability may inhibit further degradation.



S12.05 - SPECIATION AND LOSSES OF PHOSPHORUS AND METALS FROM SOILS AND MITIGATION MEASURES

Chair Persons:

Sara De Bolle, Ghent - Belgium

Gerwin F. Koopmans, Wageningen - Netherlands

Friday 06 July 2012 from 15:30 to 17:30. Room Alloro

S12.05 -1

EFFECT OF INORGANIC COLLOIDS ON THE DETERMINATION OF DISSOLVED P BY THE DGT TECHNIQUE, ION CHROMATOGRAPHY AND COLORIMETRY

Christoff Van Moorleghem, Leuven - Belgium

S12.05 -2

CHARACTERIZATION OF NANO-SIZED COLLOIDAL PHOSPHORUS SPECIES IN PIPE DRAIN AND TRENCH WATERS FROM A FERTILIZED CLAY SOIL USING ASYMMETRIC FLOW FIELD FLOW FRACTIONATION

Inge C. Regelink, Wageningen - Netherlands

S12.05 -3

PHOSPHORUS MOBILITY AFFECTED BY SLURRY APPLICATION TECHNIQUE

Nadia Glæsner, Frederiksberg - Denmark

S12.05 -4

TRANSPORT OF DISSOLVED ORGANIC PHOSPHORUS (DOP) FROM SOIL TO SURFACE WATER ON HEAVILY MANURED GRASSLAND ON A SANDY SOIL

Dries Verheyen, Leuven - Belgium

S12.05 -5

EFFECT OF DIFFERENT SLURRY APPLICATION TECHNIQUES ON PHOSPHORUS OUTPUT INTO TILE DRAINS

Rosemarie Hösl, Petzenkirchen - Austria

S12.05 -6

FIXATION OF PHOSPHORUS BY ADDING AMENDMENTS TO P SATURATED SOILS IN FLANDERS.

Sara De Bolle, Ghent - Belgium



S12.05 -7

REDUCING PHOSPHORUS LEACHING FROM DRAINED HEAVY CLAY SOIL

Barbro Ulén, Uppsala - Sweden

S12.05 -8

REMOVAL OF PHOSPHORUS FROM DRAINAGE WATER USING AN ENVELOPED PIPE DRAIN

Gerwin F. Koopmans, Wageningen - Netherlands



S12.05 -1

EFFECT OF INORGANIC COLLOIDS ON THE DETERMINATION OF DISSOLVED P BY THE DGT TECHNIQUE, ION CHROMATOGRAPHY AND COLORIMETRY

Van Moorleghem Christoff^[1], Erik Smolders^[1], Roel Merckx^[1]

^[1]KULeuven ~ Division Soil and Water Management ~ Leuven ~ Belgium

It is unclear to what extent inorganic colloids bearing phosphorus (P) are detected by analytical methods. We prepared two types of colloidal P solutions using dispersed Al₂O₃ nanoparticles (< 50 nm) and ferrihydrite stabilized by natural organic matter. The dissolved P was detected by ICP-OES and the P in solution was analysed by a colorimetric method (CM; acid condition), ion chromatography (IC; alkaline eluent) and the diffusive layer in thin films technique (DGT) that has ferrihydrite as the P binding layer. The P concentrations detected by the CM method did not differ significantly from those obtained with ICP. However, the P concentrations measured by either IC or DGT decreased as the molar ratio metal/P in the colloids increased. At Al/P = 4.8, the IC and DGT measured P decreased to respectively 91% and 84% of total dissolved P and at Fe/P = 15.9 to respectively 49% and 56%. We attribute the low recovery of colloidal P in the IC method to the high pH in the IC column. We infer that colloidal P is not able to diffuse through the diffusive layer of the DGT since we could not find any Al adsorbed on the DGT eluates and since the DGT data were similar to the IC data for the ferrihydrite-Pi solution.

S12.05 -2

CHARACTERIZATION OF NANO-SIZED COLLOIDAL PHOSPHORUS SPECIES IN PIPE DRAIN AND TRENCH WATERS FROM A FERTILIZED CLAY SOIL USING ASYMMETRIC FLOW FIELD FLOW FRACTIONATION

Regelink Inge C.*^[1], Koopmans Gerwin F.^[1], Van Der Salm Caroline^[2], Weng Liping^[1], Van Riemsdijk Willem H.^[1]

^[1]Wageningen University ~ Department of Soil Quality ~ Wageningen ~ Netherlands ^[2]Alterra ~ Soil Science Centre ~ Wageningen ~ Netherlands

The speciation of phosphorus (P) was investigated in pipe drain and trench water samples leached from a heavy clay soil under grassland of a dairy farm in The Netherlands. Water samples were collected at three times: (t1) in early spring, when P sources were absent for almost seven months, (t2) when rainfall followed the application of the solid cattle slurry fraction, and (t3) when rainfall followed within one day after dairy slurry application. Concentrations of Dissolved Reactive P (DRP), Dissolved Unreactive P (DUP), and Particulate P (PP) were determined. In addition, Asymmetric Flow Field-Flow-Fractionation (AF4) coupled to ICP-MS and UV-DAD was used to analyse the DUP speciation. Total P (TP) concentrations were highest at t3. At t1, TP concentrations were lowest, and dominated by DUP and PP. At t2 and t3, DRP concentrations strongly increased, and contributed >50% of the TP concentration. At t1 and t2, DUP was dominated by P associated to clay minerals (25-130 nm), with a small contribution of ternary complexes consisting of ortho-P bridged to dissolved organic matter by Al or Fe (1-5 nm). At t3, the presence of organic P nanoparticles was detected (10-50 nm). Based on their specific UV-spectrum, they are likely to be phospholipids, a major and highly soluble component of dairy manure. Since phospholipids can form vesicles >0.45 µm in size, they may explain the elevated PP concentrations measured at t3. In conclusion, the DUP speciation can vary in time and AF4 can be used to unravel the nature of DUP.



S12.05 -3

PHOSPHORUS MOBILITY AFFECTED BY SLURRY APPLICATION TECHNIQUE

Glæsner Nadia^{*[1]}, Kjaergaard Charlotte^[2], Rubæk Gitte H.^[2], Gerke Horst H.^[3], Magid Jakob^[1]

^[1]University of Copenhagen ~ Agriculture and Ecology ~ Frederiksberg ~ Denmark ^[2]University of Aarhus ~ Agroecology and Environment ~ Tjele ~ Denmark ^[3]Leibniz-Centre for Agricultural Landscape Research (ZALF) ~ Institute for Soil Landscape Research ~ Müncheberg ~ Germany

Eutrophication of fresh waters is mainly caused by phosphorus (P) losses from agricultural fields, and leaching through soil to tile drains is considered an important contributor to P losses. With growing emphasis on improving land application of manures to minimize P losses, it is critical to determine how application methods such as manure injection affect P leaching. We investigated the effect of injection and surface application of dairy slurry on mobilization and leaching of P in relation to soil texture. The studies were performed on intact soil columns (20 cm diam., 20 cm high) from the plow layer of a loam, sandy loam, and loamy sand with low to intermediate soil P content. The experimental setup was designed to study dissolved and particulate P leaching during unsaturated conditions with suction applied at the lower boundary. As transport occurs predominantly through larger pores, placing slurry away from large pores by injection decreased leaching of all P forms compared with surface application in the loam and sandy loam. Transport occurred through a larger fraction of the loamy sand allowing additional larger contact between the slurry and the soil matrix. Irrigation interruptions were introduced and induced fluctuations in leaching of nonreactive tracers, particulate P, and particles. We hypothesized that mass exchange between mobile and less mobile pore regions changed during interruptions. Leaching of dissolved inorganic and organic P was scarcely affected by irrigation regime because of high adsorption to soil surfaces. The results will be modeled using a mobile-immobile and dual-permeability modeling approach.



S12.05 -4

TRANSPORT OF DISSOLVED ORGANIC PHOSPHORUS (DOP) FROM SOIL TO SURFACE WATER ON HEAVILY MANURED GRASSLAND ON A SANDY SOIL

Verheyen Dries*^[1], Jan Diels^[1], Gerard Govers^[1], Roel Merckx^[1]

^[1]K.U.Leuven ~ Department of Earth and Environmental Sciences ~ Leuven ~ Belgium

Accumulation of soil P because of animal manure spreading from intensive livestock production is a serious threat to water quality in the agricultural regions in Flanders. The organic P in the soil solution accounts for the main fraction of P in the soil water. Certainly in sandy soils with low P sorption capacities and a shallow groundwater table, the subsurface transport of dissolved organic phosphorus (DOP) can be of great significance. The quantitative importance and potential mobility of DOP is known. But, despite the importance, its precise role in transfer to surface waters remains poorly understood. To investigate the DOP fluxes, a heavy manured grassland in the Campine region in Flanders is equipped with piezometers and suction cups. The field has a degree of phosphorus saturation of 45%. The field is drained by ditches that flow in a river next to the field. Concentrations of different forms of dissolved P (orthophosphate, colloidal and organic) were monitored each week in the groundwater, soil water and drainage ditches. Also, the water levels of the drainage ditches, the river and the groundwater were recorded with water level loggers. Together with the determination and modeling of the groundwater flow, a quantification on field scale was assessed of the different fluxes of phosphorus from the soil to the surface water. This research indicates that measures of phosphorus control should be specified on fields with unreactive soils and a high connectivity to surface water.



S12.05 -5

EFFECT OF DIFFERENT SLURRY APPLICATION TECHNIQUES ON PHOSPHORUS OUTPUT INTO TILE DRAINS

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^[1]Federal Agency for Water Management ~ Institute for Land and Water Management Research ~ Petzenkirchen ~ Austria ^[2]Water Management Agency ~ Traunstein ~ Traunstein ~ Germany

In Austria and Bavaria, slurry application employing near ground application techniques is subsidized to promote positive effects on gaseous N losses. We hypothesized; that additional effects regarding P transport might occur whenever near ground application is done on tile drained soils. Therefore we carried out a rainfall simulation study to evaluate the effect of near ground application techniques on P losses into tile drains. Slurry was applied on drained pasture plots near lake Waging/Taching in Bavaria and artificially rained; response in the tile drains below the plots was measured. To identify direct flow we used NaCl as tracer. The tested variants were No Slurry (N), Conventional (P), Dribble Bar (SC), Trailing Shoe (SH), and Slit Injection (D). Results showed that up to 50 % of the applied surface water was connected as direct flow to the tile drains. All near ground application techniques exhibited a positive effect on P losses –this was a consequence of the different extents of wetting of the soil surface by the various application techniques. Our results show that pastures may exhibit a considerable amount of preferential flow paths which directly connect the soil surface to underlying drains thus enabling very rapid P (and other substances) transport into linear flow paths such as tile drains.



S12.05 -6

FIXATION OF PHOSPHORUS BY ADDING AMENDMENTS TO P SATURATED SOILS IN FLANDERS.

De Bolle Sara*^[1], De Neve Stefaan^[1]

^[1]Ghent University ~ soil management ~ Ghent ~ Belgium

As a result of decades of excessive phosphorus fertilization, most acid sandy soils in Flanders (Belgium) and the Netherlands are phosphorus (P) saturated. This saturation entails a risk of significant P leaching to groundwater and causing environmental problems. A study was done to test several amendments to the soil in terms of their potential in retaining P in the soil, thereby decreasing the P availability and the risk of P leaching. In this study several chemical amendments (such as CaCO₃, CaCl₂, AlCl₃, AlSO₄, FeCl₃, FeSO₄, olivine sand, ...) were evaluated on their ability to fix P in five different acid sandy soils, with different PSD, by a filtration and a leaching experiment. The idea is to get a better understanding in which amendments are most effective and to see if the same amendments perform equally as efficient in soils with different PSD. Out of first results came that chemical amendments seem promising in reducing the availability of P in P saturated soils.



S12.05 -7

REDUCING PHOSPHORUS LEACHING FROM DRAINED HEAVY CLAY SOIL

Ulén Barbro*^[1], Etana Araso^[2], Svanbäck Annika^[3]

^[1]SLU ~ Soil and Environment ~ Uppsala ~ Sweden ^[2]SLU ~ Soil and Environment ~ Uppsala ~ Sweden ^[3]SLU ~ Soil and Environment ~ Uppsala ~ Sweden

Abstract Eutrophication of waters with too much phosphorus (P) and nitrogen (N) from agricultural land is a serious problem. In a four-year plot experiment in the watershed of a drinking water reservoir, and soil with high clay content (60%), structure liming gave a distinct, significant reduction in P leaching via tile drains, mainly in the form of particulate phosphorus (PP), together with increasing yields of barley.. Overall, total phosphorus (TP) leaching (kg ha⁻¹) declined by 35-50%. Three years after structure liming the aggregate stability, expressed as readily dispersed clay (RDC), was still significantly improved for limed plots, with a turbidity value (FTU units) of 16 compared with 20 in non-limed plots. Omitting ploughing and only cultivating in autumn significantly increased PP leaching losses, but reduced nitrate-nitrogen (NO₃-N) leaching. The soil profile demonstrates a generally high ability to sorb P to the soil matrix and leaching losses of dissolved reactive P (DRP) was low from this site. Different strategies for mineral P fertilisation have not yet shown clear tendencies.



S12.05 -8

REMOVAL OF PHOSPHORUS FROM DRAINAGE WATER USING AN ENVELOPED PIPE DRAIN

Koopmans Gerwin F.^[1], Chardon Wim J.^[2], Groenenberg Jan E.^[2]

^[1]Wageningen University ~ Department of Soil Quality ~ Wageningen ~ Netherlands ^[2]Alterra ~ Soil Science Centre ~ Wageningen ~ Netherlands

In Dutch surface waters, phosphorus (P) concentrations are often too high and eutrophication is a major problem. Mitigation measures are needed which can contribute to improving the chemical surface water quality. The effectiveness of enveloping a pipe drain with iron-coated sand for reducing P losses was tested in a field experiment in the flower bulb growing region in the western part of The Netherlands. In this region, problems with P losses and surface water quality are large, and high P concentrations in pipe drain water are rather common. Iron-coated sand is a side product of drinking water production from anaerobic groundwater, and it exhibits a high P binding capacity and a high saturated hydraulic conductivity. In September 2010, a new pipe drain was installed at a depth of 0.8 m below the soil surface between two reference pipe drains, and enveloped with a layer of 10 cm iron-coated sand. Water samples were regularly collected from the effluents of the enveloped and the two reference pipe drains, the ditch which received all water from the field, and porous suction cups placed along the enveloped pipe drain. In addition, in situ measurements of pH and redox were done. Concentrations of amongst others dissolved reactive P, total dissolved P, and particulate P were measured. We will present results on the effectiveness of the enveloped pipe drain for reducing P losses by comparing the results of this measure with those of the two reference pipe drains.



S12.06a - OPPORTUNITIES AND CHALLENGES IN MINE SITE REHABILITATION

Chair Persons:

Michael Haubold-Rosar, Finsterwalde - Germany

Thomas Baumgartl, Brisbane - Australia

Friday 06 July 2012 from 10:30 to 12:00. Room Biancospino

S12.06a -1

THE EFFECT OF COMBINED IN SITU IMMOBILISATION AND SUBSEQUENT RHIZOSPHERE ACIDIFICATION ON THE PHYTOEXTRACTION EFFICIENCY OF WILLOWS

Markus Puschenreiter, Tulln - Austria

S12.06a -2

ESTABLISHING PHYTOSTABILISATION FIELD PLOTS IN CU-RICH MINE TAILINGS: AN INITIAL EVALUATION OF PLANT SPECIES AND SOIL AMENDMENTS.

Petra Kidd, Santiago de Compostela - Spain

S12.06a -3

APPLICATION OF ORGANIC SECONDARY RAW MATERIALS FOR THE RECLAMATION OF DEGRADED SITES

Michael Haubold-Rosar, Finsterwalde - Germany

S12.06a -4

CO-EVOLUTION OF SOILS AND LANDFORMS: PEDOGENESIS AND EROSION MODELLING OVER DECADAL TIMESCALES FOR DISTURBED LANDS

Garry Willgoose, Callaghan - Australia

S12.06a -6

DEVELOPMENT OF A TOOL-BOX TO DELIVER A MICROBIAL ASSISTED PHYTOREMEDIATION PROCESS WITHIN THE MINE SITE OF INGURTOSU (SARDINIA, ITALY).

Chiara Alisi, Rome - Italy



S12.06a -1

THE EFFECT OF COMBINED IN SITU IMMOBILISATION AND SUBSEQUENT RHIZOSPHERE ACIDIFICATION ON THE PHYTOEXTRACTION EFFICIENCY OF WILLOWS

Puschenreiter Markus*^[1], Muhammad Iqbal^[1], Wenzel Walter W.^[1]

^[1]Universität für Bodenkultur Wien (BOKU) ~ Department of Forest and Soil Sciences ~ Tulln ~ Austria

*Phytoextraction is a technology that uses plants and associated microbes for the removal of potentially toxic trace elements (TE) from contaminated soils. The efficiency of this approach depends on the concentration of TE in the harvestable biomass (i.e. shoot) and the amount of produced biomass. For soils with very large soluble TE concentrations an immediate risk of TE leaching into groundwater may require additional short-term measures, e.g. in situ immobilisation, with TE-binding soil amendments. Subsequent phytoextraction will afterwards remove the contaminants from the soil. Locally enhanced TE bioavailability in the rhizosphere will re-mobilise the previously immobilised TE fractions. This locally enhanced acidification might be caused by the phytoextraction plant, but in case of insufficient proton release, also by co-cropped plants which are known for their efficiency to acidify the rhizosphere (e.g. alders). Two acidic contaminated soils were treated with a mix of gravel sludge and red mud and later planted with *Salix x smithiana*, a Zn- and Cd-accumulating plant. To mimic the rhizosphere acidification by alders, elemental sulphur was added. The results show that although the solubility and bioavailability of Zn and Cd in soil was strongly reduced with the addition of the amendment, the phytoextraction efficiency of the willow was only slightly decreased. Soil acidification could significantly increase the Zn and Cd accumulation in plant. Our results show that the combination of in situ immobilisation with phytoextraction and its enhancement by soil/rhizosphere acidification is a promising approach for soils posing strong environmental risks due to high TE solubility.*



S12.06a -2

ESTABLISHING PHYTOSTABILISATION FIELD PLOTS IN CU-RICH MINE TAILINGS: AN INITIAL EVALUATION OF PLANT SPECIES AND SOIL AMENDMENTS.

Kidd Petra^{*[1]}, Prieto-Fernández Ángeles^[1], Rodríguez-Garrido Beatriz^[1], Álvarez-López Vanessa^[1], Trasar-Cepeda Carmen^[1], Touceda-González María^[1], Mench Michel^[2], Puschenreiter Markus^[3], Crespo Queiruga Clara^[4], Macías-García Felipe^[4]

^[1]Instituto de Investigaciones Agrobiológicas de Galicia (IIAG), Consejo Superior de Investigaciones Científicas (CSIC) ~ Bioquímica de Suelo ~ Santiago de Compostela ~ Spain ^[2]Institut National de la Recherche Agronomique (INRA) ~ - - Bordeaux ~ France ^[3]University of Natural Resources and Life Sciences (Vienna – BOKU) ~ Rhizosphere Ecology and Biogeochemistry Group ~ Vienna ~ Austria ^[4]Tratamientos Ecológicos del Noroeste s.l. (TEN s.l.) ~ - - Touro ~ Spain

Mine-spoils and tailings present hostile environments for plant growth (low nutrients, low organic matter content, high acidity, elevated trace metal content). Phytostabilisation techniques aim to establish a vegetation cover and promote in situ inactivation of trace metals in this kind of environment by combining the application of soil amendments with the cultivation of metal-tolerant populations of plant species. In this study, field plots were established in Spring 2011 in an abandoned copper mine in NW Spain. The geological substrate is amphibolite, with significant quantities of metal sulfides (pyrite, pyrrhotite, and chalcopyrite). The mine-soils (Spolic Technosols (Episkeletic)) are characterised by their extreme acidity (pH 2.8-3.5), low C, N and P, and high concentrations of Cu (319-774 mg/kg). Three experimental plots (10mx45m) were established to evaluate three amendments and different metal-tolerant clones of Salix (S. caprea and S. viminalis) and Populus nigra. Amendments consisted of composted municipal solid wastes (compost) and two technosols. Technosols were mixtures of organic (anaerobic and aerobic sewage sludge) and inorganic wastes (aluminium oxides, iron oxides, fly ash from wood bark combustion, and foundry sand). Application rates of all amendments were equivalent to 250 kg Mg-1 dry tailings. Each experimental plot was sub-divided into 5m×5m sub-plots, and three replicate sub-plots were used for each plant species/clone. Soil samples were collected to determine the baseline trace metal content and general physico- and bio-chemical properties before amendment addition/planting. Results will be presented of plant growth/survival and soil properties (improvement in pH, nutrient availability and Cu bioavailability) one year after planting.



S12.06a -3

APPLICATION OF ORGANIC SECONDARY RAW MATERIALS FOR THE RECLAMATION OF DEGRADED SITES

Haubold-Rosar Michael*^[1]

^[1]Forschungsinstitut für Bergbaufolgelandschaften e.V. ~ Director ~ Finsterwalde ~ Germany

Sites degraded by over-exploitation and erosion are generally characterized by a severe loss of organic soil material or even the whole topsoil. Building and mining activities leave raw and partly artificial soils on earthworks, dumps and tips. A prior objective of land reclamation in such areas is to restore soils which will fulfill their functions as a habitat for plants and animals, as a production site for agriculture or forestry and as a regulator in the cycling of matter and water in the landscape. Herein the rapid formation and maintenance of a balanced humus and nutrient budget is of great importance. For this purpose organic secondary raw materials like compost may be conveniently used in the reclamation process as soil improving agents which contribute to a lasting development of a favorable humus and nutrient balance, structure and biological activity in those soils. The processing of organic residues for the creation of high quality organic soil improving materials will close material cycles and contribute to the value added in the regions. This should be an essential part of a sustainable material flow management. The paper will be based on results of research in the Lusatian mining region, Germany, carried out to determine the benefits of different applications of organic materials and to test the long-term environmental compatibility of such applications with regard to a possible contamination of soils, seepage water and plants, at least to work out quality criteria and recommendations for reclamation practice.



S12.06a -4

**CO-EVOLUTION OF SOILS AND LANDFORMS: PEDOGENESIS AND EROSION MODELLING
OVER DECADAL TIMESCALES FOR DISTURBED LANDS**

Willgoose Garry^{*[1]}, Hancock Gregory^[2], Cohen Sagy^[3]

^[1]The University of Newcastle ~ Civil, Surveying and Environmental Engineering ~ Callaghan ~ Australia ^[2]The University of Newcastle ~ Earth Sciences ~ Callaghan ~ Australia ^[3]University of Colorado ~ INSTAAR ~ Boulder ~ United States

Landform evolution models (LEMs) have become a routine tool for assessing the erosional stability of mine waste, tailings facilities, and low level nuclear waste facilities. LEMs have ignored temporal changes in the soils due to erosion, nor do they model pedogenesis. These changes in soils and erosion rates may be independent of (e.g. weathering of soils/rock particles), or dependent on (e.g. armouring due to selective entrainment) the fluvial erosion process. Typically, LEMs and traditional erosion models have implicitly assumed that soils are constant in time and at equilibrium. This is unlikely to be true for disturbed sites. Many of the mine and nuclear waste rehabilitation problems examined by the authors using LEMs show significant evolution of the surface erodibility at the yearly to decadal timescale. At some sites weathering of rock fragments is fast enough to interact with erosion and change the waste rock dump erodibility. We conclude that the evolution of soils must be modeled explicitly to be able to predict landscape evolution over the decadal timescale. In this way we can (1) model pedogenesis and co-evolving vegetated ecosystem dynamics and (2) erosion rates. Some insights based on our recent work in quantitative pedogenesis models will be presented and how pedogenesis can be incorporated into sustainability studies of waste dumps using LEMs. We will show that there are two important pedogenic timescales, (1) the surface of the soil and (2) the entire soil profile.



S12.06a -6

DEVELOPMENT OF A TOOL-BOX TO DELIVER A MICROBIAL ASSISTED PHYTOREMEDIATION PROCESS WITHIN THE MINE SITE OF INGURTOSU (SARDINIA, ITALY).

Sprocati Anna Rosa^[1], Tasso Flavia^[1], Pinto Valentina^[1], Alisi Chiara^{*[1]}, Marconi Paola^[1], De Giudici Giovanni^[2], Lichtscheidl Irene^[3], Adlassnig Wolfram^[3], Turnau Katarzyna^[4]

^[1]ENEA ~ Environmental Characterization, Prevention and Recovery UNIT ~ Rome ~ Italy ^[2]University of Cagliari ~ Dipartimento di Scienze della Terra ~ Cagliari ~ Italy ^[3]University of Vienna ~ Cell Imaging and Ultrastructure Research ~ Vienna ~ Austria ^[4]Jagiellonian University ~ Institute of Environmental Sciences ~ karkow ~ Poland

*The following work intends to present the experience developed at the test site of the abandoned mine of blend and galena of Ingurtosu (Sardinia, Italy), within the frame of the UMBRELLA Project (FP7, Grant No. 226870), aimed at using microorganisms to develop cost-efficient and sustainable measures for soil remediation at heavy metal contaminated sites, throughout Europe. Integrated investigations on (hydro)geochemistry, heavy metals concentration and mobility in soil, microbiology and botany provided a data set for the development of a tool-box to deliver a microbial assisted phytoremediation process. A bacterial consortium has been established with ten native bacterial strains, selected as the best performing, out of the total isolated, for heavy metal resistance and plant growth promotion (PGPB). Phytoremediation tests have been carried out-with endemic pioneer *Euphorbia pythiusa* - first in pot experiments and subsequently in a field trial, in order to assess the effectiveness of the bacteria, mycorrhiza and ViroMineTM products (limited to the field trial) on heavy metal leakage control. Microbial activity in soil, plant physiological parameters, heavy metal content in plants and in soil were monitored before and after the treatments. Integration of data sourced in pot experiment from biology (soil microbial activity, germination and plant growth parameters) showed that the bacterial bioaugmentation produced a general stimulation both of soil microbial activity and germination, shoots and roots elongation and photosynthesis. Changing in toxicologically relevant metals bioavailability - measured with a novel simple in field screening method- and the overall field trial outcome will be discussed.*



S12.06b - OPPORTUNITIES AND CHALLENGES IN MINE SITE REHABILITATION

Chair Persons:

Héctor M. Conesa, Cartagena - Spain

Marco Contin, Udine - Italy

Rafael Clemente, Murcia - Spain

Friday 06 July 2012 from 13:30 to 15:00. Room Biancospino

S12.06b -1

DO AVAILABILITY RESULTS OBTAINED BY CHEMICAL METHODS REALLY TRANSLATE INTO "BIOLOGICAL AVAILABILITY" OBTAINED BY OBSERVING EFFECTS ON ORGANISMS?

Paula Alvarenga, Beja - Portugal

S12.06b -2

PHYTOREMEDIATION OF TRACE ELEMENTS (AS, CD, CU AND ZN) IN A DERELICT ARSENOPYRITE MINE (CENTRE OF SPAIN): MULTISCALE APPROACHES

Eduardo Moreno, Leuven - Belgium

S12.06b -3

GEOCHEMICAL ASSESSMENT OF THE MIXTURE OF TAILINGS AND WASTE ROCK WITH AMENDMENTS (LIME AND BENTONITE) FOR A WATER-SHEDDING COVER ON MINE WASTES

Lu Zhao, Brisbane - Australia

S12.06b -4

CHANGES IN MICROBIAL COMMUNITY STRUCTURE LINKED TO ORGANIC AMENDMENTS IN RECONSTRUCTED SOILS.

Mark Beasse, Edmonton, Alberta - Canada

S12.06b -5

RECLAIMED LIGNITE MINING AREAS IN LUSATIA – DEVELOPMENT OF SOIL PHYSICAL PARAMETERS OF AN AGRICULTURAL SITE WITHIN THE FIRST YEARS AFTER THE CONSTRUCTION

Julia Kruemmelbein, Cottbus - Germany



S12.06b -1

DO AVAILABILITY RESULTS OBTAINED BY CHEMICAL METHODS REALLY TRANSLATE INTO "BIOLOGICAL AVAILABILITY" OBTAINED BY OBSERVING EFFECTS ON ORGANISMS?

Alvarenga Paula^[1], Laneiro Cátia^[1], Palma Patrícia^[1], De Varennes Amarilis^[2], Cunha-Queda A. Cristina^[2]

^[1]Polytechnic Institute of Beja ~ Technologies and Applied Sciences ~ Beja ~ Portugal ^[2]Instituto Superior de Agronomia (TU Lisbon) ~ DQAA ~ Lisboa ~ Portugal

*Considering that environmental risk assessment based on the total concentration of a contaminant can overestimate risks, and that organisms respond only to its fraction that is biologically available, it is very important to understand if availability results obtained by chemical methods really translate into "biological availability" obtained by observing effects on organisms. This study aims to contribute to that discussion by comparing (bio)availability results, obtained by chemical methods, with those obtained by observing effects on organisms and by determining metal uptake and bioaccumulation by the exposed organisms. Soils from São Domingos Mine, an abandoned mine located in the Portuguese sector of the Iberian Pyrite Belt, were characterized considering: (i) general physicochemical characterization; (ii) pseudo-total and bioavailable trace element concentrations obtained by chemical extractions; (iii) ecotoxicological evaluation using the whole soil (seed germination with *Lactuca sativa* L., *Eisenia fetida* mortality and reproduction bioassays); and (iv) earthworm trace element concentrations, after 28 days of exposure to the contaminated soils. In the mine area, the soils were generally acid, poor in organic matter and in plant nutrients. Pseudo-total As, Cu, Pb and Zn concentrations were very high, and the same was true for their CaCl₂ 0.01 M extractable fractions. Regardless of the soil poor physicochemical characteristics, earthworm acute toxicity bioassay was unable to identify its toxicity, but the opposite was true for the reproduction bioassay using the same organism. Results obtained in the study are discussed in order to provide an insight into the question posed at the beginning of the experiment.*



S12.06b -2

PHYTOREMEDIATION OF TRACE ELEMENTS (AS, CD, CU AND ZN) IN A DERELICT ARSENOPYRITE MINE (CENTRE OF SPAIN): MULTISCALE APPROACHES

Moreno Eduardo*^[1], Manzano Rebeca^[2], Gamarra Roberto^[3], Carpena Ramón^[2], Esteban Elvira^[2], Fresno Teresa^[2], Peñalosa Jesus^[2]

^[1]K U Leuven ~ Soil and Water Management ~ Leuven ~ Belgium ^[2]Universidad Autónoma de Madrid ~ Agricultural Chemistry ~ Madrid ~ Spain ^[3]Universidad Autónoma de Madrid ~ Biology ~ Madrid ~ Spain

Derelict mine soils often pose environmental risks. In Spain, the soils of several derelict mines have to be reclaimed as a consequence of new legislation (in 2005). With the aim to establish a robust action plan in an old mine in Madrid, we studied the contamination in the field and the transfer of contaminants to native plants naturally growing there. We found high levels of As and Zn in soils, but the transfer of As to plants was low. The field study showed how natural attenuation occurs for As, while Cd and Zn are being effectively accumulated in some plant shoots, and that there are hot spots of contamination linked to the mine tailings. With our data, we modeled the environmental risk of transfer to organisms (soil organisms, aquatic organisms, livestock, mammals and avians). We found all the contaminants are likely to pose hazard for the ecosystem, mainly in the areas adjacent to the mine wastes. As a consequence, pot and batch experiments were carried out to select the best combination plant-amendment to manage the site. Fe oxides has given good results for As but may pose a risk of metal mobilization (Zn), organic matter restricted metal mobility but induced As solubility, and inorganic fertilization with P promoted excessive As leaching. Therefore, a combination of both is being tested in pots and lysimeters. Eventually, we expect to give a management recommendation that minimizes undesirable effects.



S12.06b -3

GEOCHEMICAL ASSESSMENT OF THE MIXTURE OF TAILINGS AND WASTE ROCK WITH AMENDMENTS (LIME AND BENTONITE) FOR A WATER-SHEDDING COVER ON MINE WASTES

Zhao Lu^{*[1]}, Baumgartl Thomas^[1], Edraki Mansour^[1]

^[1]Centre for Mined Land Rehabilitation (CMLR) ~ Sustainable Minerals Institute (SMI) ~ Brisbane ~ Australia

Waste rocks and tailings produced through mining activity are often in direct contact with the environment and can potentially be major sources of acid and metalliferous drainage, containing multi-elemental contaminants. Required remediation strategies try to incorporate locally available solid materials (dry tailings and waste rocks) mixed with amendments, such as lime and clay material, to control water infiltration and oxidation processes. The objectives of the study were to characterise the geochemistry of selected materials for the construction of a water-shedding cover for mine wastes, and to assess the potential release of acid and metalliferous drainage from such constructed cover. A column experiment was carried out with two types of tailings (particle size smaller than 2 mm) and one waste rock (particle size smaller than 19 mm) mixed with 10% or 20% of amendments (lime and bentonite). The pH, EC and dissolved metal concentrations in leachate were measured over time with dry and wet cycles. Particle size influenced the water retention time and consequently the concentrations of metals. The mixture of tailings and lime produced minimum amount of soluble metals in leaching, which was a more effective approach despite of the high pH (more than 12); bentonite did not reduce metal leaching from tailings but increased the water content in the waste rock. Our results show the effects of amendments from both physical and chemical aspects. Application of this concept will allow a better understanding of material performance under conditions of wetting and drying as part of the natural climate variability.



S12.06b -4

**CHANGES IN MICROBIAL COMMUNITY STRUCTURE LINKED TO ORGANIC AMENDMENTS
IN RECONSTRUCTED SOILS.**

Beasse Mark^[1], Quideau Sylvie^[1]

^[1]University of Alberta ~ Renewable Resources ~ Edmonton, Alberta ~ Canada

Landscape scale reclamation of upland forests in the Athabasca oil sands regions of north-eastern Alberta, Canada, utilizes peat as an organic soil amendment due to shortages in forest floor, the organic material native to these target ecosystems. Considering the differences in physical and chemical properties between these two materials, there is a concern that using peat will fail to recreate the diverse interactions within the soil microbial community consistent with the target ecosystems. This study investigates the differences in microbial community structure and activity between forest floor, peat and mixtures of both at differing water contents and pH values using phospholipid fatty acid analysis and basal respiration. Indicator species analyses demonstrated that 10 of the 70 lipids analysed progressively changed in indicator values across treatments, 5 of which remained constant when the pH of the peat treatment was adjusted to near that of the forest floor. Basal respiration was significantly higher in the forest floor than peat treatments. While forest floor basal respiration varied in response to differences in water content, no differences were detected in peat treatments among the different water contents or between the natural peat and pH adjusted treatments. These results provide evidence that the physical and chemical characteristics of the organic matter types are related to the expression of specific segments of the microbial community. These further suggest that the sole use of peat as an organic amendment in reforestation scenarios is unlikely to provide the microbial community consistent with the target plant community.



S12.06b -5

RECLAIMED LIGNITE MINING AREAS IN LUSATIA – DEVELOPMENT OF SOIL PHYSICAL PARAMETERS OF AN AGRICULTURAL SITE WITHIN THE FIRST YEARS AFTER THE CONSTRUCTION

Kruemmelbein Julia^{*[1]}, Raab Thomas^[1]

^[1]Brandenburg University of Technology ~ Chair of Geopedology and Landscape Development ~ Cottbus ~ Germany

In Lusatia, lignite mining induces major disturbances on the landscape scale. Reclamation procedures are applied to recover the reconstructed landscape for different land use options. In this study we investigate soil physical properties of an agricultural reclamation/recultivation site directly after site construction and the development of selected parameters within the first years after site construction depending on varying recultivation strategies. The sandy substrates used for recultivation stem from depths of several meters. They are unstructured, free of recent organic matter and have high contents of calcium carbonate. During reconstruction and most of all during surface levelling with heavy crawlers the substrate undergoes strong mechanical stresses. This leads to partly severe soil or substrate compaction, depending e.g. on strata water content and mechanical stresses during site construction. We investigate the effect of different organic soil amendments, different crop rotations and partly sub soiling on the development of soil structure. We compare results of laboratory measurements directly after site construction before any recultivation measures had been applied to results we gained after three and four years of recultivation. The results show that the site is strongly heterogeneous concerning its mechanical stability, its permeability for air and water as well as pore volume and bulk density directly after site construction. The results after three and four years show that the heterogeneity of soil physical parameters decreases. The selection of suitable crop rotations superimposes the effects of other recultivation measures, e.g. varying organic fertilizers or deep loosening.



S12.07a - POTENTIALLY HARMFUL ELEMENTS IN SOILS

Chair Persons:

Jaume Bech, Barcelona - Spain

Claudio Bini, Venezia - Italy

Tuesday 03 July 2012 from 10:30 to 12:00. Room Acero

S12.07a -1

*RISK ASSESSMENT OF ARBUTUS UNEDO FRUITS FROM PLANTS GROWING ON
CONTAMINATED MINE SOILS FROM PANASQUEIRA, PORTUGAL*

Maria Manuela Abreu, Lisboa - Portugal

S12.07a -2

*ANTIMONY (SB) IN MINING IMPACTED PADDY SOIL: MOBILITY AND SOLUBILITY IN SOIL
AND UPTAKE IN RICE*

Gudny Okkenhaug, Oslo - Norway

S12.07a -3

*USE OF THE COMPUTER MINTEQ MODEL TO WATERS AFFECTED BY MINING ACTIVITIES:
A PARTICULAR CASE IN SE SPAIN*

Carmen Perez- Sirvent, Murcia - Spain

S12.07a -4

*MODELLING BACKGROUND CONCENTRATIONS OF POTENTIALLY HARMFUL ELEMENTS
FOR EVALUATION OF ANTHROPOGENIC CONTAMINATION: FOCUS ON CALCAREOUS
SOILS IN THE SOUTH-WEST OF FRANCE*

Paul-Olivier Redon, Castanet-Tolosan - France

S12.07a -5

*QUANTIFYING THE SPATIAL DISTRIBUTION OF HEAVY-METAL SOIL POLLUTION IN
ELBASAN, ALBANIA, VIA PORTABLE X-RAY FLUORESCENCE*

Ryan Perroy, La Crosse - United States

S12.07a -6

*THE INFLUENCE OF COMPOST APPLICATION ON SOIL VULNERABILITY TO HEAVY METAL
POLLUTION*

Vasily Rosen, Rehovot - Israel



S12.07a -1

RISK ASSESSMENT OF ARBUTUS UNEDO FRUITS FROM PLANTS GROWING ON CONTAMINATED MINE SOILS FROM PANASQUEIRA, PORTUGAL

Abreu Maria Manuela^{*[1]}, Godinho Berta^[1], F. Magalhães Maria Clara^[2]

^[1]Instituto Superior de Agronomia, Universidade Técnica de Lisboa (TULisbon) ~ Unidade de Investigação de Química Ambiental (UIQA) ~ Lisboa ~ Portugal ^[2]Universidade de Aveiro ~ Centro de Investigação em Materiais Cerâmicos e Compósitos (CICECO), Departamento de Química ~ Aveiro ~ Portugal

*Panasqueira mine located in the north centre of Portugal is still operating, being one of the main European tungsten producers. Tungsten, tin and copper have been exploited for over a century. The main environmental concerns for this site comes from the active and old huge tailings, acid mine generation and the water treatment plant. The objective of this study was to evaluate the biogeochemical impact of the mine activity in soils, mainly developed on old waste materials, and strawberry tree (*Arbutus unedo*) growing on these soils. The potential danger for strawberry tree fruits and the derived alcohol for human's consumption were also assessed. Soils developed on waste materials and soils influenced by mine drainage present variable concentrations (mg/kg) of As (158-7790), Cd (0.6-79), Cu (51-4080), W (19-1450) and Zn (142-12300). The available fraction concentration of the elements, extracted with DTPA, is quite variable depending on the element. Soils are mainly silty loam, acidic (pH (mean) ~5) with a wide range of Corganic (5.2-93.4 g/kg). Plants (branches and leaves) present, in some samples, concentrations (mg/kg) above the normal range for plants in general (maximum: As-5; Cd-13; Zn-570) but no signs of toxicity were observed. *Arbutus unedo* is a tolerant species but not trace elements accumulator. The strawberry tree fruits are not contaminated and can be used to produce local liquor. The concentration of the chemical elements in alcohol is within the range of the European legislation. The fruits consumption do not constitute risks (nephrotoxicity) for human health (Hazard Quotient <1).*



S12.07a -2

ANTIMONY (SB) IN MINING IMPACTED PADDY SOIL: MOBILITY AND SOLUBILITY IN SOIL AND UPTAKE IN RICE

Okkenhaug Gudny^[1], Zhu Yong-guan^[2], He Junwen^[2], Li Xi^[2], Mulder Jan^[3]

^[1]Norwegian Geotechnical Institute (NGI) ~ Environmental department ~ Oslo ~ Norway ^[2]Research Center for Eco-Environmental Sciences (RCEES) ~ Department of Soil Environmental Science ~ Beijing ~ China ^[3]Norwegian University of Life Sciences (UMB) ~ Department of Plant and Environmental Sciences ~ Ås ~ Norway

In the present study we investigated the behavior of Sb in flooded paddy soil sampled downstream an active Sb mining area in Xikuangshan, located in Hunan Province (China). Rice (Oryza sativa L. cv Jiahua) was grown under controlled conditions, and soil pore water concentrations and speciation of Sb were monitored during 50 days to study the effect of flooding, nutrient addition and rice plants. Results were compared with behavior and uptake of arsenic (As). Flooding the paddy soil (no rice plants) increased both the concentration of Sb and As, most likely due to increased pH and subsequent decrease in positive charge on oxides and clay minerals and reduced anion sorption capacity. Phosphate supply, in form of fertilizer, led to an initial increased Sb and As mobilization caused by the competition for the same sorption sites. When rice was present, Fe plaque developing on rice roots acted as a scavenger for both As and Sb, whereby the concentration of As, but not Sb, in porewater decreased substantially. Sb occurred mainly as Sb(V) in the porewater, and a strong negative correlation between Sb(V) and calcium (Ca) concentrations in porewater indicated a Sb solubility governed by Ca antimonate. Greater relative concentration of Sb(V) was found in rice shoots compared to rice root and porewater, indicating either a preferred uptake of Sb(V) or possibly an oxidation of Sb(III) to Sb(V) in shoots. No significant differences in bioaccumulation factor and translocation factor between Sb and As were observed.



S12.07a -3

USE OF THE COMPUTER MINTEQ MODEL TO WATERS AFFECTED BY MINING ACTIVITIES: A PARTICULAR CASE IN SE SPAIN

Martínez-Sánchez Maria Jose^[1], Garcia -Lorenzo Maria Luz^[2], Perez- Sirvent Carmen^{*[1]}, Hernandez-Cordoba Manuel^[3]

^[1]University of Murcia ~ Agricultural Chemistry, Geology and Pedology ~ Murcia ~ Spain ^[2]Complutense University of Madrid ~ Petrology and Geochemistry ~ Madrid ~ Spain ^[3]University of Murcia ~ Analytical Chemistry ~ Murcia ~ Spain

Trace elements contained in the residues from mining and metallurgical operations are often dispersed by wind and/or water after their disposal. Water pollution by dissolved metals in mining areas has mainly been associated with the oxidation of sulphide-bearing minerals exposed to weathering conditions, resulting in low quality effluents of acidic pH and containing a high level of dissolved metals. According to transport process, three types of pollution could be established as a result of metal extraction. The aim of this work was to study trace element in water samples affected by mining activities. In addition, MINTEQ model was applied for calculating aqueous geochemical equilibria in water samples. Primary contamination: Sampling point S1 is located in a tailing dump and showed high trace element content. In addition this point is located close to the sea, and then, chloride, bromide, sodium and magnesium content is high. MINTEQ simulation suggested that soluble zinc content could precipitate as a carbonate (hidrozincite and smithsonite), just as manganese (rhodocrosite) and cadmium (otavite). Secondary contamination. Points affected by secondary contamination receive dissolved and particulated materials from Lo Poyo tailing dump and also receives trace element from surrounding soils (calcic Luvisols). Sea influence could be confirmed by chlorides, bromides, sodium and magnesium content also and also showed nitrates from agricultural soils located in topographically higher areas- Tertiary contamination: Water samples collected showed basic pH, soluble carbonates and low trace element concentrations. MINTEQ results suggested Cd, Zn and Mn could precipitate as carbonates, while aluminium would do it as oxihydroxide.



S12.07a -4

MODELLING BACKGROUND CONCENTRATIONS OF POTENTIALLY HARMFUL ELEMENTS FOR EVALUATION OF ANTHROPOGENIC CONTAMINATION: FOCUS ON CALCAREOUS SOILS IN THE SOUTH-WEST OF FRANCE

Redon Paul-Olivier^[1], Thomas Bur^[1], Maritxu Guiresse^[1], Jean-Luc Probst^[1], Aurore Toiser^[1], Jolivet Claudy^[2], Jean-Claude Revel^[1], Anne Probst^[1]

^[1]CNRS/UPS/INPT/ENSAT ~ EcoLab ~ Castanet-Tolosan ~ France ^[2]INRA ~ InfoSol ~ Orléans ~ France

Determining natural background concentrations of potentially harmful elements (PHE) in soils is difficult since these elements undergo many complex processes, both pedo-geogenic and anthropogenic. PHE concentrations observed in soil samples are resulting from: (1) atmospheric deposition, mineral weathering, migration along the soil profile (depending on the investigated element, the soil type and the environmental conditions) and (2) enrichment by exogenous deposition, mainly due to diverse human activities. We explore a dataset from cultivated soils (RMQS, French Soil Monitoring Network, Midi-Pyrénées region, S-W of France) to model adequately the background concentrations of As, Cd, Co, Cr, Cu, Mo, Ni, Pb, Sn, Ti, Tl, V, Zn. Different methods were investigated using a range of soil properties in order to identify anthropogenic contaminations. Descriptive statistics, enrichment factor and multiple linear regressions were used for diagnosis purpose. A discussion about the most suitable method is proposed. A confrontation with land use and agricultural practices at each studied site also allows the identification of potential contamination sources. Many contaminations were detected but of low intensity; a PCA is used to discriminate different groups of metals fates in soils. In this French region, a large proportion of soils are alkaline because of their formation on sedimentary calcareous bedrock. Indeed, typical related behaviours of PHE are poorly documented since such soil types are not so frequently investigated worldwide. Actual fates of PHE in alkaline soils are not very well predicted by current models. This needs improvement for decision about local risk assessment and agricultural soil management.



S12.07a -5

QUANTIFYING THE SPATIAL DISTRIBUTION OF HEAVY-METAL SOIL POLLUTION IN ELBASAN, ALBANIA, VIA PORTABLE X-RAY FLUORESCENCE

Perroy Ryan^[1], Sallaku Fatbardh^[2], Tota Odeta^[2], Hill Brian^[1]

^[1]University of Wisconsin-La Crosse ~ Geography and Earth Science ~ La Crosse ~ United States ^[2]Agricultural University of Tirana ~ Agriculture and Environment ~ Tirana ~ Albania

We used a portable X-ray fluorescence detector and a high-resolution GPS system to determine the spatial distribution of heavy-metal soil contamination in and around a large communist-era industrial metallurgy complex situated along the Shkumbini River in central Albania. Over 2500 geo-referenced samples were collected and measured over a 5-week period in the summer of 2010. In-situ surficial contamination levels of Cr (>300,000 ppm), Ni (>66,000 ppm), Cd (>3,000 ppm), and Pb (>110,000 ppm) were measured within the ~ 4 km² metallurgy complex, values supported by confirmatory ICP and other digestion analyses. Highly elevated soil contamination levels were also found in surface and sub-surface samples collected from residential areas, urban parks, roadsides, and agricultural fields in the surrounding area. Although large state ore-processing activities halted following the upheaval of the communist regime in 1997, new foreign-owned businesses and small scale Albanian land-holders and squatters now use the industrial complex area for housing, agriculture, livestock grazing, and new industrial activities like scrap-metal smelting. High-resolution maps of heavy metal soil contamination produced as a result of this work provide valuable knowledge of the magnitude and spatial distribution of these contaminants, as well as baseline data for understanding the associated ecological and public health impacts on surrounding and downstream communities.



S12.07a -6

THE INFLUENCE OF COMPOST APPLICATION ON SOIL VULNERABILITY TO HEAVY METAL POLLUTION

Rosen Vasiliy^{*[1]}, Chen Yona^[1]

^[1]Faculty of Agriculture, Food and Environment, Hebrew University of Jerusalem ~ Department of Soil and Water Sciences ~ Rehovot ~ Israel

Soil vulnerability may be defined as the soil's capacity to hold and release various contaminants and pollutants. The less vulnerable soils are those with high but finite capacities for storage of potentially mobilizable and harmful chemicals, particularly heavy metals. We propose to evaluate soil vulnerability to heavy metal pollution based on its ability to retain metals in forms which exhibit low phyto-availability. These geochemical forms can be defined as geochemical fractions following sequential extraction procedures. The fractions studied are listed below from the most to the least bioavailable ones: water-extractable (WE), exchangeable-adsorbed (EXC), associated with carbonates (CARB), occluded by reducible (hydro)oxides of Fe and Mn (RO), associated with organic matter (OM) and a residual fraction (RES). Chinese cabbage plants were grown in pots with soils and soil:compost mixtures spiked with soluble metal salts (Cd, Cu and Pb). The highest compost doses (72 and 115 Mg ha⁻¹) enhanced cabbage yield significantly. No excessive phyto-accumulation of metals has been observed in plants grown on the clayey soil and its mixtures with compost. The compost dose of 72 Mg ha⁻¹ was optimal in decreasing Cu accumulation by plants grown on the sandy soil, and 28.8 Mg ha⁻¹ was found to be effective in reducing Cd and Pb uptake. Metals were accumulated in plants primarily from the WE, EXC and CARB fractions, while other fractions decreased phyto-accumulation. Compost addition suppressed heavy metal mobility but different fractions were active in pollutant sorption depending on soil type and metal.



S12.07b - POTENTIALLY HARMFUL ELEMENTS IN SOILS

Chair Persons:

Manuela Abreu M., Lisbon - Portugal

Carmen Perez-Sirvent, Murcia - Spain

Tuesday 03 July 2012 from 13:30 to 15:00. Room Acero

S12.07b -1

POTENTIALLY HARMFUL ELEMENTS IN THE FOOD CHAIN: TRANSLOCATION FROM SOIL TO PLANTS AND FOODSTUFF

Silvia Fontana, Venice - Italy

S12.07b -2

TRACE METAL CONTENTS OF CROATIAN SOILS: REGIONAL DIFFERENCES AND EFFECT OF

Marija Romic, Zagreb - Croatia

S12.07b -3

TRACE ELEMENT TOTAL CONTENT AND BEHAVIOR IN FOREST SOIL OF SOUTHERN QUÉBEC, CANADA

Jacynthe Masse, Vancouver - Canada

S12.07b -4

TIME SERIES OF HEAVY METAL AND RARE EARTH ELEMENT ACCUMULATION IN TOP SOIL OF A LONG-TIME P FERTILIZATION EXPERIMENT

Geerd Smidt, Bremen - Germany

S12.07b -5

ASSESSING THE EFFECTS OF INCREASING SOIL ANTIMONY CONCENTRATIONS ON PLANT GROWTH: AN OVERVIEW

Mertens Jelle, Brussels - Belgium

S12.07b -6

ASSESSING EXPOSURE TO CADMIUM IN A METAL RECYCLING COMMUNITY IN VIETNAM

Rupert Hough, Aberdeen - United Kingdom



S12.07b -1

POTENTIALLY HARMFUL ELEMENTS IN THE FOOD CHAIN: TRANSLOCATION FROM SOIL TO PLANTS AND FOODSTUFF

Fontana Silvia^{*[1]}, Bini Claudio^[1], Vannuzzo Lisa^[1], Wahsha Mohammad^[1]

^[1]University of Venice ~ Environmental Sciences ~ Venice ~ Italy

In recent years great attention has been paid on the presence of PHEs (potentially harmful elements) in soils employed for food or feed production. The main sources of these pollutants in agroecosystems are: industrial and mining activities, vehicular traffic along major roads, use of fertilizers and pesticides, amendment with sewage sludge. The contaminants enter the soil system, and can be absorbed by humans through several paths: dermal contact, inhalation, soil particle ingestion, ingestion of contaminated crops. In this work we focus on the absorption of potentially harmful elements through the food chain, and in particular on PHEs' plant uptake from soil through the root system and translocation to the aerial parts. The study area is located in the proximity of an industrial district (mainly tannery industries, but also chemical industries and smelters) and along a highway in North-East Italy. Five transects parallel to the highway were sampled (totally 22 sampling sites). For each location, the following samples were collected: topsoil (0-20 cm), subsoil (45-70 cm), maize and wheat (approximately 20 plants for each sample). The following potentially harmful elements were determined by ICP-OES after complete acid digestion: Al, Fe, Mn, Cr, Pb, Ni, Zn, Cu. The area is slightly contaminated by Cr, Ni and Cu, but there seems to be any health risk due to food consumption, being these elements substantially immobilized in the roots. Wheat seems to behave as an excluder species in relation to most PHEs considered in this study, especially the non-nutrients.



S12.07b -2

TRACE METAL CONTENTS OF CROATIAN SOILS: REGIONAL DIFFERENCES AND EFFECT OF

Romic Marija*^[3], Bakic Helena^[4]

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Soil survey on trace metals in agricultural soils of Croatia was carried out to assess soil quality, determine management and land conversion elements, and based on that assess risk of toxic element spreading into environment, first of all into groundwater and surface water bodies. A multi-element geochemical survey consists of soil sampling from 1294 locations covering the Croatian territory (56.594 km²) from the two depths. The following soil properties were retained: (i) element concentrations determined by ICP-OES after aqua regia dissolution, (ii) the TOC measured by dry combustion, (iii) the particle-size distribution using wet sieving and the pipette method, (iv) CEC and exchangeable cations (BaCl₂ method), (v) pH and ECe, (vi) "labile pool" trace metals and nutrients (CaCl₂ extraction). A GIS geochemical database was compiled followed by statistical and geostatistical analyses and mapping. Geomorphologically, Croatia is divided into three main regions, each of which having specific climate, geology, hydrology, soil types and land use. The spatial variability and baseline of elements in soils separately for different regions were determined applying multivariate geostatistics. The influence of natural conditions on regional differences was observed, and the apportionment of natural vs. anthropogenic contribution to trace metals soil accumulation was assessed, as well.



S12.07b -3

TRACE ELEMENT TOTAL CONTENT AND BEHAVIOR IN FOREST SOIL OF SOUTHERN QUÉBEC, CANADA

Masse Jacynthe*^[3], François Courchesne^[2]

^[1]University of British Columbia ~ Forest Science ~ Vancouver ~ Canada ^[2]Université de Montréal ~ Département de géographie ~ Montréal ~ Canada ^[3]University of British Columbia ~ Forest Sciences ~ Vancouver ~ Canada

Forest soils represent a considerable stock of nutrients available to sustain forest productivity. They also contain a trace elements (TE) pool of unknown size. Since many of these trace elements can be toxic, quantifying the concentration and the total content of TE in forest soils is necessary to assess their impact on soil quality. The specific objectives of this project were: 1) to measure the concentration and the total content of TE in the solid phase of the various soil horizons from two forest ecosystems in southern Quebec and 2) to unravel the associations existing between the bioavailable TE fraction and soil horizon properties. To achieve these goals, four soil profiles, two situated in a protected forested area (St-Hippolyte, Québec) and two from the urban area of Montréal, were excavated down to the parent material, sampled on a horizon basis, and analyzed for TE using ICP-MS. We found that the main pool of total TE is concentrated in coarse fragments of the soil. Conversely, the bioavailable TE fraction resides mainly in the organic horizon of the studied profiles. Multivariate statistical analyses revealed that, organic carbon, Fe-Al oxides, and amorphous forms of Si explained the vertical distribution of TE in soil profiles. By quantifying total TE reserve in the sampled soils, this project increases our understanding of the factors controlling spatial heterogeneity in TE in southern Quebec soils, and allows for better understanding of the role of soils in the biogeochemical cycle of TE in terrestrial ecosystems

S12.07b -4

TIME SERIES OF HEAVY METAL AND RARE EARTH ELEMENT ACCUMULATION IN TOP SOIL OF A LONG-TIME P FERTILIZATION EXPERIMENT

Smidt Geerd^[1], Iliev Milen^[2], Schnug Ewald^[3], Koschinsky Andrea^[1]

^[1]Jacobs University Bremen ~ Integrated Environmental Studies ~ Bremen ~ Germany ^[2]University of Bremen ~ Departement of Geosciences ~ Bremen ~ Germany ^[3]Technical University Braunschweig ~ Department of Life Sciences ~ Braunschweig ~ Germany

Mineral fertilizers with a phosphorus component contain numerous heavy metals in wide concentration ranges. In products traded in Germany average concentrations of up to 19.3 mg As kg⁻¹, 25 mg Cd kg⁻¹, 53.7 mg Cu kg⁻¹, 27.4 mg Ni kg⁻¹ and 280 mg Pb kg⁻¹ and 97.5 mg U kg⁻¹ were found. While fertilizers processed from sedimentary rock phosphates are enriched in heavy metals and radionuclides, products derived from igneous sources contain 10 times higher concentrations of rare earth elements (REE, e.g. 0.1 % La and 0.15 % Ce). In our study, we investigated the accumulation of the named elements in top soils of a long-time fertilization experimental field as a function of fertilization rates and application time. The fertilization experiments started in 1983 and the 6 different treatments received annual P₂O₅ applications between 0-510 kg ha⁻¹. Differences between the initial (1983), intermediate (1995) and recent (2011) heavy metal and REE concentrations in soil samples from the different plots will be presented. Furthermore, it will be tested if REE patterns of highly fertilized top soils show coherences with the unique REE pattern of P fertilizers of marine sedimentary origin, which are preferentially (87 %) used in Germany.



S12.07b -5

ASSESSING THE EFFECTS OF INCREASING SOIL ANTIMONY CONCENTRATIONS ON PLANT GROWTH: AN OVERVIEW

Jelle Mertens*^[1]

^[1]International Antimony Association vzw (i2a) ~ ~ Brussels ~ Belgium

*Effects of antimony on plant growth have been extensively reviewed and studied in the EU Risk Assessment Report (2008) on diantimony trioxide (ATO). Readily soluble Sb compounds (such as antimony trichloride, ATC) have been frequently used as test substance. Yet, addition of these substances also affects the soil solution chemistry (release of counter ions/protons/...) next to Sb concentrations complicating data interpretation; the NOEC and EC10 for lettuce (*Lactuca sativa*) shoot yield in ATC spiked soil were 0.4 and 2.7 mmol Sb/kg, but effects were entirely explained by the increasing chloride concentrations. Alternatively, ATO has been used (no release counter ions, no effects on soil pH), but most studies reveal unbounded threshold concentration (no effects observed at the largest Sb dose) due to slow dissolution kinetics of ATO. It was agreed at EU-level that sufficient ageing needs to be applied to allow the release of Sb ions and, as such, overcome an increasing 'toxic pressure' over time. A study was performed using 31-weeks aged ATO spiked soils (0-83 mmol Sb/kg). Sb effects on plants were assessed using the barley (*Hordeum vulgare*) root elongation and lettuce shoot yield assay. The former assay was most sensitively affected with a NOEC and EC10 of 8.2 and 16 mmol Sb/kg, or 80 and 110 $\mu\text{mol Sb/l}$ on a soil solution base. Effects were solely attributed to increased Sb concentration; soil pH, soil solution metal concentrations (except Sb) and ionic strength remained constant with increasing Sb dose. Latter data are used in the EU regulatory context.*



S12.07b -6

ASSESSING EXPOSURE TO CADMIUM IN A METAL RECYCLING COMMUNITY IN VIETNAM

Minh Ngo^[1], Hough Rupert^{*[2]}, Thuy Le^[1], Nyberg Ylva^[3], Mai Le^[4], Vinh Nguyen^[1], Oborn Ingrid^[3]

^[1]Soils & Fertilizers Research Institute ~ Vietnam Academy of Agricultural Science ~ Hanoi ~ Viet nam ^[2]The James Hutton Institute ~ Informatics and Computational Sciences ~ Aberdeen ~ United Kingdom ^[3]Swedish Agricultural University (SLU) ~ Department of Soil Sciences ~ Uppsala ~ Sweden ^[4]Hanoi University of Science ~ Faculty of Environmental Science ~ Hanoi ~ Viet nam

In Vietnam, human susceptibility to trace metals, in particular Cd, has specific gender and wealth aspects. Levels of iron (Fe), zinc (Zn) and calcium (Ca) in rice are insufficient for human needs. Further, polishing rice grain causes further Fe and Zn losses whilst levels of Cd in grain remain unaffected by this process. Iron deficiency predisposes individuals to a higher Cd absorption and therefore women are a more vulnerable group since they are more prone to Fe deficiency (anaemia). In 1995, 40% of Vietnamese women between 15 and 40 yrs were considered anaemic. In 2004, the national average has through an effective Fe supplementation program declined to 28%. However, for pregnant women, the percentage with anaemia was still high (34%). In order to estimate risks to specific population sub-groups (age, gender, socio-economic status), self-reported questionnaire data are being used to link measured concentrations of metals to exposure via contact with soils, the environment, and through consumption of rice. The project will provide local communities and authorities with background data to support improvement and implementation of policies related to environmental and food safety.



S12.07c - POTENTIALLY HARMFUL ELEMENTS IN SOILS

Chair Persons:

Jaume Bech, Barcelona - Spain

Dominik Weiss, London - United Kingdom

Tuesday 03 July 2012 from 15:30 to 17:00. Room Acero

S12.07c -1

THE GEOCHEMICAL BASELINE MAPPING OF A STRONGLY URBANIZED AREA IN SOUTHERN ITALY: THE ACERRA-MARIGLIANO-POMIGLIANO CONURBATION

Benedetto De Vivo, Napoli - Italy

S12.07c -2

MECHANISMS OF REALIZATION OF POTENTIALLY DANGER OF MICROELEMENTS

Galina Motuzova , Moscow - Russian Federation

S12.07c -3

ECODYNAMIC OF TRACE ELEMENTS IN A PHYTOMANAGED SOIL, CONTAMINATED WITH INCREASING COPPER CONCENTRATION LEVELS

Nour Hattab, Orleans - France

S12.07c -4

DETERMINISM OF THE SPATIAL DISTRIBUTION OF METALLIC TRACE ELEMENTS CONCENTRATIONS IN SOILS CONTAMINATED BY ATMOSPHERIC FALLOUTS: THE CASE OF THE SCLAIGNEAUX AREA (BELGIUM)

Amandine Liénard, Gembloux - Belgium

S12.07c -5

TESTING OF INORGANIC AND ORGANIC AMENDMENTS FOR IN SITU STABILIZATION OF CD, CU & ZN IN A STRONGLY CONTAMINATED KASTANOZEM

Stephan Jung, Giessen - Germany

S12.07c -6

THE INFLUENCE OF BIOGEOCHEMICAL AND PHYSICAL SOIL PROPERTIES ON THE NATURAL VARIABILITY OF SELECTED HEAVY METALS – A GEOCHEMICAL SOIL SURVEY OF CONTINENTAL EUROPE

Rannveig Anna Guicharnaud, Ispra - Italy



S12.07c -1

THE GEOCHEMICAL BASELINE MAPPING OF A STRONGLY URBANIZED AREA IN SOUTHERN ITALY: THE ACERRA-MARIGLIANO-POMIGLIANO CONURBATION

De Vivo Benedetto^{*[1]}, Albanese Stefano^[1], Lima Annamaria^[1], Rezza Carmela^[1], Ferullo Giampiero^[1], Chen Wei^[2], Qi Shihua^[2]

^[1]Università degli Studi di Napoli Federico II ~ Dipartimento di Scienze della Terra ~ Napoli ~ Italy ^[2]China University of Geoscience ~ School of Environmental Studies ~ Wuhan ~ Canada

In the framework of the URGE (Urban Geochemistry) project aiming at depicting the environmental conditions of several cities in Europe, the north-eastern sector of the Naples metropolitan area (Italy), namely the Acerra-Pomigliano-Marigliano area (with ~130.000 inhabitants), has undergone a geochemical characterization based on topsoil sampling (145 samples over an area of 90 sqkm). This area has been selected because of both the presence of an historical industrial settlement on it (mainly devoted to plastic materials and synthetic fibres production) and of an incinerator which came into operation in March 2009. The main objective of the study is to define the local geochemical baselines both for 53 elements (among which the toxic ones) and for some organic compounds, including Dioxins and Furans. Furthermore, the study aims to support epidemiological researches and to establishing a record of the environmental status quo to evaluate in the future the impact of the incinerator on both territory and population. First results show that the most urbanized areas of the Acerra-Pomigliano-Marigliano conurbations are characterized by concentrations of Pb, Zn and V exceeding the intervention limits established by the Italian Environmental law (D.Lgs. 152/2006). Agricultural soils, in the surroundings of the urbanized areas, are enriched in Cu, Co, Cd, Be and Ni, and the probable presence of illegal waste disposals in the area could be considered as a source for them. In the area where the incinerator has been built Se, Hg, Cu, Cd and Sb baselines are generally higher than in the rest of the territory.



S12.07c -2

MECHANISMS OF REALIZATION OF POTENTIALLY DANGER OF MICROELEMENTS

Motuzova Galina*^[1]

^[1]Moscow State University ~ Faculty of Soil Science ~ Moscow ~ Russian Federation

Microelements (ME) - one of the most important groups of elements in the environment. Their low quantity is necessary for living organisms. At the same time they present potentially harmful elements. Their danger can be realized when the content of microelements in environment increases. The mechanisms of the realization of their danger are specific for every sphere. As far as soils, high content of microelements (including metals) in soils provides the changes of two groups of soil properties: the state of metals and some important chemical properties of soils. The results of laboratory and field investigations have shown the mechanisms of such changes. In soils, polluted by different metals, the share of their mobile species always increases and it provides the negative influence of the polluted soils on plants, on natural water. Simultaneously the negative changes of the important chemical properties occur. The changes in the state of soil organic matter take place as a result predominantly of the formation of their complexes with ions of the added metals. These processes lead to the restructuring of organic components, including the separation of some fragments from the molecules of humus acids. These processes are accompanying by the additional acidification of liquid phases of soils and by decreasing of cation-exchangeable ability of soils. The properties of clay minerals also can change under the influence of metals excess in soils. The degradation of soil components under the influence of excess of microelements leads to decrease of stability of soils to pollution.



S12.07c -3

ECODYNAMIC OF TRACE ELEMENTS IN A PHYTOMANAGED SOIL, CONTAMINATED WITH INCREASING COPPER CONCENTRATION LEVELS

Hattab Nour^[1], Motelica Mikael^[1], Bourrat Xavier^[1], Guégan Régis^[1], Mench Michel^[2]

^[1]UMR 6113 - CNRS/Université d'Orléans ~ Institut des Sciences de la Terre d'Orléans ~ Orleans ~ France ^[2]Université Bordeaux 1 ~ UMR INRA 1202 BIOdiversité, GENes et COMMunautés ~ Bordeaux ~ France

The ecodynamic of As, Cr, Cu and Zn was studied in phytomanaged soils contaminated with levels of Cu from a former wood preservation site (Bordeaux, FRANCE). This alluvial sandy soil is managed with natural attenuation, assisted management (organic matter, dolomite), phytoextraction (sunflower) and present an increasing level of Cu contamination by patches in the same site. This study aims at obtaining data on the concentrations and speciation of trace elements (TE) in the water-soil-plant system and on the soil reaction mechanisms for the TE. Biotests (dwarf beans) were carried out on soil sampled from the site as well as physico-chemical characterisation of the soils and trace metal speciation (Rhizon, DGT). This experimental set-up was applied on two years to monitor the effect of amendments and the increasing concentrations of Cu on the dynamics of the TE in this soil. Effect of increasing concentrations of Cu on the mobility/availability of TE to the plants and microorganisms of the soil, effects of dissolved organic compounds in the solution of soil on the speciation and the fixation of TE on the organic/inorganic colloids and TE impacts and bioaccumulation in plant communities were investigated. Preliminary results showed that the high concentrations of Cu in the phytomanaged soils treated with organic matter and dolomite inhibited the mobility and the availability of other TE in the soil.



S12.07c -4

DETERMINISM OF THE SPATIAL DISTRIBUTION OF METALLIC TRACE ELEMENTS CONCENTRATIONS IN SOILS CONTAMINATED BY ATMOSPHERIC FALLOUTS: THE CASE OF THE SCLAIGNEAUX AREA (BELGIUM)

Liénard Amandine^{*[1]}, Dère Christelle^[1], Colinet Gilles^[1]

^[1]University of Liege - Gembloux Agro-BioTech ~ Sciences et Technologies de l'environnement ~ Gembloux ~ Belgium

The valleys of Sambre and Meuse in Wallonia hosted numerous metal ore treatment factories. They engendered a contamination of soils by metallic trace elements that may migrate in the landscape through erosion, lixiviation, biological transportation, aso. We investigated the spatial distribution of some metallic trace elements in soils around a former zinc-ore treatment plant to a distance of 3km. The sampling strategy aimed at (i) verifying that the main source of trace elements was the plant chimney, (ii) assessing the impact of the wind directions on fallout dispersion and (iii) evaluating whether there were differences of contents according to soil types and to soil occupation. Two hundred and fifty topsoil samples were collected according to a stratified design dealing with distance to the chimney, direction of dominant winds, soil type, and land use. Pseudo-total contents in inorganic elements, pH, TOC, and N were determined in the laboratory. Besides, classical statistical analysis (i) ANCOVA (three-way ANOVA with the distance as a co-variate) and (ii) Principal Component Analysis were also performed. First results show that (i) zinc, lead and cadmium contents are closely correlated to each other and (ii) negatively correlated with the distance. If the geographical location is the major driving factor of trace elements contents in soils, significant differences were also found between soil type and land use ($p\text{-value} < 0.05$). The highest MTE concentrations were associated with North-East winds, forest cover and pebbles rich soils. Further investigations will concern the vertical and toposequential distributions, and the speciation of MTE.



S12.07c -5

TESTING OF INORGANIC AND ORGANIC AMENDMENTS FOR IN SITU STABILIZATION OF CD, CU & ZN IN A STRONGLY CONTAMINATED KASTANOZEM

Jung Stephan^[1], Thomas Hanauer^[2], Sven Schubert^[1], Peter Felix-Henningsen^[2], Diedrich Steffens^[1]

^[1]Justus Liebig University Giessen / Research Center for BioSystems, Land Use and Nutrition ~ Institute of Plant Nutrition ~ Giessen ~ Germany ^[2]Justus Liebig University Giessen / Research Center for BioSystems, Land Use and Nutrition ~ Institute of Soil Science and Soil Conservation ~ Giessen ~ Germany

The objective of our project was the *in situ* remediation of a Kastanozem in Georgia highly polluted with Cd, Cu and Zn. A pot experiment with a top soil of this region was conducted at Justus Liebig University Giessen, Germany. Four soil amendments were applied: elementary iron (Fe⁰), natural zeolite, Divergan® (a synthetic polymer) and a biochar product. Each amendment was applied in various concentrations to 4 kg of contaminated soil. The soil was moistened and incubated in a growth chamber for 5 weeks. After this time spinach (*Spinacia oleracea* L.), vegetable rape (*Brassica napus* L.), wheat (*Triticum aestivum* L.) and again spinach were cultivated in the timeframe of one year. In all treatments 1 M NH₄NO₃-extractable Cd was reduced compared to the control treatment. The strongest effects on the reduction of 1 M NH₄NO₃-extractable Cd, Cu and Zn were measured in the Divergan® treatments. Furthermore a 7-step sequential extraction confirmed a shift from easily mobilizable to heavily bound fractions. Application of the soil amendments increased plant growth in most cases, most likely due to a reduction of Cu and Zn toxicity. The plants in the control treatment always showed Cd concentration above EU threshold values. The Cd concentration in plant tissue was mostly decreased below these thresholds in the Divergan® treatment. In conclusion, Divergan® seems to be a useful amendment for *in situ* immobilization of Cd, Cu and Zn- polluted soils.



S12.07c -6

THE INFLUENCE OF BIOGEOCHEMICAL AND PHYSICAL SOIL PROPERTIES ON THE NATURAL VARIABILITY OF SELECTED HEAVY METALS – A GEOCHEMICAL SOIL SURVEY OF CONTINENTAL EUROPE

Guicharnaud Rannveig Anna*^[1], Montanarella Luca^[1]

^[1] Joint Research Centre (JRC), Institute for Environment and Sustainability (IES) ~ Land Management and Natural Hazard Unit ~ Ispra ~ Italy

Heavy metals (HM) in soils can directly influence human health via the food chain and have hence become an important factor in terms of determining soil quality. The mobility and bioavailability of HM in the environment depends on the total concentration of the elements but also on soil physical and biogeochemical properties. Soils are generally long term HM sinks and HM have been found to accumulate in organic layers and clay rich layers of forest soils. Geochemical soil surveys on natural variability and distribution of HM can play an important role in assessing environmental quality. Here, we present the results from the BIOSOIL forest soil survey conducted on 12 forested soil types (WRB) in 33 European countries. A special emphasis was placed on assessing the influence of biogeochemical and physical soil properties on the accumulation of HM in organic and mineral layers in both top and sub soil horizons. Land use changes can affect accumulation of HM in soils and in turn soil fertility and ground water quality. Monitoring of HM in different management systems can provide a theoretical base for controlling soil HM concentrations. An additional land survey has therefore been launched by combining the BIOSOIL to the LUCAS-soil, a pilot project to monitor changes in land management, where 1/3 of forest sample points were transferred to arable and grassland in 25 EU countries.



W12.01a - PESTICIDES IN SOIL, FATE AND EFFECTS ON ENVIRONMENT - In collaboration with GRIFA

Chair Persons:

Sabino Bufo, Potenza - Italy

Tomas Undabeytia, Sevilla - Spain

Monday 02 July 2012 from 13:30 to 15:00. Room Leccio

W12.01a -1

ASSESSING THE EXPOSURE OF SOIL ORGANISMS TO PESTICIDES IN THE EUROPEAN UNION

Aaldrik Tiktak, Bilthoven - Netherlands

W12.01a -2

PESTICIDE INTERACTIONS IN SOILS, SEDIMENTS AND WATER

Rebecca Harrison, Bristol - United Kingdom

W12.01a -3

INTERACTIONS OF HERBICIDES WITH ORGANIC MATTER AND DISSIPATION PROCESSES

Peter Burauel, Juelich - Germany

W12.01a -4

ROLE OF CLAY AND ORGANIC MATTER IN AN AGRICULTURAL SOIL ON THE FATE OF THE HERBICIDE SULCOTRIONE

Pascale Besse-Hoggan, Aubière Cedex - France

W12.01a -5

BIOMIX CAPACITY ON RETAINING PESTICIDES FROM CONTAMINATED WATER IN OXYGEN-LIMITED CONDITIONS

Nicoleta Alina Suciu, Piacenza - Italy

W12.01a -6

NEW VIEWS ON NON-EXTRACTABLE RESIDUE FORMATION FROM PESTICIDES IN SOIL

Karolina Nowak, Leipzig - Germany



W12.01a -1

ASSESSING THE EXPOSURE OF SOIL ORGANISMS TO PESTICIDES IN THE EUROPEAN UNION

Tiktak Aaldrik^[1], Boesten Jos^[2], Klein Michael^[3], Vanderborght Jan^[4]

^[1]PBL Netherlands Environmental Assessment Agency ~ WLV ~ Bilthoven ~ Netherlands ^[2]Wageningen UR ~ Alterra ~ Wageningen ~ Netherlands ^[3]Fraunhofer Institute ~ Biology and Applied Ecology ~ Schmallenberg ~ Germany ^[4]Forschungszentrum Jülich GmbH ~ Agrosphere, ICG-4 ~ Jülich ~ Germany

EFSA developed a methodology for the assessment of exposure of soil organisms to pesticides, because harmonised European procedures are currently not available. Based on ecotoxicological considerations, this methodology was developed both for the concentration in total soil and for the concentration in soil pore water. The goal of the exposure assessment has been chosen to be the 90th percentile of the exposure concentration (maximum over time) in the intended area of use in the three regulatory zones defined in the Pesticides Regulation. The endpoint of the exposure assessment is a spatio-temporal percentile of a concentration distribution, so this distribution had to be modelled first. This was done with a simple analytical model, because data to parameterise detailed numerical models are not available at the scale of the EU-27. From the so-obtained concentration distribution, 90th percentile scenarios were selected. Separate scenarios were developed for the concentration in total soil and for the concentration in pore water giving six scenarios to be developed. The scenarios were defined by their air temperature, soil organic matter content and soil textural class. For each of these scenario's, the numerical models PEARL and PELMO were parameterised. (These models are already routinely used for the assessing the potential for movement of pesticides to groundwater.) The concentration in total soil decreased in the order North>Central>South, whereas the concentration in the pore water showed an opposing trend with the highest concentration in the Southern European scenario. This is caused by the North-South trend of organic matter in the EU.



W12.01a -2

PESTICIDE INTERACTIONS IN SOILS, SEDIMENTS AND WATER

Harrison Rebecca^{*[1]}, Michaelides Katerina^[1], Freer Jim^[1], Bull Ian^[2], Hurley Steven^[3]

^[1]Bristol University ~ Geographical Science ~ Bristol ~ United Kingdom ^[2]Bristol University ~ Organic Geochemistry Unit, Department of Chemistry ~ Bristol ~ United Kingdom ^[3]Wessex Water Ltd ~ Operations ~ Bath ~ United Kingdom

Transport of pesticides in runoff and subsurface flow during rainfall events poses a significant concern for water quality with adverse effects on drinking water and aquatic life which may lead to serious and long-lasting ecotoxicological effects. Pesticide transport from fields to water courses has been shown to be accentuated by erosion of sediment-bound pesticides which can be a significant component of surface-water contamination and off-site pollution. Laboratory soil lysimeter experiments (0.03 m³) were used to monitor the vertical, flow-driven movement of different pesticide compounds over successive storm events. Known concentrations of commonly used pesticides were applied to dried and pre-wetted soil and subjected to rainfall simulations over a 2-week period. Leachate was collected at regular intervals during each rainfall simulation and analysed for pesticide concentrations. Cored soil samples from the lysimeters were analysed after each experiment in order to determine the concentration profile of sediment-bound pesticides and the relative partitioning between the dissolved and sediment-bound phases. Pesticides with different properties (half-life, degradation products, toxicity, soil-water partition coefficient) were used in order to determine differences in transport characteristics according to compound classes. The experimental results are used to constrain catchment sampling design for determining large-scale transport and residence times of pesticides in the context of drinking-water management.



W12.01a -3

INTERACTIONS OF HERBICIDES WITH ORGANIC MATTER AND DISSIPATION PROCESSES

Burauel Peter*^[1], Nicolai Jablonowski^[1]

^[1]Forschungszentrum Juelich GmbH ~ Agrosphere Institute, IBG 3 ~ Juelich ~ Germany

There are almost no sites worldwide which are not affected in various manner by the use of agrochemicals. In terrestrial systems, soils function as the major sorbent and sink for locally and widely applied pesticides. This function critically depends on the quantity and quality of soil organic matter, the microbial activity and diversity, and the amount and accessibility of biogeochemical interfaces in soil. Soils are highly heterogeneous, complex and sensitive to changing environmental conditions and land use systems. In this respect the deterioration of soils by an increasing loss of soil organic matter is a challenge. Almost half of European soils can already be assessed as being degraded with unknown effects in matter cycling (nutrients, pesticides, contaminants). This will be fostered by an increased demand of farmland used for biomass/bioenergy production. Soils can also function to offset CO₂ emissions from fossil fuel combustion by introducing soil and crop management practices which enhance the input of biomass carbon into the soil – another challenge in matter cycling. A changing carbon status of our soils will effect persistence, bioaccumulation, bioaccessibility, and toxicity of pesticides. The behaviour of binding and remobilization of aged pesticide molecules in soil and their microbial remobilization potential will be highlighted in this presentation. Results will as well tackle the potential remobilization of aged pesticide residues by an intense sequence of drying and wetting cycles which simulate drastic soil water potential changes increasingly occurring due to regional effects of climate change.



W12.01a -4

ROLE OF CLAY AND ORGANIC MATTER IN AN AGRICULTURAL SOIL ON THE FATE OF THE HERBICIDE SULCOTRIONE

Dumas Edith^[1], Alekseeva Tatiana^[2], Sancelme Martine^[1], Forano Claude^[1], Besse-Hoggan Pascale^{*[1]}

^[1]Institut de Chimie de Clermont-Ferrand - CNRS ~ Université Blaise Pascal ~ Aubière Cedex ~ France ^[2]Institute of Physical, Chemical and Biological Problems of Soil Science ~ Russian Academy of Sciences ~ Pushchino ~ Russian Federation

Dissemination of pesticides in agricultural soils occurs via interactions with solid particles and microorganisms. These interactions play a key role in their biodegradation by acting not only on their bioavailability but also on the microbial metabolic activity. In order to better understand the mechanisms involved in the transfer/transformation processes of pesticides and to identify the role of each soil component on their fate, we developed a multi-scale experimental study. Agricultural soil samples (Limagne plain, France), particularly rich in clay and organic matter, were separated into three fractions : 50 μ m -500 μ m; 2 μ m- 50 μ m; < 2 μ m. A particular focus is put on the fine fraction, containing mainly clay minerals, known to determine most of the physicochemical properties of the raw soils and to have a major effect on the adsorption of xenobiotics. A triketone herbicide, sulcotrione, used as a selective herbicide in maize, was chosen. Adsorption isotherms and kinetics of the various soil fractions were determined to quantify the soil response to pesticide contamination. The effect of organic matter on sulcotrione immobilization was studied by comparison of clay fractions and organo-clay fractions. Biodegradation is another important process controlling the fate of pesticides. Using a soil-mineral medium containing the herbicide, sulcotrione-degrading microorganisms were isolated. Among four bacterial colonies, one strain showed high capacities of biotransformation. A detailed study of the biodegradative pathway was carried out to identify the metabolites formed. The metabolism in water and in the presence of bulk or soil fractions was compared in terms of kinetics and pathways.



W12.01a -5

BIOMIX CAPACITY ON RETAINING PESTICIDES FROM CONTAMINATED WATER IN OXYGEN-LIMITED CONDITIONS

Suciu Nicoleta Alina^[1], Ferrari Federico^[2], Ferrari Tommaso^[4], Merli Annalisa^[5], Capri Ettore^[6], Trevisan Marco^[7]

^[1]Università Cattolica del Sacro Cuore ~ Agricultural and Environmental Chemistry ~ Piacenza ~ Italy ^[2]AEIFORIA srl ~ - ~ Fiorenzuola ~ Italy ^[3]AEIFORIA srl ~ - ~ Piacenza ~ Italy ^[4]AEIFORIA srl ~ - ~ Fiorenzuola ~ Italy ^[5]EXPEDIA MRCC srl ~ - ~ Piacenza ~ Italy ^[6]Università Cattolica del Sacro Cuore ~ Agricultural and Environmental Chemistry ~ Piacenza ~ Italy ^[7]Università Cattolica del Sacro Cuore ~ Agricultural and Environmental Chemistry ~ Piacenza ~ Italy

With the coming into forces of the European directive 2009/128/EC the sustainable use of pesticides becomes a duty for all the European Member States. The directive establishes a framework to achieve sustainable use of pesticides by reducing them risks and impacts on both human health and environment. Many studies report the good capacity of organic substrates on retaining or/and degrading pesticides but a high influence of substrates characteristics and the adsorption/degradation conditions (aerobic/anaerobic) was observed. The present study aims at testing the capacity of a biomix on retaining pesticides from a mixture solution in oxygen - limited conditions. The oxygen-limited conditions of working of the biological plant were mainly chosen for practicability and safety system reasons. The system is composed by two cylindrical plastic containers. The first one, where the pesticides solution is collected, is open, whereas the second one, where the biomix is disposed, is closed. The pesticides solution was pumped at the biomix surface and subsequently recollected and disposed in the first container, for 15 days. Four pesticides with different physic-chemical characteristics and in two environmental temperature conditions were tested. The results obtained after the first retention test revealed a relatively good retention capacity of the biomix for the pesticides tested, but repeating the experiment, in some cases, was observed even an increase of pesticides concentration into the water ,which could be due to desorption of previously adsorbed quantities. Therefore, the developed water treatment plant doesn't show the expected efficiency and further modifications are required.



W12.01a -6

NEW VIEWS ON NON-EXTRACTABLE RESIDUE FORMATION FROM PESTICIDES IN SOIL

Nowak Karolina^{*[1]}, Nicolai Jablonowski Peter^[2], Girardi Cristobal^[1], Miltner Anja^[1], Schäffer Andreas^[4], Kästner Matthias^[1], Jablonowski Nicolai^[1]

^[1]UFZ - Helmholtz-Centre for Environmental Research ~ Environmental Biotechnology ~ Leipzig, ~ Germany ^[2]Research Centre Jülich, Institute of Chemistry and Dynamics of the Geosphere ~ ICG-4, Agrosphere ~ Jülich ~ Germany ^[3]RWTH Aachen University ~ Institute for Environmental Research (Biology V) ~ 52074 Aachen ~ Germany ^[4] RWTH Aachen University ~ Institute for Environmental Research (Biology V) ~ Aachen ~ Germany

Biodegradation of pesticides in soil is actually understood as their transformation into various metabolites, microbial biomass, mineralisation products and non-extractable residues (NER). NER are believed to mainly consist of hazardous parent compounds or primary metabolites sorbed to or sequestered by soil organic matter (SOM). Up to date, however, their chemical composition remains still unclear. This is because numerous studies on NER formation are limited to quantitative analyses in soils or to simple humic acids-contaminant systems. During biodegradation of organic contaminants, the C is used by microorganisms for their biomass synthesis. After the cell lysis, biomass components are stabilised in the SOM forming ultimately harmless biogenic residues. We compared the transformation of isotope labelled model pesticides (2,4-D, atrazine) into the NER in the biotic and abiotic soil experiments. In both setups we quantified the contribution of microbial biomass to NER formation. We prove for the first time that nearly all NER formed from readily biodegradable pesticides in soil derived from non-hazardous microbial biomass components. In contrast, in the abiotic set-up, the total NER contents were much lower than those in the biotic set-up. The absence of labelled biogenic components in the NER fraction in abiotic soils thus demonstrated that they contained exclusively potentially hazardous parent compound and / or their metabolites. Therefore, for the proper assessment of the potential risks of a target contaminant in soil to human and environment it is necessary to consider a possible biogenic origin of NER in the mass balances of contaminants in soils.



W12.01b - PESTICIDES IN SOIL, FATE AND EFFECTS ON ENVIRONMENT - In collaboration with GRIFA

Chair Persons:

Tomas Undabeytia, Sevilla - Spain

Sabino Bufo, Potenza - Italy

Monday 02 July 2012 from 15:30 to 17:00. Room Leccio

W12.01b -1

NANO-PESTICIDES: STATE OF KNOWLEDGE, FATE AND EXPOSURE ASSESSMENT

Melanie Kah, Vienna - Austria

W12.01b -2

ASSESSMENT AND MAPPING OF THE SEASONAL VARIABILITY OF PCBS CONTAMINATION IN ALPINE SOILS

Cristiano Ballabio, Milan - Italy

W12.01b -3

EFFECT OF TWO RAINFALL REGIMES ON THE DEGRADATION AND TRANSPORT OF S-METOLACHLOR IN SOIL COLUMNS COVERED WITH DECOMPOSING MULCH

Aslam Sohaib, Thiverval-Grignon - France

W12.01b -4

IMPACT OF MAIZE HERBICIDE COCKTAILS ON SOIL MICROBIAL COMMUNITIES: A MICROCOSM APPROACH

Pierre Joly, Aubière - France

W12.01b -5

SOIL PROCESSES AFFECTING THE PRESENCE OF OXYFLUORFEN IN SURFACE AND GROUNDWATERS OF SOUTH SPAIN

M. Alegria Cabrera, Sevilla - Spain

W12.01b -6

EFFICIENCY OF ADVANCED MEMBRANE WASTEWATER TREATMENT TECHNOLOGY COUPLED WITH ACTIVATED CARBON AND CLAY MICELLES COMPLEXES TOWARDS REMOVAL OF NSAID DRUGS

Rafik Karaman, Jerusalem - Palestinian Territory



W12.01b -1

NANO-PESTICIDES: STATE OF KNOWLEDGE, FATE AND EXPOSURE ASSESSMENT

Kah Melanie^{*[1]}, Beulke Sabine^[5], Tiede Karen^[5], Hofmann Thilo^[1]

^[1]University of Vienna ~ Environmental Geosciences ~ Vienna ~ Austria ^[2]Sand Hutton ~ Food and Environment Research Agency ~ York ~ United Kingdom ^[3]Food and Environment Research Agency ~ n/a ~ York ~ United Kingdom ^[4]Food and Environment Research Agency ~ Sand Hutton ~ York ~ United Kingdom ^[5]Food and Environment Research Agency ~ Sand Hutton ~ York ~ United Kingdom

Nano-formulations are already used in the pharmaceutical and food industries. In comparison, applications in the agrochemical sector are only emerging and a rapid growth is predicted in the upcoming years. Deliberate application of nanoparticles as within agricultural practices could be one of the rare intentional diffuse inputs of engineered nanoparticles into the environment. It is thus essential that risks and benefits to human and environmental health are adequately evaluated. Nano-pesticides encompass a great variety of products and cannot be considered as a single category. Many nano-formulations combine several surfactants, polymers, and metal nanoparticles in the nm size range. The aims of nano-formulations are generally common to other pesticide formulations and consist in increasing the apparent solubility of poorly soluble active ingredient (a.i.), releasing the a.i. in a slow/targeted manner and/or protecting against premature degradation. Nano-formulations are thus expected (i) to have significant impacts on the fate of a.i. and/or (ii) to introduce new ingredients whose environmental fate is still poorly understood (e.g. nano-silver). Therefore, it seems that adaptations of current exposure assessment approaches will be necessary, at least for some nano-pesticides. The aim of the present study is to (i) review the current state of knowledge on nano-pesticides, (ii) identify possible impacts on environmental fate and (iii) analyse the suitability of current pesticide exposure assessment procedures to account for novel properties. A variety of sources were extensively searched and relevant information was combined from published literature, company websites, patent databases, reports from governmental and non-governmental institutions.



W12.01b -2

**ASSESSMENT AND MAPPING OF THE SEASONAL VARIABILITY OF PCBS CONTAMINATION
IN ALPINE SOILS**

Ballabio Cristiano^[1], Comolli Roberto^[1], Tremolada Paolo^[2]

^[1]Milan Bicocca University ~ Environmental and Land Sciences ~ Milan ~ Italy ^[2]Milan University ~ Biology ~ Milan ~ Italy

PolyChlorinated Byphenyls (PCBs) are among the most widely spread and persistent organic pollutants. Given their hydrophobicity and low vapor pressure, PCBs accumulate in the soil organic fraction. In spite of this affinity, a portion of the soil PCBs is released into the atmosphere due to seasonal soil temperature variations. Soil temperature is also influenced by terrain features, which can account for differences in the soil PCBs reservoir. Thus the assessment of PCBs contamination requires a reliable spatial and temporal mapping for flux assessment. This is particularly critical, as the mobilization of PCBs increases their transfer to the food chain through capture by vegetation. In this work, we propose a general framework for the prediction and mapping of soil PCBs contamination based on soil organic carbon content and terrain features. This includes the setup of physical algorithms to derive the spatial and seasonal distribution of the contamination potential for PCBs in the soil. The developed maps were validated with an external set of CB-153 contamination data, showing good performance ($R^2 = 0.80$, $p\text{-value} = 2.2 \cdot 10^{-06}$). The model was used for the mapping of the actual soil contamination, taking into account the temporal shifts in concentrations from the equilibrium (as defined by K_{sa} values). A consequent dynamic model of seasonal variation of the soil concentrations was able to describe the observed concentrations asymmetries between the discharge and the recharge stage, explaining the observed low autumn PCB concentrations in relation to the high K_{sa} values of this period.

W12.01b -3

EFFECT OF TWO RAINFALL REGIMES ON THE DEGRADATION AND TRANSPORT OF S-METOLACHLOR IN SOIL COLUMNS COVERED WITH DECOMPOSING MULCH

Sohaib Aslam^{*[3]}, Akhtar Iqbal^[2], Marjolaine Deschamps^[3], Christophe Labat^[3], Nathalie Bernet^[3], Sylvie Recous^[2], Patricia Garnier^[3], Pierre Benoit^[3]

^[1]INRA ~ Environnement et Grandes Cultures ~ Thiverval-Grignon ~ France ^[2]INRA ~ UMR Fractionnement des AgroRessources et Environnement ~ Reims ~ France ^[3]INRA ~ UMR Environnement et Grandes Cultures ~ Thiverval-Grignon ~ France

In conservation agriculture, pesticide interception by plant residues used as mulch is major process affecting their degradation and further mobility. The efficiency in the reduction of losses may highly depend on mulch decomposition in relation to climatic conditions. We studied the transformations of S-metolachlor under two different rainfall regimes in soil columns covered with mulch of Zea mais + Doliquos lablab. Rain1 (temperate, twice a week) with week intensity (6 mm/hr) and Rain2 (tropical, twice a month) with stronger intensity (20 mm/hr) were chosen as treatments resulting in the same amount of rainwater received per month (20 mm). Columns were incubated at 20 °C for 85 days to monitor soil water, C, N and pesticide dynamics. Destructive sampling allowed to analyse herbicide residues in mulch and soil at three depths after 0, 14, 41 and 85 days. Soil solutions were sampled at the same depths through porous suction cups 8 hours after rainfall every fifteen days. Results showed that 55-60% of applied herbicide was intercepted by mulch residues whereas 35% was found in the 0-5 cm soil layer. Rainfall regime strongly influenced the dissipation of S-metolachlor in mulch and soils. S-metolachlor was transported to deeper soil horizons under the tropical regime. A greater mobility was observed for the more soluble and less sorbed metabolites OA and ESA. By contrast, s-metolachlor remained mainly in surface layer and was more rapidly degraded in the mulch under temperate rainfall regime. Water, mulch C transformations and S-metolachlor dynamics were simulated with the PASTIS model.

W12.01b -4

IMPACT OF MAIZE HERBICIDE COCKTAILS ON SOIL MICROBIAL COMMUNITIES: A MICROCOSM APPROACH

Joly Pierre^[1], Pascale Besse-Hoggan^[2], Frédérique Bonnemoy^[1], Isabelle Batisson^[1], Jacques Bohatier^[1], Clarisse Mallet^[1]

^[1]Laboratoire Microorganismes : Génome et Environnement ~ Biology ~ Aubière ~ France ^[2]Laboratoire de Synthèse et Etude de Systèmes à Intérêt Biologique ~ Chemistry ~ Aubière ~ France

In a context of production system sustainability, new generation molecules, more specific in their targets, are applied at "low doses" and as "mixtures". However, these new agricultural practices are rarely taken into account in assessing eco-toxicological profiles of pesticides. The "cocktail effect" approach is essential to link cumulative, synergistic or antagonistic effects of pesticide mixtures and to permit a better comprehension of environmental consequences of multiple applications. In this approach, we assessed the impact of maize herbicide "cocktails" on microbial communities. Callisto® (Mesotrione) and DualGold® (S-metolachlor) were applied at recommended and ten-fold field rates on soil microcosms. Our results emphasized a synergistic effect in "cocktail" treated microcosms with (1) an increase of the Mesotrione herbicide dissipation time and (2) an effect on the bacterial, fungal and phototrophic communities which were at least equally impacted by the field rate mixture application compared to the ten-fold field rate application of molecules used separately. Moreover, variations observed for the nitrogen could also be explained by impacts on the communities involved in its mineralization. In order to confirm our previous hypothesis and to pursue the investigation, the Nicosulfuron herbicide (Milagro®) was added to the mixture. We focused our work on structural and functional proxies of the total communities (bacteria and fungi) involved in the mineralization of organic matter and on phototrophics, nitrifiers and denitrifiers groups. By linking chemical and biological data, our experiments will contribute to develop tools that assess the soil health, for a reasoned choice of pesticides use.



W12.01b -5

SOIL PROCESSES AFFECTING THE PRESENCE OF OXYFLUORFEN IN SURFACE AND GROUNDWATERS OF SOUTH SPAIN

Hermosin M. Carmen^[1], Calderon M. Jesus^[1], Cabrera M. Alegria^{*[1]}, Real Miguel^[1], Koskinen William C.^[2], Cornejo Juan^[1]

^[1]IRNAS-CSIC ~ Agrochemistry & Soil Conservation ~ Sevilla ~ Spain ^[2]USDA-ARS. University of Minnesota ~ Crop & Soil Science ~ St Paul, Minnesota ~ United States

The presence of herbicides used in olive orchards at Guadalquivir river basin is a severe problem and hence, the study of the soil processes affecting those herbicides is important to design strategy to minimize that adverse effect. The objective of this work was to assess the soil processes affecting the herbicide oxyfluorfen (2-chloro-4-trifluoromethylphenyl-3-ethoxy-4-nitrophenyl ether) and the effect of olive oil mill waste (OMW) amendment in two soils (P2 and SJ) of South. The relationships of relevant oxyfluorfen soil processes and its concentrations measured in surface and ground water is attempted. Sorption-desorption studies showed higher oxyfluorfen sorption upon amendment, presumably due to the higher OM. DT50 values for SJ (29d) and P2 (19d) increased with moisture, whereas OMW amendment with increased much longer. Leaching potential of oxyfluorfen was very low, decreased with temperature and increased upon amendment. This mobility is related to soil porosity distribution and their changes with amendment enhancing the vertical movement. Dissolved organic matter (DOM) it could have also a role. The low deep mobility at 4°C, as compared to 25°C, it could be related with the maximum oxyfluorfen concentration in surface water measured at December (4-12°C), whereas those of ground water were measured at April-May (17-25°C).



W12.01b -6

EFFICIENCY OF ADVANCED MEMBRANE WASTEWATER TREATMENT TECHNOLOGY COUPLED WITH ACTIVATED CARBON AND CLAY MICELLES COMPLEXES TOWARDS REMOVAL OF NSAID DRUGS

Karaman Rafik^[1], Khamis Mustafa^[1], Bufo Sabino^[2], Abbadi Jehad^[1], Qurei Muhannad^[1], Khalaf Samer^[1], Rimawi Fuad^[1], Nir Shlomo^[3], Scrano Luara^[2], Malek Fida^[1]

^[1]Al-Quds University ~ Bioorganic Chemistry/College of Pharmacy ~ Jerusalem ~ Palestinian Territory, Occupied

^[2]University of Basilicata ~ - Department of Agriculture, Forestry and Environment, University of Basilicata, Via dell'Ateneo Lucano 10, 85100, Potenza, Italy ~ Potenza ~ Italy ^[3]The Hebrew University ~ Department of Soil and Water Sciences, The R.H. Smith Faculty of Agriculture, Food and Environment, The Hebrew university of Jerusalem, Rehovot 76100, Israel ~ Jerusalem ~ Israel

Pharmaceuticals used in large quantities throughout Palestine as prescription and non-prescription drugs have been reaching the environment via different routes. Hence, a new technology is needed for the removal of such pharmaceuticals from wastewater. In the study to be presented, the efficiency of the components of an integrated system containing hollow fiber, spiral wound (UF membranes), carbon, clay micelle complex filters and RO membranes towards the removal of several NSAID drugs were investigated. Kinetic studies on the removal of several NSAIDs drugs and their degradation products were studied in pure water and wastewater conditions. Adsorption of studied compounds onto a clay- (octadecyltrimethylammonium) micelle complex and activated charcoal adsorbents were investigated. Equilibrium relationships between adsorbents (i.e. clay micelle complex and activated charcoal) and adsorbate (i.e. NSAID drug) were described by Langmuir adsorption isotherms. A list of the Langmuir constants, k , and the values of maximum mass of pharmaceutical removed per gram of adsorbent, Q_{max} , is reported. Aspirin and Paracetamol were easily degraded in water or sludge giving rise to salicylic acid and p-aminophenol, respectively, and a stoichiometric amount of acetic acid. Naproxen resulted in desmethylnaproxen as main byproduct in sludge. Diclofenac, ibuprofen and mefenamic acid were not degraded during the observation time.



S13.01a - SOIL MEMORY: ARCHAEOLOGICAL AND NATURAL HERITAGE PRESERVED IN SOILS

Chair Person:

György Füleký, Gödöllő - Hungary

Friday 06 July 2012 from 08:30 to 10:00. Room Mirto

S13.01a -1

KEEPING OF INFORMATION ABOUT ENVIRONMENT OF ANCIENT MAN HABITAT IN PALEOSOLS OF DIFFERENT BURIAL CONDITIONS

Maria Dergacheva, Novosibirsk - Russian Federation

S13.01a -2

PALEOENVIRONMENT AND POTENTIAL USE OF NATURAL RESOURCES OF A PRECERAMIC OCCUPATION AT VERACRUZ MEXICO: AN APPROACH FROM PALEOPEDOLOGY

Paris Alejandro Ferrand Alcaraz, Mexico - Mexico

S13.01a -3

APPLYING SOIL CHRONOLOGY IN STUDIES OF ANCIENT LAND USE

Vladimir F. Stolba, Aarhus - Denmark

S13.01a -4

INFLUENCE OF HUMAN ACTIVITIES ON SOIL PROPERTIES AND LANDSCAPE EVOLUTION IN LES ALCUSSES (VALENCIA, SPAIN) SINCE NEOLITHIC TIMES

Rebeca Tallón-Armada, Santiago de Compostela - Spain

S13.01a -5

GEOCHEMICAL SOIL SIGNATURES ON A CLASSICAL-HELLENISTIC SITE IN SOUTH-WESTERN TURKEY AS A PROXY FOR ANCIENT HUMAN ACTIVITY

Katrijn Dirix, Leuven - Belgium



S13.01a -1

KEEPING OF INFORMATION ABOUT ENVIRONMENT OF ANCIENT MAN HABITAT IN PALEOSOLS OF DIFFERENT BURIAL CONDITIONS

Dergacheva Maria*^[1], Gavrilov Denis^[1]

^[1]Institute of Soil Science and Agrochemistry SB RAS ~ Laboratory of biogeocenology ~ Novosibirsk ~ Russian Federation

The problem of information keeping about past environment in paleosols is very actual in archaeological pedology. There are no enough materials experimentally proving the degree of pedogenic feature preservation in time. Preservation and changeability of pedogenic features under different conditions of paleosol and deposit burials on the Nura – Ishim interfluvium (Northern Kazakhstan) were studied. The territory is typical for dry steppe and has a number of archaeological objects with paleosols buried in different Holocene periods under barrows, banks and old buildings ruins. A chronosequence of paleosols (1200-1100 yrs, 1000-800 and 700-600 yrs) buried under same genesis deposits (settlement Bozok), underbarrow paleosols of the same age overlapped with the deposits of sharply different genesis (burial ground Kuigenzhar) and of different age and paleosols buried under stone barrows (burial ground Tegiszhol) was considered. All compared objects are located in a short distance. Study of paleosol morphological, physico-chemical characteristics, humus composition and humic acids revealed that their preservation depends on the composition of the overlapped depth. Paleosols buried with the material close to them in genesis and features have well preserved main characteristics and man habitat reconstruction coincides with that of other paleogeographical methods. When a barrow was made of the ground with genesis differing from that of burial ground site, i.e. under sharp change of paleosol functioning conditions after burring, paleosol mineral part changed greatly and morphological and physico-chemical pedogenic features vanished. And information about paleoecological conditions of ancient man habitat in the changed environment is best kept in humic acids composition.



S13.01a -2

**PALEOENVIRONMENT AND POTENTIAL USE OF NATURAL RESOURCES OF A
PRECERAMIC OCCUPATION AT VERACRUZ MEXICO: AN APPROACH FROM
PALEOPEDOLOGY**

Solleiro Ellizabeth^[1], Acosta Guillermo^[2], Ferrand Alcaraz Paris Alejandro^{*[2]}

^[1]UNAM ~ Instituto de Geologia ~ Mexico ~ Mexico ^[2]UNAM ~ Instituto de Antropologia ~ Mexico ~ Mexico

The preceramic and continental peopling issues at Veracruz has been abandoned almost completely. Only two projects on this concern have been developed, one between the last century 60's and 80's by Jeffrey Wilkerson (1973- 1987) and the other one is the present research: that begins at 2009. We have done three intensive excavation units, where we found several lithic artifacts, in order to understand how people utilized various resources across the landscape and through time. Another important question is how the environmental conditions were in this site during the occupation period. To solve the latest we have done a soil profile, identifying the buried paleosols in relation to the presence of artifacts. Samples from each paleosol horizon have been taken. Then we have analyzed texture, stable isotope composition, organic matter content, magnetic susceptibility and micromorphology, properties that integrate the soil memory. The stratigraphy between the three archaeological units is similar however in one of the sections we recognized the presence of a buried paleosol. This paleosol has a well differentiated Ah horizon (dark color, granular to subangular blocky structure), a thin E horizon (paler than Ah, more silty), a Bt (brownish, clayey, with subangular blocky structure) and C horizon (weathered gravels of alluvial origin). This well developed soil overlies the artifacts, thus it represents the conditions after the first settlement, giving, additionally a good material to establish the chronological frame.



S13.01a -3

APPLYING SOIL CHRONOLOGY IN STUDIES OF ANCIENT LAND USE

Stolba Vladimir F.^{*[1]}, Lisetskii Fedor N.^[2]

^[1]Aarhus University ~ Department of Culture and Society, Section of Classical Archaeology ~ Aarhus ~ Denmark

^[2]Belgorod State University ~ Department of Nature Management and Land Cadastre, Faculty of Geology and Geography ~ Belgorod ~ Russian Federation

Modern archaeological studies are becoming increasingly multi-disciplinary by drawing on the expertise of the natural sciences, including soil science. The contribution of soil science is pivotal in the study of ancient land use systems, where opportunities for archaeological dating are often limited. New prospects for their chronological attribution are offered by the method of soil-genetic chronology (SGC), which is based on the mathematical dependency of irreversible genetic soil properties on time. Both the morphological and functional properties of the newly formed soils prove to be chronologically indicative. The SGC method has been effectively applied in the study of the Early-Iron-Age archaeological sites and features on the Tarkhankut Peninsula, Crimea (e.g. Panskoe, Ak-Mechet and Jarylgach 2). Soils were studied in trenches, revealing the entirety of recent horizons accumulated since the end of habitation for residential areas or the last addition for earthen structures. The study of a land division system identified near Cape Tarkhankut and the regional calibration of the model allowed the end of its use to be assigned to the early 3rd century BC. This conforms to the date suggested by pottery from individual land plots and associated farmsteads identified there. To enhance its reliability, the dating by the thickness of the humus horizon of newly formed soil must be supported by the data on soil properties such as the supply of organic material and its 'maturity', the extent of leaching carbonate and/or their distribution across the soil profile, and the development of soil structure.



S13.01a -4

INFLUENCE OF HUMAN ACTIVITIES ON SOIL PROPERTIES AND LANDSCAPE EVOLUTION IN LES ALCUSSES (VALENCIA, SPAIN) SINCE NEOLITHIC TIMES

Tallón-Armada Rebeca^{*[1]}, Schellekens Judith^[1], Costa-Casais Manuela^[1], Ferro-Vázquez Cruz^[1], Ferrer García Carlos^[2], Vives-Ferrándiz Jaime^[2], Martínez Cortizas Antonio^[3]

^[1]Consejo Superior de Investigaciones Científicas ~ Instituto de Ciencias del Patrimonio (Incipit) ~ Santiago de Compostela ~ Spain ^[2]Museo de Prehistoria de Valencia ~ Museo de Prehistoria de Valencia ~ Valencia ~ Spain

^[3]Universidade de Santiago de Compostela ~ Edafoloxía e Química Agrícola ~ Santiago de Compostela ~ Spain

We investigated a pedo-sedimentary sequence (Bosquet) located in the Pla de Les Alcusses, an area that was occupied at least since Neolithic times and probably intensely cultivated during the Iberian period (5th-4th centuries BC). The sequence, developed on marls, was sampled at high-resolution. Analyses included physico-chemical properties, mineralogy, elemental composition (XRF), infrared spectroscopy (FTIR), molecular composition of the organic matter (pyrolysis GC-MS), and radiocarbon age dating. Six cycles were identified. A significant increase in carbonate leaching and enrichment in low-mobility elements (like Al, Fe and Ti) was found from cycles VI to V, pointing to humid, and possibly warm, conditions in the mid Holocene. A sharp increase in carbonate content at the base of cycle IV -which remains almost constant until the top of the sequence- reflects a change to much drier conditions after ca. 5580-5300 cal BP. The molecular composition of soil organic matter showed a simultaneous shift from microbial-derived SOM in cycles VI-V towards predominantly plant-derived SOM, suggestive of a strong difference in SOM dynamics accompanying aridification. Cycle IV contained abundant pottery fragments at its top and may represent the cultivated Iberian age soil. Cycle III showed Pb enrichment at its surface, pointing to significant mining and metallurgical activities in Roman times. Cycle II is a modern agricultural soil with evidence of management and application of pesticides. While cycle I represents the present cultivated surface. Acknowledgements. Financial support for this research was provided by the Diputación of Valencia, ERC project AGRIWESTMED and project HAR2008/08435 of Spanish MICINN.



S13.01a -5

GEOCHEMICAL SOIL SIGNATURES ON A CLASSICAL-HELLENISTIC SITE IN SOUTH-WESTERN TURKEY AS A PROXY FOR ANCIENT HUMAN ACTIVITY

Dirix Katrijn^{*[1]}, Muchez Philippe^[1], Degryse Patrick^[1], Kaptijn Eva^[2], Mušić Branko^[3], Poblome Jeroen^[2]

^[1]K.U.Leuven ~ Earth and Environmental Sciences ~ Leuven ~ Belgium ^[2]K.U.Leuven ~ Sagalassos Archaeological Research Project ~ Leuven ~ Belgium ^[3]University of Ljubljana ~ Department of Archaeology ~ Ljubljana ~ Slovenia

In this study multi-element soil analysis is applied to Çatal Oluk, a Classical-Hellenistic to Roman-Late Roman archaeological site located in the suburban zone of ancient Sagalassos (Taurus Mountains, SW-Turkey). The aim of the research is to evaluate to what extent geochemical analysis of the soils at this site can help delineate local activity areas. Çatal Oluk has not yet been excavated, but geophysical research has revealed the presence of buried kilns, which show a spatial association with large concentrations of ceramic tiles and pottery that were collected during archaeological surveying campaigns. A total of 150 topsoil samples have been gathered in a regular grid, together with 40 soil samples taken in 3 drill cores with depths between 0.7 and 2.5m. Aqua Regia extractions were conducted on the fine fraction (<63 µm) and the elements Al, As, Ba, Ca, Cu, Co, Cr, Fe, K, Mn, Mg, Na, Ni, Pb, P, Si, Sr, Ti, V and Zn were measured using inductively coupled plasma optical emission spectrometry (ICP-OES). Spatial and statistical data analysis revealed a geochemical anomaly of Co, Cr, Ni and Mg at and around the buried kilns. This could reflect the remnant signatures of ophiolitic clays that were transported to the kilns, to be used as a raw material for the production of ceramics. As Çatal Oluk is situated on a colluvial plain, the presence of colluvial material in the soil, including fragments of ophiolitic material, has to be taken into account in the interpretation of the geochemical data.



S13.01b - SOIL MEMORY: ARCHAEOLOGICAL AND NATURAL HERITAGE PRESERVED IN SOILS

Chair Person:

Karen Vancampenhout, Leuven - Belgium

Friday 06 July 2012 from 10:30 to 12:00. Room Mirto

S13.01b -1

THE ECHO-SOIL INCENTIVE: TOWARDS A EUROPEAN COOPERATION ON SOIL HERITAGE

Karen Vancampenhout, Leuven - Belgium

S13.01b -2

UNLOCKING THE HIDDEN LEGACY OF HUMAN SOIL INHUMATION: MICROMORPHOLOGY OF ST. ROMBOUTS GRAVEYARD, MECHELEN.

Carol Lang, York - United Kingdom

S13.01b -3

IN SITU PRESERVATION AND PRESENTATION OF HERITAGE SOILS IN LANDSCHAP DE LIEREMAN (BELGIUM)

Bas Van Der Veken, Kasterlee - Belgium

S13.01b -4

COLLUVIAL SOILS AS ARCHIVES OF NATURAL AND CULTURAL HERITAGE: THE CASE STUDY OF THE ARCHAEOLOGICAL SITE OF MONTENEGRO (GALICIA, SPAIN)

Manuela Costa-Casais, Spain - Spain

S13.01b -5

CHARCOAL-AFFECTED SOILS AT MOUND KILN SITES IN WALLONIA, BELGIUM: FROM HISTORICAL LAND USE TO SOIL HERITAGE

Brieuc Hardy, Louvain-la-Neuve - Belgium

S13.01b -6

INVESTIGATING THE RELATIONSHIP BETWEEN ARSENIC POLLUTION AND SOCIAL CRISES IN ETRUSCAN CIVILISATION: WAS ARSENIC POISONING A CONCOMITANT CAUSE?

Ilenia Cattani, Piacenza - Italy



S13.01b -1

THE ECHO-SOIL INCENTIVE: TOWARDS A EUROPEAN COOPERATION ON SOIL HERITAGE

Vancampenhout Karen*^[1], Costantini Edoardo^[2], Ibañez Marti Juan Jose^[3], Blum Winfried^[4], Deckers Seppe^[5]

^[1]K.U.Leuven / KHKempen University College ~ Earth and Environmental Sciences ~ Leuven ~ Belgium ^[2]CRA-ABP ~ Research Centre for Agrobiolology and Pedology ~ Florence ~ Italy ^[3]University of Burgos/Spanish Society of Soil Sciences ~ Soil Science ~ Madrid ~ Spain ^[4]University of Natural Resources and Life Sciences (BOKU) ~ Institute for Soil Science ~ Vienna ~ Austria ^[5]K.U.Leuven ~ Earth and Environmental Sciences ~ Leuven ~ Belgium

Soils have a capacity to store information, referred to as 'soil memory'. Hence, they herald our natural and cultural heritage: soils provide insights into their development under past environmental conditions and into past (agri)cultural practices. This information may be so relevant that soil can be considered to all effects and purposes - including legal – having “cultural and/or natural heritage”. During recent decades however, the area of undistrubed soils in Europe decreased at a dramatic rate. An important cause for this degeneration and loss is the lack of knowledge and methods to recognise and validate remarkable soil bodies. Therefore, a framework to recognise, evaluate and manage soils of natural and cultural heritage value is necessary for conserving and validating these soils in Europe. Despite an increasing number of soil scientists who are actively working on the topic, widespread co-ordinated work in Europe is still lacking. An international effort is vital to identify and evaluate European soil bodies of national and international importance, to harmonize definitions and criteria, to explore the scientific, educational and touristic potential and to develop the incentive necessary to propose a conservation strategy. In order to achieve such a joint European effort, the ECHo-Soil incentive is proposed: “European Cultural Heritage of Soil”. This incentive aims at providing a forum for discussion for scientists working in the field of soil heritage, hereby providing a framework for idea’s and impact evaluation, an aid in soil heritage science and education and a starting point for raising awareness.



S13.01b -2

UNLOCKING THE HIDDEN LEGACY OF HUMAN SOIL INHUMATION: MICROMORPHOLOGY OF ST. ROMBOUTS GRAVEYARD, MECHELEN.

Lang Carol^[1], Wilson Clare^[2], Brothwell Don^[1], Usai Maria-raimonda^[1]

^[1]University of York ~ Archaeology ~ York ~ United Kingdom ^[2]University of Stirling ~ School of Biological and Environmental Science ~ Stirling ~ United Kingdom

This paper focuses on a case study within a larger multi-disciplinary ERC-funded research project, InterArChive. One hypothesis of the project is that archaeological, historical and burial information can be retrieved from grave soils/sediments by integrating a micromorphological approach with chemical investigations. St Rombouts Cathedral's graveyard, on the River Dijl, Mechelen, Belgium was instrumental in preliminarily testing aspects of the InterArChive methodology. The graveyard and burials were the results of complex multi-period utilisation (13th to 19th centuries), thus an ideal site to test the hypothesis. A systematic sampling protocol was followed, and micromorphological and elemental SEM investigations and image analysis were carried out. Significant uniformity of elemental composition, soil texture and mineralogy were observed, with rubified clay and glauconite present throughout all graves and site controls. In contrast, pedality of the soil from the skull region was significantly different to that of most other samples. This suggested that investigation on soil aggregation in relation to regional body decay should be extended to a wider selection of sites/soils. Dirty coatings were also in preferential positions near the skull, and lined bone voids and surfaces. This prompted the question on whether such accumulations might have helped in the preservation of the bone. The presence of excremental pedofeatures indicated post burial bioturbation, whilst parallel referred distribution of channels and micro-structure suggested post-burial anthropogenic influence and compaction. Concentrations of Ca and Fe were higher in the foot region. This work induces wider debate surrounding the preservation, degradation, and subsequent dispersal of burial products.



S13.01b -3

IN SITU PRESERVATION AND PRESENTATION OF HERITAGE SOILS IN LANDSCHAP DE LIEREMAN (BELGIUM)

Van Der Veken Bas^[1], Bastiaens Jan^[2], Van Gils Marijn^[2], Huyghe Natalie^[2], Oomen Evelien^[2], Vancampenhout Karen^[3]

^[1]Regionaal Landschap Kleine en Grote Nete ~ - ~ Kasterlee ~ Belgium ^[2]Flanders Heritage Agency ~ - ~ Brussels ~ Belgium ^[3]Affiliation KULeuven / KHKempen ~ Earth and Environmental Sciences ~ Leuven ~ Belgium

Landschap De Liereman is a 1000 ha landscape and important nature reserve in the Campine area in northern Belgium. It has a high heritage value, including Palaeolithic and Mesolithic archaeological sites. Landschap De Liereman is characterized by a north-south topographical gradient with dry sand dunes and wet marshes and a west-east anthropogenic gradient from agricultural land to undisturbed natural soils. As such, it is a pattern-card of soils typical for the region and a living memory of landscape evolution and former land-use. Therefore preservation and presentation of 'geo-diversity', as opposed to 'bio-diversity', was included as a main goal in the management plan. Some principles regarding the conservation of soils were adopted, every action to improve bio-diversity is weighed to preservation of geo-diversity and soil research is stimulated. Moreover, presenting soil heritage to the public is quite a challenge, given the complexity of soil profiles and the instability of classical profile pits. New ideas were evaluated, and the first steps have been taken in the development of an educational soil trail together with a prototype of a new method for in situ presentation, showing both the in situ soil profile and archaeological findings along with educational information. The location chosen for the prototype is a heathland setting with a podzol (with Mesolithic artefacts) over an Usselo-soil (with late-Palaeolithic artefacts). The educational soil trail is intended to use in situ soil profiles as means to explain the local pedology, geomorphology, past and present vegetation, archaeology and human land-use to the general public.



S13.01b -4

COLLUVIAL SOILS AS ARCHIVES OF NATURAL AND CULTURAL HERITAGE: THE CASE STUDY OF THE ARCHAEOLOGICAL SITE OF MONTENEGRO (GALICIA, SPAIN)

Costa-Casais Manuela*^[1], Martín Seijo María^[2], Ferro-Vázquez M. Cruz^[1], Tallón-Armada Rebeca^[1], Criado-Boado Felipe^[1], Martínez Cortizas Antonio^[3]

^[1]Consejo Superior de Investigaciones Científicas (CSIC) ~ Instituto de Ciencias del Patrimonio (Incipit) ~ Spain ~ Spain

^[2]Universidad de Santiago de Compostela (USC) ~ GEPN-Grupo de Estudios para a Prehistoria do NW Ibérico. Departamento de Historia I. ~ Santiago de Compostela ~ Spain ^[3]Universidad de Santiago de Compostela ~ Departamento de Edafología e Química Agrícola ~ Santiago de Compostela ~ Spain

The main objective of our research was evaluate the potencial of colluvial soils from an archaeological site to reconstruct Holocene environmental changes. We aimed to understand the link between human activity and the wider environmental context. To developed the research we sampled at high resolution a thick (150 cm), black, organic matter rich, colluvial soil. Analyses included: sedimentary features, elemental composition and physico-chemical properties of the inorganic phase, an pedoanthracological study and radiocarbon age dating. We identified two stratigraphic units: the basal one was represented by a paleosol formed between 7670-7580 cal. BP and 4090-3920 cal BP. This unit is rich in gravels, sands and charcoal, and showed significant vertical variations in the elemental composition of the inorganic phase (Ti, Zr, Fe, Al). The younger unit began to accumulate after 4090-3920 cal BP and it is a sandy, highly organic, and more acidic colluvial soil. Charcoal analyses suggested a landscape dominated by forest in the lower unit and a sharp change to shrub vegetation in the upper unit, to the point that the charcoal of the bottom samples (the highest content in the sequence) of the upper unit are exclusively composed of Fabaceae. This points to a dramatic regression of the forest after ~4000 cal BP promoted by human-induced fires, leading to shrubland expansion, landscape instability, and increased soil erosion and acidification. Acknowledgements. Manuela Costa-Casais is supported by a Research Program "Isidro Parga Pondal 2007" - Xunta Galicia. This research was partially funded by the Project 09SEC015606PR (2009-2012).



S13.01b -5

CHARCOAL-AFFECTED SOILS AT MOUND KILN SITES IN WALLONIA, BELGIUM: FROM HISTORICAL LAND USE TO SOIL HERITAGE

Hardy Brieuc*^[1], Cornelis Jean-Thomas^[1], Dufey Joseph E.^[1]

^[1]Université Catholique de Louvain ~ Earth and Life Institute - Environment ~ Louvain-la-Neuve ~ Belgium

From the 16th to the early 20th century, iron metallurgy was the biggest economic activity in Wallonia, Belgium; more than 75 metallurgic operations of varying size have been listed during this time period. Ancient forge and stove locations mainly depended on the proximity of three key resources: iron ore; rivers ; and forests to supply charcoal, the unique combustible used for heating and reducing iron until the late 19th century. Charcoal was produced in the forest by the “mound kiln” method: after removing the soil organic layers, wood was accumulated in a circular mound and isolated from oxygen with a covering of soil and vegetation residues. A fire was set within a central chimney, and the thermal action exerted by warm gases passing through the mound induced wood charring by pyrolysis. Soil has been highly disturbed at mound kiln sites where charcoal residues, given their stability within the soil, are still present in large quantities. These residues affect physical, chemical and biological soil properties, as well as pedogenic processes. Mound kiln sites can be identified in ploughed fields as dark circular or elliptical areas 25 to 40 m in diameter, and on forest floors as heightened domes with diameters of 6 to 15 m. Here we focus on : (1) the spatial and temporal occurrence of charcoal production by mound kiln; (2) the technical aspects of this charring method; (3) the approach we use to inventory mound kiln sites at regional scale using aerial photographs, historical documents and ancient maps.



S13.01b -6

INVESTIGATING THE RELATIONSHIP BETWEEN ARSENIC POLLUTION AND SOCIAL CRISES IN ETRUSCAN CIVILISATION: WAS ARSENIC POISONING A CONCOMITANT CAUSE?

Cattani Ilenia^{*[1]}, Turfa Jean M.^[2], Harrison Adrian Paul^[3], Cagnin Massimo^[4], Beone Gian Maria^[1], Gonnelli Cristina^[6], Boccelli Raffaella^[1]

^[1]Università Cattolica del Sacro Cuore ~ Istituto di Chimica Agraria ~ Piacenza ~ Italy ^[2]University of Pennsylvania ~ Museum of Archaeology and Anthropology ~ Philadelphia ~ United States ^[3]University of Copenhagen ~ Department of Animal and Veterinary Basic Sciences ~ Copenhagen ~ Denmark ^[4]Università di Padova ~ DAFNAE ~ Padova ~ Italy

^[5]Università di Firenze ~ Dipartimento di Scienze dell'Antichità, Medioevo, Rinascimento e Linguistica ~ Firenze ~ Italy

^[6]Università di Firenze ~ Department of Evolutionary Biology ~ Firenze ~ Italy

Since the Etruscan Iron Age (8th–6th centuries BC), southern Tuscany (Italy) has been characterized by intensive mining and smelting activity, resulting in a significant release of arsenic to the environment. In a previous work, Harrison et al. (2010) hypothesized that industrial pollution and arsenic poisoning might actually have stimulated, among other related events, social crises in Etruscan civilisation and the peaceful abandonment of several important settlements which occurred, during and at the end of the Archaic period, in sites such as Lago dell'Accesa, Acquarossa and Poggio Civitate-Murlo. However, the X-ray fluorescence analysis of a hair sample from a Faliscan woman (c. 350 BC), did not allow a thoroughly satisfactory demonstration of this hypothesis, most probably because women buried in chamber tombs were not exposed to high levels of arsenic in life, or arsenic concentration in the tested hairs did not exceed the instrumental detection limit. Rasmussen et al. (2009) found a very high concentration of arsenic in Danish and Swedish Mesolithic and Neolithic human bones and discussed the origin of this contamination. In the present study, we analysed the arsenic concentration of bones, soil and other environmental samples from Lago dell'Accesa site, to discuss further the phenomenon of toxic exposure among ancient Etruscans and to exclude bone diagenesis as a possible source of arsenic in human remains. We used both ED(P)-XRF and ICP- (OES and MS) technique, since the former is less sensitive but allows for non-destructive testing, whereas the latter is much more sensitive but necessitates destructive testing.



S13.02 - SOIL STATUS AND SOCIETY

Chair Persons:

William Towers, Aberdeen - United Kingdom

Ingrid Hartmann, Berlino - Germany

Tuesday 03 July 2012 from 15:30 to 17:00. Room Biancospino

S13.02 -1

SOILS FOR SUSTAINABLE DEVELOPMENT

Lorenz Klaus, Potsdam - Germany

S13.02 -2

SOIL, PARTNER IN SUSTAINABLE DEVELOPMENT: IMPORTANCE OF AN ACTIVE SCIENCE POLICY INTERFACE

Sandra Boekhold, The Hague - Netherlands

S13.02 -3

LAND-USERS EDUCATION IN SOIL AND SOIL QUALITY FOR SUSTAINABLE FARMING IN A COMMUNITY-BASED PARTICIPATORY RESEARCH PROJECT IN ORDUÑA (BASQUE COUNTRY, SPAIN)

Maria José Imaz, Pamplona - Spain

S13.02 -4

RAISING AWARENESS: SOIL SCIENCE'S GREATEST CHALLENGE?

Arwyn Jones, Ispra - Italy

S13.02 -5

SOILS AND SOCIETY: FRAMEWORKS AND APPROACHES – A STOCKTAKING EXERCISE

Ingrid Hartmann, Berlin - Germany

S13.02 -6

EXPLORING THE SUCCESS FACTORS OF BROWNFIELD REGENERATION: A COMPARATIVE ANALYSES OF FOUR EUROPEAN COUNTRIES (GERMANY, CZECH REPUBLIC, POLAND AND ROMANIA)

Petr Klusáček, Brno - Czech Republic



S13.02 -1

SOILS FOR SUSTAINABLE DEVELOPMENT

Klaus Lorenz^{*[1]}, Jes Weigelt^[1], Rattan Lal^[2], Thando Tilmann^[1], Klaus Töpfer^[1]

^[1]IASS Institute for Advanced Sustainability Studies Potsdam ~ Global Contract for Sustainability ~ Potsdam ~ Germany

^[2]The Ohio State University ~ School of Environment and Natural Resources ~ Columbus, OH ~ United States

Soil is a finite global resource. Fertile soils form the basis needed to sustain the demands of an ever increasing human population for food and play also a pivotal role in global material cycles. However, soil quality is declining due to a wide range of degradation processes (i.e., erosion and the depletion of soil organic matter and plant nutrients). Existing policy instruments, charters and resolutions have not been sufficient to restore, improve, sustain and enhance global soil resources. Thus, more coordinated efforts are needed to sustainably manage soils to address the important global issues of the 21st century, like food security and climate change mitigation. The paper reviews analyses of international environmental policy initiatives to infer lessons that could inform global soil policy processes. These analyses converge in emphasizing the importance of the following elements: (i) international organizations as actors in the process, (ii) independent scientific advisory bodies and, (iii) multilaterally accepted institutional design that unites ecological and economic concerns of the parties under the umbrella of sustainable development. Based on these elements, the paper analyses current international policy efforts towards sustainable soil management. It is emphasized that current global initiatives such as the Global Soil Partnership initiated under the auspices of FAO are starting to implement the necessary elements identified above. However, concerted efforts by a range of actors are needed to cope with the challenges posed by soil degradation. In conclusion, the paper outlines possible steps towards global sustainable management of the finite resource soil.



S13.02 -2

SOIL, PARTNER IN SUSTAINABLE DEVELOPMENT: IMPORTANCE OF AN ACTIVE SCIENCE POLICY INTERFACE

Boekhold Sandra^{*[1]}, De Cleen Margot^[2], Otte Piet^[3]

^[1]Soil Protection Technical Committee ~ secretariat ~ The Hague ~ Netherlands ^[2]Ministry of Infrastructure and the Environment ~ Space and water ~ The Hague ~ Netherlands ^[3]National Institute for Public Health and the Environment ~ ecology lab ~ Bilthoven ~ Netherlands

Climate change, energy shortages, urbanization, health and food security are societal and economic challenges for the coming decades. Soil, together with seas, oceans and lakes determines interregional climate effects, water balance, food production and conditions for biodiversity and human health. Therefore, soils are part of the answer to meet these major challenges imposed to man. We believe that advocating this perspective may contribute to raising awareness on the importance of soil for society. In 2009 a contract was signed with the competent national, regional and local authorities in which they support a transition from a soil policy developed for protection goals only towards an integral policy based on sustainable use of soil (including protection). The design of a national agenda on strategic knowledge needs and the development of an innovative research program was part of this contract. Knowledge gaps were identified, analysed and discussed. The physical environment acts on scales in time and space which may differ with interventions and their effects. The response time for soil related interventions is usually slow. Understanding of the functioning of the soil, the ecosystem services and the interrelations of the different soil functions, is essential for planning and defining the right policy measures. The agenda also contains proposals for an efficient organisation and planning of soil research. We will present the process of consensus building between the authorities and other stakeholders and its result. We will elaborate on the importance of an active science policy interface.



S13.02 -3

LAND-USERS EDUCATION IN SOIL AND SOIL QUALITY FOR SUSTAINABLE FARMING IN A COMMUNITY-BASED PARTICIPATORY RESEARCH PROJECT IN ORDUÑA (BASQUE COUNTRY, SPAIN)

Imaz Maria José^{*[1]}, Virto Iñigo^[1], Enrique Alberto^[1], Bescansa Paloma^[1]

^[1]Universidad Pública de Navarra ~ Ciencias del Medio Natural ~ Pamplona ~ Spain

Although traditional knowledge on soil and soil quality has been wide among farmers and rural population, reality in many areas of Western countries is that many land users ignore or have confusing information on the soil they use for crops or cattle production. This is so because, in many cases, traditional knowledge has been replaced by commercial or market-oriented advice without enough attention paid to the site-dependent characteristics of the soil resources. In this work, we present the results of a community-based participatory research project in Orduña (Basque Country) in the framework of Agroecology, in which education on soils and soil quality, and the recuperation of knowledge on local soils and traditional land management have been the basis for a successful local development program. The program started in 2007 with the support of the local administration. It involved the local farmers association, local extensionists, and soil scientists from the Universidad Publica de Navarra. Seminars and workshops on soil and soil quality were among the various activities undergone during this program. Four years later, this program has resulted in the creation of a group of promoter farmers which designs alternatives for the improvement of their own farms at the beginning of each production season. These alternatives are followed-up and evaluated by the entire community. As a result, previous management techniques have been replaced by more sustainable land use systems, based in soil quality conservation principles, in more than 200 ha.



S13.02 -4

RAISING AWARENESS: SOIL SCIENCE'S GREATEST CHALLENGE?

Montanarella Luca^[1], Jones Arwyn^{*[1]}, Panagos Panos^[1], Gardi Ciro^[1]

^[1]European Commission ~ Joint Research Centre ~ Ispra ~ Italy

Communicating the value and importance of soil is arguably one of the greatest challenges facing the soil science community today. Active protection and sustainable use of soil can only be achieved through a societal understanding of its role and the value, from an economic, ecological and community perspective. Increasingly, soil scientists have begun to realize the importance of the need to communicate these issues to the wider world. However, these efforts are often local and temporal. This presentation discusses the possibilities to address society as a whole and bring about a sea-change in public perception of soil through actions and measures at both pan-European level and within individual Member States.



S13.02 -5

SOILS AND SOCIETY: FRAMEWORKS AND APPROACHES – A STOCKTAKING EXERCISE

Hartmann Ingrid*^[1]

^[1]Desertnet International ~ Soil Science ~ Berlin ~ Germany

Hans Jenny perceived the status of soils as a function of climate, relief, paternal material and anthropogenic influences. Conventional soil science has focused particularly on the former factors and therefore remained almost a biophysical science until now. Nobelist Paul Crutzen on the other had has named the present era the anthropocene, indicating that it is no more predominantly the biophysical factors which determine the environment for humans since about 1950, but humans themselves who influence their environment to a highest degree. Nevertheless, anthropogenic or social factors have only been marginally the topic in soil science, although related scientific communities, like the desertification community, explicitly highlighted the need for connecting human-environmental relationships to address land degradation. And while first approaches like DPSIR or the Desertification Paradigm and their linkages are already in place, still it is obvious that there is a striking gap in research in respect to the social relations of humans with soils. The proposed presentation tries to give a systematic overview about the research efforts which have been undertaken up to now and the respective approaches, both from the soil science community itself and the desertification community, as well as in other emerging initiatives like the Global Soil Partnership or the Soil-Sustainable Development Nexus.



S13.02 -6

EXPLORING THE SUCCESS FACTORS OF BROWNFIELD REGENERATION: A COMPARATIVE ANALYSES OF FOUR EUROPEAN COUNTRIES (GERMANY, CZECH REPUBLIC, POLAND AND ROMANIA)

Klusáček Petr^[1], Frantál Bohumil^[1], Martinát Stanislav^[1], Kunc Josef^[1]

^[1]Institute of Geonics Czech Academy of Sciences ~ Department of Environmental Geography ~ Brno ~ Czech Republic

The paper the main purposes are to answer following questions: What are the drivers of specific projects of brownfield regeneration? What are the factors of successful and sustainable brownfield regeneration? Are there any regional differences in the scope of four studied countries (Germany, Czech Republic, Poland and Romania)? The first part of research is based on a statistical analysis with collected databases of brownfields in order to identify significant correlations between independent (input) variables (e.g. geographical location, site characteristics, former use, ownership type, stakeholder composition, etc.) and a dependent variable (current status of the site). The result of regression analyses is a basic probability model identifying what characteristics make brownfield sites more likely to be object of investors' interest and more likely to be regenerated. Then a detailed survey of „best-practice“ regeneration projects was made identifying the key factors of „success“ in different geographical conditions and political-institutional contexts. Survey design did not define „success“ a-priori but different respondents (end-users, decision makers, investors, NGOs, urban planners, environmental experts, researchers, etc.) were asked to assess (Delphi method) a relative significance of specific factors in different geographical, economical, social and political-institutional conditions. The most important result of research is a framework of “success” indicators.



S13.03 - SOIL POLICY AND SOIL INFORMATION IN A CHANGING WORLD

Chair Persons:

Pavel Krasilnikov, Moscow - Russian Federation

Allan Lilly, Aberdeen - United Kingdom

Friday 06 July 2012 from 13:30 to 15:15. Room Mirto

S13.03 -1

THE GLOBAL SOIL PARTNERSHIP

Ronald Vargas-Rojas, Rome - Italy

S13.03 -2

SOIL ATLAS OF LATIN AMERICA: AN INNOVATIVE TOOL FOR POLICY DEVELOPMENT AND AWARENESS RAISING

Ciro Gardi, Ispra - Italy

S13.03 -3

SOIL CONSERVATION IN EU AGRICULTURE: INTERACTION BETWEEN POLICY MEASURES AND FARMING PRACTICES TO REACH SOIL QUALITY

Geertrui Louwagie, Seville - Spain

S13.03 -4

THE IMPLEMENTATION OF SOIL CONSERVATION POLICIES IN BRANDENBURG (GERMANY) – DEFICITS AND POLICY RECOMMENDATIONS

Nina Hagemann, Leipzig - Germany

S13.03 -5

PROVISIONAL EUROPEAN SOIL DATA INFRASTRUCTURE - THE GS SOIL APPROACH

Katharina Feiden, Hannover - Germany

S13.03 -6

DATA REQUIREMENTS FOR EUROPEAN ENVIRONMENTAL REPORTING AND POLICY IMPLEMENTATION

Geertrui Louwagie, Seville - Spain



S13.03 -7

*THE ROLE OF EUROPEAN SOIL DATA CENTRE (ESDAC) TO EUROPEAN POLICY SUPPORT
AND PUBLIC DATA REQUIREMENTS*

Panos Panagos, Ispra - Italy



S13.03 -1

THE GLOBAL SOIL PARTNERSHIP

Vargas-Rojas Ronald*^[1], Bunning Sally^[1], Montanarella Luca^[2]

^[1]FAO ~ NR ~ Rome ~ Italy ^[2]European Commission ~ JRC ~ Ispra ~ Italy

Soils are a finite natural resource that can be considered as non-renewable in the time frame of human activities. There is increasing degradation of soil resources due to population pressures, inappropriate practices and inadequate governance over this valuable resource. FAO, with the support of the European Commission has launched the GSP in September 2011 to raise awareness of decision makers on the vital role of soil resources for achieving food security, adapt to and mitigate climate change and guarantee provision of environmental services. The vision of the GSP is for healthy and productive soils for a food secure world. The GSP as an intergovernmental mechanism will facilitate the dialogue and interaction among the various partners working on soils. The improvement of soil information and its use in developing sound soil policies and improved decision making for soil protection and management are main aims of the GSP addressing five main pillars of action: a) Harmonization and establishment of guidelines and standards; b) Strengthening of soil data and information; c) Promoting targeted soil research and development; d) Promoting sustainable management of soil resources, and e) Encouraging investment, policy and technical cooperation in soils. The GSP will be implemented by regional partnerships (national institutions and networks). This will help to identify and develop mechanisms to address the priority issues related to soils in each region, ensuring that actions will be targeted to national and regional interests. The GSP motto is Securing soil resources today, guarantying human lives tomorrow.



S13.03 -2

SOIL ATLAS OF LATIN AMERICA: AN INNOVATIVE TOOL FOR POLICY DEVELOPMENT AND AWARENESS RAISING

Gardi Ciro^[1], Comerma Juan^[2], Cruz-Gaistardo Carlos^[3], Encina Rojas Arnulfo^[4], Jones Arwyn^[1], Mendonça-Santos Maria Lourdes^[5], Montanarella Luca^[1], Ortega-Blu Rodrigo^[7], Muniz Olegario^[6], Schad Peter^[8], Vargas Ronald^[9], Castilla Carlos^[10]

^[1]Join Research Center ~ Institute for the Environment and Sustainability ~ Ispra ~ Italy ^[2]Sociedad Venezolana de la Ciencia del Suelo ~ ~ ~ Venezuela, Bolivarian Republic of ^[3]Collegio de postgraduados ~ ~ ~ Mexico ^[4]Universidad Nacional de Assuncion ~ ~ Assuncion ~ Paraguay ^[5]EMBRAPA - Brazilian Agricultural Research Corporation ~ The National Centre of Soil Research ~ Rio de Janeiro ~ Brazil ^[6]Sociedad Cubana de la Ciencia del Suelo ~ Instituto de Suelos ~ La Habana ~ Cuba ^[7]Universidad Federico Santa Maria ~ ~ Valparaiso ~ Chile ^[8]Lehrstuhl für Bodenkunde ~ ~ München ~ Germany ^[9]FAO ~ NRL ~ Rome ~ Italy ^[10]Corpoica ~ ~ La Libertad ~ Colombia

Soil resources in Latin America are crucial for meeting the food, fiber and fuel demands of a rapidly growing population. An outlook published in 2009 by the FAO and OECD states that the current area of cropland could be more than doubled by adding 1.6 billion hectares, mostly in Latin America and Africa. Knowledge about the soils and its functions in the region is fundamental. Improving communication to civil society and raising awareness of the importance of soil are important tasks for science. Today, soils have been acknowledged again to be the key resource, dealing with global issues such as food insecurity and climate change. Yet, communication of soil information to key stakeholders has not been achieved. With the objective of filling the communication gap between science and society, the European Commission's Joint Research Center (JRC) launched a series of thematic atlases on soil. The latest in this series is the Soil Atlas of Latin America and the Caribbean. This publication is a cooperative effort among the JRC, a wide representation of soil science community of Latin America and Caribbean countries, Europe and International Organizations such as the FAO and is supported through EUROCLIMA Project. The Atlas will include the geographic distribution of the major soil types in LAC using the World Reference Base system, highlighting the key soil forming processes and drawing attention to their potential threats, and sustainable management; a specific focus will be on the links between climate change and soils in the region.



S13.03 -3

SOIL CONSERVATION IN EU AGRICULTURE: INTERACTION BETWEEN POLICY MEASURES AND FARMING PRACTICES TO REACH SOIL QUALITY

Louwagie Geertrui*^[1], Gay Stephan Hubertus^[1], Sammeth Frank^[1], Ratinger Tomáš^[1], Kutter Thomas^[4], Schuler Johannes^[2], Zander Peter^[2], Helming Katharina^[2], Prager Katrin^[5], Hagedorn Konrad^[3]

^[1]European Commission / Joint Research Centre ~ Institute for Prospective Technological Studies ~ Seville ~ Spain (changed affiliation since the 'Sustainable agriculture and soil conservation (SoCo)' project ended) ^[2]Leibniz-Centre for Agricultural Landscape Research (ZALF) ~ Müncheberg ~ Germany ^[3]Humboldt University Berlin ~ Department of Agricultural Economics - Division of Resource Economics ~ Berlin ~ Germany ^[4]Leibniz-Centre for Agricultural Landscape Research (ZALF) ~ Müncheberg ~ Germany (changed affiliation since the 'Sustainable agriculture and soil conservation (SoCo)' project ended) ^[5]Humboldt University Berlin ~ Department of Agricultural Economics - Division of Resource Economics ~ Berlin ~ Germany (changed affiliation since the 'Sustainable agriculture and soil conservation (SoCo)' project ended)

An EU policy review showed that existing EU policies have the potential to address soil degradation in EU agriculture. Currently, the most important EU environmental directives with respect to soil quality are the Nitrates Directive and the Water Framework Directive. The Common Agricultural Policy (CAP) also plays an important role in soil conservation. Cross compliance, a horizontal tool and compulsory since 2005, contains relevant mandatory and optional measures, while within rural development, Member States can specify actions to reduce soil degradation on agricultural land under a range of measures. However, in contrast to other environmental domains (such as water and air), no coordinated piece of EU legislation exists on soils. In addition, given differences in the implementation of policy measures, the cause-and-effect models used in policy development may not always reflect what happens in the agri-environmental reality. Therefore, ten case studies identified some of the complex causal chains between factors that shape the adoption of different farming practices, and their impact on agricultural soils. Some drivers proved to be economic, while others were institutional, socio-cultural or technological.



S13.03 -4

**THE IMPLEMENTATION OF SOIL CONSERVATION POLICIES IN BRANDENBURG
(GERMANY) – DEFICITS AND POLICY RECOMMENDATIONS**

Hagemann Nina^{*[1]}, Prager Katrin^[2]

^[1]Helmholtz Centre for Environmental Research - UFZ ~ Economics ~ Leipzig ~ Germany ^[2]The James Hutton Institute
~ Social, Economic, and Geographical Sciences Group ~ Aberdeen ~ United Kingdom

Agricultural soil degradation is a serious issue for society as it results in long-term and sometimes even permanent damage of soils which leads to economic, social and environmental costs. The paper is based on a case study carried out in the Uckermark region (Brandenburg) as part of the SoCo project. It analyses the shortcomings of current mandatory and incentive based soil conservation policies with respect to policy design and implementation. Data was gathered through qualitative interviews with relevant stakeholders in the region and document analysis. The results show that two aspects are crucial in this respect: 1) The design of the policies that address soil conservation, and 2) the implementation strategies that are applied by local authorities. We discuss the shortcomings of the implementation strategies of soil conservation policies by outlining the deficits such as the lack of personnel, financial capacity and extension but also the lack of integration of relevant local actors and a decline in scientific support. Furthermore, we make recommendations to enhance the implementation of soil conservation policies by taking into account the issues raised by interviewees.



S13.03 -5

PROVISIONAL EUROPEAN SOIL DATA INFRASTRUCTURE - THE GS SOIL APPROACH

Feiden Katharina^{*[1]}, Fulajtár Emil^[2], Dobos Endre^[3], Eberhardt Einar^[4], Baritz Rainer^[4], Huber Sigbert^[5], Figueiredo Carlos^[6], Klug Hermann^[7]

^[1]Lower Saxony Ministry of Environment and Climate Protection ~ Coordination Center PortalU ~ Hannover ~ Germany

^[2]Soil Science and Conservation Research Institute ~ Soil Science and Conservation Research Institute ~ Bratislava ~ Slovakia ^[3]University of Miskolc ~ Physical Geography and Environmental Sciences ~ Miskolc ~ Hungary ^[4]Federal

Institute for Geosciences and Natural Resources ~ Federal Institute for Geosciences and Natural Resources ~ Hannover ~ Germany ^[5]Umweltbundesamt GmbH ~ Umweltbundesamt GmbH ~ Vienna ~ Austria ^[6]EDISOFT S.A. ~ EDISOFT

S.A. ~ CAPARICA ~ Portugal ^[7]Paris Lodron University of Salzburg ~ Zentrum für Geoinformatik (Z_GIS) ~ Salzburg ~ Austria

Soil data in Europe exists in several formats, scales and semantic representations of soil properties. Harmonization and data interoperability is one of the biggest challenges for the soil science community – enforced lately by the INSPIRE directive. The requirements to develop interoperable datasets are difficult to comprehend; the expected and possible degree of harmonization is unclear; the opportunities and requirements to provide soil information through web-based services is still fairly unknown. To regard this, the European consortium GS SOIL “Assessment and strategic development of INSPIRE compliant Geodata-Services for European soil data” worked on the establishment of a European Soil Data Infrastructure. It provides reference applications for metadata, cross-border view, discovery and transformation services. The project contributes to the harmonization and provision of interoperable soil geodata in Europe. Further examples are the soil specific thesaurus, metadata editor, catalogue service, provision of WMS and prototype WFS to serve the needs of public data requirements. It is offered via the GS SOIL portal (based on PortalU and open sources technologies (as e.g. GeoNetwork)). The following issues out of GS SOIL should be discussed: 1. Best practice recommendations a. framework for developing harmonized soil data sets (focus on mid to small-scale soil maps) b. soil specific metadata profiles 2. Lessons learned a. INSPIRE- and ISO- conform soil data exchange b. definition of a common data access framework c. technical provisions (portal functionalities, WMS, WFS), maintenance effort 3. Joint vision that leads to an operational European Soil Data Infrastructure on the basis of the presented approaches



S13.03 -6

DATA REQUIREMENTS FOR EUROPEAN ENVIRONMENTAL REPORTING AND POLICY IMPLEMENTATION

Erhard Markus^[1], Louwagie Geertrui^{*[1]}

^[1]European Environment Agency (EEA) ~ Copenhagen ~ Denmark

Soils are providing a number of essential ecosystem services for human well-being. The drafted European Soil Framework Directive identifies erosion, organic matter decline, contamination, salinization, compaction, soil biodiversity loss, sealing, landslides and flooding as the eight main soil degradation processes to which soils in the EU are confronted. The Soil Framework Directive didn't come into force so far. Soil protection is addressed in other policy frameworks such as Waste and Water Framework Directives, CAP including good farming practice, or Flood Directive. Soil related information is required for EEA's European wide regular monitoring and reporting (e.g. Climate Change, SOER2015), the EU 2020 resource efficiency target 'land-soil', the UNSD-SEEA framework for water, carbon, ecosystem accounting, and the valuation of ecosystem services in the context of Green GDP. Soil data is also needed as input and reference data for environmental assessments e.g. GMES services for land, atmosphere and climate change monitoring. There is progress but still significant gaps in soil data availability in terms of completeness (thematic and geographic coverage), spatial resolution, QA/QC (harmonization, accuracy, timeliness), and soil functional services such as water capacity or suitability in adequate spatial representation. Even more important is the urgent need for soil related monitoring which is crucial to describe changes in soil conditions and to underpin decision making with appropriate information.



S13.03 -7

THE ROLE OF EUROPEAN SOIL DATA CENTRE (ESDAC) TO EUROPEAN POLICY SUPPORT AND PUBLIC DATA REQUIREMENTS

Panagos Panos*^[1], Van Liedekerke Marc^[1], Jones Arwyn^[1], Montanarella Luca^[1]

^[1]Joint Research Centre of the European Commission ~ Institute for Environment and Sustainability ~ ISPRA ~ Italy

In the context of the European Union's Soil Thematic Strategy, policy makers require easy access to soil data and information of various types and scales to assess the state of soils at European level. To satisfy this need, the European Commission and the European Environment Agency decided to establish the European Soil Data Centre (ESDAC), located at the European Commission's Joint Research Centre. The ESDAC is one of ten environmental data centres that have been established in support of policy development, implementation and monitoring by the European Commission's Directorate General for Environment. The ESDAC, located at <http://esdac.jrc.ec.europa.eu>, has become the focal point for soil data and information at European Union level by hosting a series of soil products and web-based tools that allow access to the data. The establishment and the evaluation of harmonised databases should facilitate improved soil protection measures. The ESDAC supports an increasing number of customers from the European Commission and Member States. They range from policy makers, public organizations and local authorities, and public administrations to research institutes, technical institutions, universities and schools, modeling groups, research projects and citizens. Most of the datasets are used for research purposes (Modeling, FP7 projects, PhDs, etc). ESDAC data and information are highly relevant for the development, implementation and assessment of a number of EU policy areas: agriculture, soil protection, bio-energy, climate change, water protection, food security, nature protection, spatial planning, development policy, health, research and sustainable development.



S13.04 - INTERNATIONAL CRITICAL ZONE OBSERVATORY RESEARCH FOCUSING ON SOIL

Chair Persons:

Winfried E.H. Blum, Vienna - Austria

Pauline F.M. Van Gaans, Utrecht - The Netherlands

Friday 06 July 2012 from 08:30 to 10:00. Room Biancospino

S13.04 -1

CHARACTERIZATION OF EUROPEAN CRITICAL ZONE OBSERVATORIES AT SOIL PROFILE SCALE – AN OVERVIEW

Svetla Rousseva, Sofia - Bulgaria

S13.04 -2

IMPACT OF TIME AND LAND USE ON CARBON ACCUMULATION AND STRUCTURE FORMATION IN SOILS

Georg J. Lair, Vienna - Austria

S13.04 -3

A COUPLED CARBON, AGGREGATION, AND STRUCTURE TURNOVER MODEL FOR TOPSOILS

Fotini Stamati, Chania - Greece

S13.04 -4

CHARACTERISATION OF THE MICROBIAL COMMUNITIES WITHIN SOIL AGGREGATES DEVELOPED UNDER DIFFERENT LAND MANAGEMENT

Manoj Menon, Sheffield - United Kingdom

S13.04 -5

OXIDE NANOPARTICLES IN A PODZOL SOIL: EXTRACTION AND SIZE DISTRIBUTION

Inge C. Regelink, Wageningen - Netherlands

S13.04 -6

AN INTERNATIONAL INITIATIVE FOR CRITICAL ZONE OBSERVATORIES (CZO) AND RESEARCH ALONG GLOBAL ENVIRONMENTAL GRADIENTS

Steven Banwart, Sheffield - United Kingdom



S13.04 -1

CHARACTERIZATION OF EUROPEAN CRITICAL ZONE OBSERVATORIES AT SOIL PROFILE SCALE – AN OVERVIEW

Rousseva Svetla^[1], Blum Winfried^[4], Kercheva Milena^[5], Lair Georg J.^[4], Regelink Inge^[6], Van Gaans Pauline^[7], Shishkov Toma^[8], Ilieva Rossitsa^[8], Bloem Jaap^[6], Van Leeuwen Jeroen^[6]

^[1]Institute of Soil Science N. Poushkarov ~ Soil Erosion ~ Sofia ~ Bulgaria ^[2]BOKU ~ Soil Science ~ Vienna ~ Austria

^[3]Institute of Soil Science ~ Soil Physics ~ Sofia ~ Bulgaria ^[4]University of Natural Resources and Applied Life Sciences ~ Institute of Soil Research ~ Vienna ~ Austria ^[5]Institute of Soil Science N. Poushkarov ~ Soil Physics ~ Sofia ~ Bulgaria

^[6]Wageningen University ~ Soil Science Center ~ Wageningen ~ Netherlands ^[7]Deltares ~ Soil and Groundwater System Department ~ Utrecht ~ Netherlands ^[8]Institute of Soil Science N. Poushkarov ~ Soil Genesis and Classification ~ Sofia ~ Bulgaria

Soil Critical Zone is the intersection area of pedosphere, biosphere, hydrosphere, lithosphere and atmosphere. Critical Zone Observatories (CZOs) network enables studies of important physical, chemical, and biological interfacial processes and reactions occurring over a range of spatial and temporal scales. These processes impact mass and energy exchange necessary for biomass productivity, chemical recycling, and water storage. Detailed soil morphological, physical, chemical and microbiological characterization of different soil genetic horizons at soil profile scale was commenced in 2010 at four field sites with successful track records of research and data collection, which form the SoilTrEC Project network of European Critical Zone Observatories (CZOs). The 4 European CZOs represent key stages of soil development and degradation. Three replicates at each sampling site selected within these CZOs were sampled to represent the spatial variability of soil parameters and to identify soil processes with statistics. Taking sets of replicate soil pits and carrying out a common set of measurements for each site provided quantitative data needed for mathematical modelling of food-webs, carbon dynamics, geochemical processes and reactive transport. The primary output from this modelling exercise will be an analysis of the dominant soil processes and their rates at different stages of the soil life cycle. The presentation will report the sampling methodology and determined soil characteristics with example for one soil profile in triplicate focusing on (i) the composition and the stability of soil aggregates and their size distribution within soil profiles and (ii) the soil (geo)chemistry and (micro)biology including the microbial community structure.



S13.04 -2

IMPACT OF TIME AND LAND USE ON CARBON ACCUMULATION AND STRUCTURE FORMATION IN SOILS

Lair Georg J.*^[1], Lehtinen Taru^[1], Djukic Ika^[1], Schiefer Jasmin^[1], Bloem Jaap^[2], Blum Winfried E.h.^[1]

^[1]University of Natural Resources and Life Sciences (BOKU) ~ Institute of Soil Research ~ Vienna ~ Austria

^[2]Wageningen University and Research Centre ~ Alterra ~ Wageningen ~ Netherlands

Soil studies across substrate age gradients (chronosequences) have enhanced our understanding of the directions and the rates of biogeochemical processes under different ecological conditions. Biogeochemical processes, such as soil organic matter (SOM) and nutrient dynamics, can act in different timescales depending on climatic conditions, plant cover and biomass inputs as well as living organisms. SOM is a main driver for soil development and the build-up of soil structure and is therefore governing the main physical and chemical properties of soil. However, SOM dynamics in the initial stages of soil development as well as the stability of SOM within aggregates and by sorption on soil mineral surfaces are still poorly understood. Even less is known about the impact of different land uses on these short to medium-term processes. In the present study we assess SOM quantity and its chemical composition within different micro- and macro-aggregates of genetic soil horizons, developed under forest, grassland and cropland. The studied soils of a chronosequence comprise an age gradient of approximately 5000 years in the Marchfeld region (Austria). This allows for investigating the influence of SOM, physico-chemical soil properties as well as soil microbial processes on soil structure build-up with time. Results of our study show that ecosystems progressively evolve through biogeochemical processes at different time scales and can be strongly altered by anthropogenic land management.



S13.04 -3

A COUPLED CARBON, AGGREGATION, AND STRUCTURE TURNOVER MODEL FOR TOPSOILS

Stamati Fotini^{*[1]}, Nikolaidis Nikolaos^[1], Banwart Steve^[2], Blum Winfried^[3]

^[1]Technical University of Crete ~ Department of Environmental Engineering ~ Chania ~ Greece ^[2]University of Sheffield ~ Kroto Research Institute ~ Sheffield ~ United Kingdom ^[3]University of Natural Resources and Applied Life Sciences ~ Institute for Soil Science ~ Vienna ~ Austria

Current multi-pool soil organic carbon (SOC) models have been a major improvement over the single carbon ones. However, they are not always able to capture soil saturation capacity and give reliable predictions for climate change effects, since they do not account for environmental constraints, like physical protection. In this work we developed a soil carbon, aggregation, and structure (CAST) turnover model based on the proposed mechanism of aggregate formation that suggests that macro-aggregates are formed around particulate organic matter, followed by the release of micro-aggregates. A simple mechanistic Nitrogen model was also developed. The CAST model was evaluated by field data of cropland to set aside conversions in Greece (fine textured-Mediterranean) and Iowa (coarse textured-humid continental). The model was able to capture the carbon content and the C-to-N ratio of the pools comprising the three aggregate types (macro-aggregates: >250 μm , micro-aggregates: 53-250 μm , silt-clay sized aggregates: <53 μm) in both sites. The soil systems reached maximum macro-aggregation/porosity and minimum bulk density after 7 and 14 years in Greece and Iowa, respectively. Afterwards, macro-aggregate disruption presented a constant seasonal pattern and any further SOC increase was due to micro-aggregation resulting in the increase of bulk density and decrease of porosity towards to a steady value. The CAST model can assist in revealing the primary factors that determine SOC, aggregation, and structure turnover in different ecosystems and for predicting the response of the soil system to management practices, land use changes, and climate change in order to design/optimize the appropriate measures/practices.



S13.04 -4

**CHARACTERISATION OF THE MICROBIAL COMMUNITIES WITHIN SOIL AGGREGATES
DEVELOPED UNDER DIFFERENT LAND MANAGEMENT**

Menon Manoj^[1], Zhang Dayi^[1], Van Der Zaan Bas^[2], Lair Georg^[3], Lehtinen Taru^[3], Huang Wei^[1], Banwart Steve^[1]

^[1]Kroto Research Institute, University of Sheffield ~ Civil and Structural Engineering ~ Sheffield ~ United Kingdom

^[2]Deltares ~ Deltares ~ Utrecht ~ Netherlands ^[3]Institute of Soil Research Department of Forest and Soil Sciences ~ University of Natural Resources and Life Sciences (BOKU) ~ Vienna ~ Austria

It is well established that microbes as well as their metabolic products play a vital role in the formation of soil aggregates. The relationship between microbial diversity (and their functions) and soil aggregate properties like size, composition, physical structure, mechanical stability and nutrient status is poorly understood. Furthermore, we propose that aggregates provide essential ecological niches for soil function: to transform nutrients, store carbon, store and transmit water, and attenuate contamination from infiltration. In this proof-of-concept study, we hypothesize that the aggregate characteristics -beside particle size distribution and mineralogy- are controlled by the total amount and diversity of microbes (including specific functional groups) as well as their products (e.g. EPS). The aim of this study is to understand the microbial communities and their function in different aggregate size fractions developed in soil of similar age but under three land management (forest, grassland and agriculture) practices prevailing in Marchfeld Critical Zone Observatory (CZO). The stability of the aggregates from the topsoil has been assessed previously by our collaborators (Kercheva et al 2011). In the proposed work, the DNA from various aggregate fractions (<0.25, 0.25-0.5, 0.5-1.0, 1-2, 2-5, 5-10mm) from different land management will be extracted and microbial community and functional groups will be studied using DGGE and qPCR. The results will be linked to various physical and geochemical soil properties in order to get insights on aggregate formation.



S13.04 -5

OXIDE NANOPARTICLES IN A PODZOL SOIL: EXTRACTION AND SIZE DISTRIBUTION

Regelink Inge C.*^[1], Weng Liping^[1], Van Riemsdijk Willem^[1]

^[1]Wageningen University ~ Soil Quality ~ Wageningen ~ Netherlands

The topic of nanoparticles in environmental systems is receiving increasing interest. Engineered and natural nanoparticles can be expected to show similar behavior in environmental systems. In this paper we aim to understand the factors controlling the dispersion/aggregation of oxide nanoparticles in soils. Soil samples from a podzol soil with a high Fe- and Al (hydr)oxide content were used. We analyzed the amount, composition and size-distribution of dispersible oxide nanoparticles in various extracts using AF4 (Asymmetric-Flow-Field-Flow-Fractionation) coupled to HR-ICP-MS. Three different extracts were used to disperse the particles: a dilute NaCl solution, a NaOH solution (pH 9.3) and a pyrophosphate solution (pH 8.5). The amount of dispersed Fe- and Al-(hydr)oxide nanoparticles increased in the order of NaCl < NaOH < pyrophosphate. In pyrophosphate, 27% to 69% of the amorphous Fe-(hydr)oxides (Fe extracted with ammonium oxalate) were extracted as nano-sized particles (<130 nm). Smallest (hydr)oxide particles are a few nanometers only and weight-average hydrodynamic diameters are between 25 and 28 nm. Based on the minor change in phosphorus to oxide ratio with increasing size, we suggest that the specific reactive surface area of the particles is almost constant, which indicates that the larger nanoparticles are aggregates composed of smaller nanoparticles. The release of mineral nanoparticles coincides with the release of soil organic matter, which shows the importance of organic matter for the aggregation behaviour of (hydr)oxide particles.



S13.04 -6

AN INTERNATIONAL INITIATIVE FOR CRITICAL ZONE OBSERVATORIES (CZO) AND RESEARCH ALONG GLOBAL ENVIRONMENTAL GRADIENTS

Banwart Steven*^[1]

^[1]University of Sheffield, Kroto Research Institute ~ Civil and Structural Engineering ~ Sheffield ~ United Kingdom

Critical Zone scientists convened an international workshop during November 8-9, 2011, at the University of Delaware, USA. The meeting included 87 scientists from 15 countries presenting current research and new opportunities at 25 CZOs worldwide. The aim was to prioritise science questions to drive Critical Zone Observatory (CZO) research during the coming decade. The broad research challenges are to understand the geological and evolutionary processes that shape the Critical Zone, and the physical, biological and chemical processes that result and deliver Critical Zone ecoservices to humanity. These include production of soil, storage of carbon, nutrient transformations, providing biological habitat, maintaining the terrestrial gene pool, base flow to surface waters, groundwater recharge, attenuating soil and water pollution, and many others. Six science questions were divided into 2 themes: 1) understanding long-term evolution of the near-surface Earth environment as antecedent conditions to modern environmental change, and short-term changes that require prediction and management responses for humans to mitigate and adapt to the environmental impacts. The primary result is the outline design of international networks of CZOs that are geographically located along environmental gradients at planetary scale. This will allow the study of Critical Zone responses to key environmental variables representing, e.g. land use change and global warming. This effort aims to be a leading integrating activity for environmental geosciences research worldwide. The meeting received financial support from the USA National Science Foundation and was part of commissioned activity of the European SoilTrEC project, funded by the European Commission.



S13.05 - TAILORED IMPROVEMENT OF BROWNFIELD REGENERATION IN EUROPE: A DISCUSSION OF STATE-OF-THE-ART APPROACHES, TECHNOLOGIES AND TOOLS, AND COMPARISON WITH INTERNATIONAL CONTEXT

Chair Persons:

Stephan Bartke, Leipzig - Germany

Antonio Marcomini, Venezia - Italy

Friday 06 July 2012 from 15:30 to 17:00. Room Mirto

S13.05 -1

HOLISTIC INTEGRATED DECISION SUPPORT SYSTEMS FOR BROWNFIELD REVITALIZATION – KNOWLEDGE TRANSFER CHALLENGES IN TOOL DEVELOPMENT

Maximilian Morio, Tübingen - Germany

S13.05 -2

SOME CRITICAL ISSUES ON RISK ASSESSMENT AND REMEDIATION OF INDUSTRIAL CONTAMINATED SITES

Fasheng Li, Beijing - China

S13.05 -3

TREE CORING AS A PHYTOSCREENING METHOD

Mette Algreen, Kgs. Lyngby - Denmark

S13.05 -4

SOIL-WASHING WITH REUSED FLUIDS FOR IN-SITU AND ON-SITE REMEDIATION

Nicolas Fatin-Rouge, Besançon - France

S13.05 -5

TIMBRE EXPERT SYSTEM AS INFORMATION PLATFORM FOR INNOVATIVE AND WIDELY APPLICABLE STRATEGIES, TECHNOLOGIES AND SOLUTIONS FOR BROWNFIELD REGENERATION

Lisa Pizzol, Venice - Italy

S13.05 -6

KNOWLEDGE AND DECISION MAKING IN BROWNFIELD REVITALIZATION: CROSS-CULTURAL VARIATIONS WITHIN EASTERN EUROPE

Filip Alexandrescu, Leipzig - Germany



S13.05 -1

**HOLISTIC INTEGRATED DECISION SUPPORT SYSTEMS FOR BROWNFIELD
REVITALIZATION – KNOWLEDGE TRANSFER CHALLENGES IN TOOL DEVELOPMENT**

Morio Maximilian*^[1], Sebastian Schädler^[1], Michael Finkel^[1]

^[1]University of Tübingen ~ Centre for Applied Geoscience ~ Tübingen ~ Germany

With land becoming a scarce resource in many regions, revitalizing these so-called brownfields becomes more and more attractive, representing an opportunity for sustainable urban development. The process of managing and revitalizing brownfields requires a holistic view that considers ecological, economical as well as sustainability aspects. Integrating evaluation methods and communicating results of the latter to the stakeholders from these different disciplines requires a common language which may include clarification and simplification of various assessment aspects. Decision support systems (DSS) that aid the assessment and revitalization process of brownfields and adequately provide such integration, still need to be developed. Given that each brownfield has different characteristics and problems, a single DSS may not be capable of considering all relevant aspects. Moreover, the required involvement and participation of expert and non-expert stakeholders, whose knowledge and expectations have to be transferred into the software tools, determines the abstraction and generalization of the chosen methods. Finally, the evaluation methods have to be implemented into user friendly software that is suitable for the largest possible fraction of stakeholders and that covers all relevant aspects of brownfield redevelopment. We exemplify the development of one specific DSS and its continuous evolvement through various national and international research projects. This DSS software, which has been initiated during the BMBF research program REFINA, was extended to a megasite management system (SAFIRA II MMT), and is proposed to be transferred to a tailored web-based DSS tool within the EC research program TIMBRE.



S13.05 -2

SOME CRITICAL ISSUES ON RISK ASSESSMENT AND REMEDIATION OF INDUSTRIAL CONTAMINATED SITES

Li Fasheng^{*[1]}, Guo Guanlin^[1], Marcomini Antonio^[3], Critto Andrea^[3]

^[1]Chinese Research Academy of Environmental Sciences ~ State Key Laboratory of Environmental Criteria and Risk Assessment ~ Beijing ~ China ^[2]Chinese Research Academy of Environmental Sciences ~ State Key Laboratory of Environmental Criteria and Risk Assessment ~ Beijing ~ China ^[3]University Ca' Foscari ~ Department of Environmental Sciences and Centre IDEAS ~ Venice ~ Italy

Recently, the accelerated industrialization and urbanization generated numbers of contaminated sites in China, which are leading to environmental damage and arousing the public concern. Risk assessment and remediation of the contaminated land are urgently needed for the future land development and environmental safety. During the past five years, government and institutes developed series of policies, regulations and guidelines for the risk management of contaminated sites, but some critical issues still need further improvements: the exposure factors as well as the site-specific parameters should be localized and optimized according to the native condition; the maximum acceptable risk level (ranging from 10^{-4} to 10^{-6} , and related to the risk based remediation thresholds) should be feasible and effective according to national economic development; how to define a scientifically sound and cost effective sampling plan in order to optimize the characterization of site contamination; how to develop and screen out the most suitable remediation technologies for different sites based on cost-effective, aesthetic, modern and green requirements. These critical issues should be taken into consideration in order to provide the better settlement for risk assessment and remediation of industrial contaminated sites in China.



S13.05 -3

TREE CORING AS A PHYTOSCREENING METHOD

Algreen Mette^{*[1]}, Rein Arno^[1], Trapp Stefan^[1]

^[1]Technical University of Denmark (DTU) ~ Department of Environmental Engineering ~ Kgs. Lyngby ~ Denmark

Phytoscreening where plants are used as an indicator of subsurface pollution may be a useful screening method for subsurface plumes, because several pollutants are transferred readily into vegetation. Wood and/or other plant parts can then be sampled for detection as well as for monitoring of soil and/or groundwater contamination. Tree coring as a phytoscreening method has been investigated. Tree cores of poplar (populus), willows (salix) and other species have been sampled at different sites in Europe. Samples have been taken from reference sites without contamination and from test sites contaminated with different compounds such as heavy metals, organic solvents and PAH. The use of the method and the evaluation of the results appear to be specific to compounds. Detections of compounds in wood not necessarily indicates contaminated soil/groundwater but may be due to natural background levels, e.g. for some metals, or due to pollution from air. Results from samples taken on a test site should therefore, always be compared with samples from a nearby reference site. The method is semi-quantitative, and bioaccessibility and bioavailability of the compounds, and the plant biology have shown to have impact on the method. For organic solvents correlations between the concentrations in the wood and soil/ground have been seen. For metals the case is more difficult, and statistical analyses seem to be needed to compare test samples and references samples, to identify elevated concentrations in the wood.



S13.05 -4

SOIL-WASHING WITH REUSED FLUIDS FOR IN-SITU AND ON-SITE REMEDIATION

Fatin-Rouge Nicolas^{*[1]}, Mahmoud Ahmed Mohamed^[1], Jacques Persello^[2], Jérôme Husson^[1], Ioan Bica^[3], Constantin Radu Gogu^[3]

^[1]University of Franche-Comté ~ UTINAM ~ Besançon ~ France ^[2]University of Nice ~ LPMC ~ Nice ~ France

^[3]Technical University of Civil Engineering Bucharest ~ Hydrogeology ~ Bucarest ~ Romania

Washing is among the few systematic alternatives to remove contaminants from soils, specially in case of metals, which are not degradable and that often have high vaporisation temperatures. In addition, it has the advantages to help the physical separation of macroscopic contaminants in on-site operations, and the removal of all micro-pollutants simultaneously by using an adapted train of chemical reactions. Efficient and wide-targeted reactions are needed to realise fast decontamination operations. Therefore, one of the main limitations of chemical washing over large contaminated sites, are costs associated with the use of chemical reagents and the treatment of huge amounts of wastewater. To be economically feasible, chemical agents must be recovered and reused at least several times by using simple and cheap treatments. Furthermore, they must be biostable and not accumulated in soils during repeated extractions. Finally, foams can replace advantageously solutions because of their exceptional properties that fit better with in-situ treatments, their wide-targeting of hydrophobic pollutants and the large reduction of wastewater volume to treat after their destabilisation. Here we will present some technologies developed in our laboratory, within the EU project TIMBRE, to reuse aqueous solutions of ligands and foams to mobilise heavy metals and a wide range of VOC and SVOC compounds from polluted soils. Remediation performances and fluids reuse performances will be presented on contaminated soils obtained from an old iron works in Hunedoara (Romania) as well as results from an on-site pilot test.



S13.05 -5

TIMBRE EXPERT SYSTEM AS INFORMATION PLATFORM FOR INNOVATIVE AND WIDELY APPLICABLE STRATEGIES, TECHNOLOGIES AND SOLUTIONS FOR BROWNFIELD REGENERATION

Pizzol Lisa^[1], Rizzo Erika^[1], Critto Andrea^[1], Marcomini Antonio^[1]

^[1]University Ca' Foscari Venice ~ Department of Environmental Sciences, Informatics and Statistics ~ Venice ~ Italy

Brownfield regeneration is an essential step to realize sustainable land management in European Member States. However, the success in brownfield regeneration is unsatisfying in terms of financial and eco-efficiency or social acceptance. Identified obstacles for an effective regeneration are (i) the abundance of strategies, tools, documented case studies and remediation technologies available at the EU level as well as (ii) the difficulties in adapting them to cultural, regional and site-specific requirements. Moreover, the non-visibility of already available, useful and innovative technologies and decision making processes is the reason that problem owners, managers, local authorities and other stakeholders do not regenerate brownfields using the best available technology and decision support systems measures. The 7th Framework Programme project TIMBRE (Tailored Improvement of Brownfield Regeneration in Europe) starts from these considerations and aims at overcoming these barriers by providing brownfields' owners, local authorities and stakeholders with a web-based and target-oriented customizable decision support toolbox. This contribution focuses on the presentation of the timbre expert system database, developed in TIMBRE Work Package 1, which collects the available information on previous projects, programs, and other activities focused on the regeneration of brownfields. The database data collection is based on a conceptual framework, composed of the main phases of the brownfield regeneration process, which has been developed in strong collaboration with the timbre case studies stakeholders. On the basis of the identified brownfield remediation process phases, the available methods, tools, strategies, best practices, and technologies, expressly developed for brownfield rehabilitation are collected and classified.



S13.05 -6

KNOWLEDGE AND DECISION MAKING IN BROWNFIELD REVITALIZATION: CROSS-CULTURAL VARIATIONS WITHIN EASTERN EUROPE

Bleicher Alena^[1], Alexandrescu Filip^{*[1]}, Gross Matthias^[1]

^[1]Helmholtz Centre for Environmental Research ~ Department of Urban and Environmental Sociology ~ Leipzig ~ Germany

In most industrialized countries the revitalization of contaminated brownfields is seen as a major challenge for sustainable regional development. This challenge demands collaborative action between diverse actors on multiple scales (local, regional, national, European). This presentation includes a selection of preliminary results from the EU research project TIMBRE (Tailored Improvement of Brownfield Regeneration in Europe) that aims to analyze social actors' strategies of "translating" European and national legal regulations into their local needs and expectations in several Eastern European contexts. The main focus of the research is the role and types of knowledge that different actors acquire during a brownfield revitalization process, how this knowledge is marshaled and how it is deployed in decision making processes. Knowledge is generated and retrieved by actors from different sources, including local site-specific sources, regional and national-level regulations for brownfield revitalization and scientific sources. The ways in which this knowledge is assembled and assessed by actors, strategies on how gaps are filled and new opportunities are sensed are pivotal for our understanding of the cultural contexts of decision making processes. This presentation will built on a first set of analyses of interviews and focus group meetings in Hunedoara, Romania in 2011 and 2012 to illustrate how decision making on the ground can be made by constructively transforming EU regulations into local specificities to develop unique spaces to maneuver. These preliminary results will be used as comparative material for cases in the Czech Republic, Poland, and Germany.



BM01 - MEET THE EDITORS

Chair Persons:

Steve Jarvis, European Journal of Soil Science - United Kingdom

Donald Davidson, Soil Use and Management - United Kingdom

Wednesday 04 July 2012 from 18:30 to 20:00. Room Olmo

BM02 - BUSINESS MEETING OF IUSS COMMISSION ON PALAEOPEDOLOGY

Chair Person:

Daniela Sauer, Hohenheim - Germany

Thursday 05 July 2012 from 18:30 to 20:00. Room Olmo

BM03 - EUROPEAN SOIL BUREAU NETWORK (ESBN)

Chair Persons:

Luca Montanarella, Ispra - Italy

Arwin Jones, Ispra - Italy

Tuesday 03 July 2012 from 18:30 to 20:00. Room Biancospino

BM04 - JOINT MEETING OF THE CROPLANDS RESEARCH GROUP AND C-N CROSSCUTTING TEAM OF THE GLOBAL RESEARCH ALLIANCE (GRA)

Chair Persons:

Steven Shafer, Beltsville - United States

Jean-Francois Soussana, Paris - France

Sylvie Recous, Reims - France

Alan Franzluebbers, Beltsville - United States

Tuesday 03 July 2012 from 18:30 to 20:00. Room Leccio



BM05 - JOINT MEETING OF THE C-N CROSSCUTTING TEAM AND CROPLANDS RESEARCH GROUP OF THE GLOBAL RESEARCH ALLIANCE (GRA)

Chair Persons:

Jean-Francois Soussana, Paris - France

Steven Shafer, Beltsville - United States

Sylvie Recous, Reims - France

Alan Franzluebbers, Beltsville - United States

Thursday 05 July 2012 from 18:30 to 20:00. Room Leccio

BM06 - GENERAL ASSEMBLY OF THE EUROPEAN CONFEDERATION OF SOIL SCIENCE SOCIETIES (ECSSS)

Chair Persons:

Nicola Senesi, Bari - Italy

Teodoro Miano, Bari - Italy

Thursday 05 July 2012 from 18:30 to 20:00. Room Acero

BM07 - GENERAL ASSEMBLY OF SOCIETÀ ITALIANA DELLA SCIENZA DEL SUOLO (SISS)

Chair Person:

Nicola Senesi, Bari - Italy

Wednesday 04 July 2012 from 18:30 to 20:00. Room Acero

BM08 - GET TOGETHER OF ASSOCIAZIONE ITALIANA PEDOLOGI (AIP)

Chair Person:

Fabio Petrella, Torino - Italy

Wednesday 04 July 2012 from 18:30 to 20:00. Room Leccio



OD01 - SOIL SCIENCE EDUCATION: HOW CAN WE MAKE SOILS SEXY AGAIN?

Chair Person:

Philippe C. Baveye, Troy - United States

Thursday 05 July 2012 from 18:30 to 20:00. Room Alloro

R01 - CURRENT STATE OF KNOWLEDGE AND POTENTIAL FOR FUTURE EXPERIMENTS TO HELP ADVANCE OUR UNDERSTANDING AND MODEL REPRESENTATION OF SOIL ORGANIC CARBON STABILIZATION PROCESSES AND DYNAMICS

Chair Persons:

Thomas Wutzler, Jena - Germany

Myroslava Khomik, Jena - Germany

Marion Schrumpf, Jena - Germany

Tuesday 03 July 2012 from 18:30 to 20:00. Room Alloro

R02 - SOIL SCIENCE: ARE WE FACING REAL NEEDS FROM SOCIETY?

Chair Persons:

Johan Bouma, Wageningen - Netherlands

Angelo Basile, Ercolano - Italy

Fabio Terribile, Napoli - Italy

Wednesday 04 July 2012 from 18:30 to 20:00. Room Alloro

R03 - SOIL CONSERVATION POLICIES IN EUROPE: A DISCUSSION OF DIFFERENT IMPLEMENTATION STRATEGIES AND POLICY OPTIONS

Chair Persons:

Nina Hagemann, Leipzig - Germany

Katrin Prager, Aberdeen - United Kingdom

Wednesday 04 July 2012 from 18:30 to 20:00. Room Mirto



R04 - GUIDELINE DEVELOPMENT FOR FOREST BIOENERGY - Sponsored by OECD

Chair Persons:

Heljä-Sisko Helmisaari, Helsinki - Finland

Elena Vanguelova, Farnham - United Kingdom

Tuesday 03 July 2012 from 18:30 to 20:00. Room Mirto

SC02 - GLOBAL SOIL INFORMATION FACILITIES - CONTRIBUTION FROM ISRIC WORLD SOIL INFORMATION

Chair Persons:

Hannes I. Reuter, Wageningen - The Netherlands

Tom Hengl, Wageningen - The Netherlands

Wednesday 03 July 2012 from 18:30 to 20:00. Room Biancospino

TD01 - NEW TECHNIQUES FOR SOIL PARTICLE SIZE ANALYSIS: ADVANCEMENTS AND PROBLEMS

Chair Persons:

Roberto De Mascellis, Ercolano - Italy

Angelo Basile, Ercolano - Italy

Thursday 05 July 2012 from 18:30 to 20:00. Room Biancospino

TM01 - THE WAY AHEAD FOR LAND MANAGEMENT AND SOIL CONSERVATION: THE DEVELOPMENT OF SOIL-DRIVEN WEB DECISION SUPPORT SYSTEMS

Chair Persons:

Fabio Terribile, Napoli - Italy;

Carlo De Michele, Napoli - Italy

Wednesday 03 July 2012 from 18:30 to 20:00. Room Olmo



S01.01-P - SOILS AND SEDIMENTS AS NATURAL ARCHIVES

Wednesday 04 July 2012 from 17:00 to 18:30. Room Poster Areas

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ASSESSING BIOCHEMICAL AND BIOMOLECULAR GRADIENTS ALONG AN OMBROTROPHIC PEAT BOG PROFILE

Edoardo Puglisi, Piacenza - Italy

S01.01-P -2

CLIMATIC RECONSTRUCTIONS AND ENVIRONMENTAL CHANGES RECORDED IN PEAT BOGS IN THE NORTH-EASTERN ITALIAN ALPS DURING THE HOLOCENE

Luisa Poto, Venice - Italy

S01.01-P -3

COMPLEX PEDOGENESIS IN THE EOPLEISTOCENE PALEOPEDOCOMPLEX OF THE NORTHERN CISCAUCASIA: POLYGENETIC MODELS

Ilya Shorkunov, Moscow - Russian Federation

S01.01-P -4

CONFRONTATION OF CARBONATE BEDROCK WITH POLYGENIC ALLOCHTHONOUS MATERIAL: WHICH PARENT MATERIAL PREVAILS IN SOIL EVOLUTION?

Lorraine Martignier, Lausanne - Switzerland

S01.01-P -5

CORRESPONDENCE BETWEEN VERTICAL PROFILE OF SOIL COMPACTNESS AND INTENSITY OF LAND GRADING PROCESS IN URBAN GREEN PARKS, TOKYO METROPOLIS

Natsuko Uoi, Tokyo - Japan

S01.01-P -6

DOES SPECIFIC PEDOGENESIS OCCUR IN TECHNOSOLS DEVELOPING ON IRON INDUSTRY WASTES DEPOSITS?

Hermine Huot, Vandoeuvre-lès-Nancy - France



S01.01-P -7

EFFECTS OF THE ADDITION OF ALKALI-SOLUBLE ORGANIC MATTER EXTRACTS FROM TWO COMPOSTS MADE FROM OLIVE MILL WASTE ON CHEMICAL PROPERTIES OF A CALCAREOUS SOIL

Inmaculada Bautista Carrascosa, Valencia - Spain

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ENHANCED GROWTH OF CORN AND IMPROVEMENT OF SOIL QUALITY ON THE APPLICATIONS OF CLAY MINERALS TO SOIL

Sangseung Lee, Eum Seong Gun - Korea, Republic of

S01.01-P -9

ENHANCED GROWTH OF RED PEPPER BY THE APPLICATIONS OF CLAY MINERALS TO THE BED SOIL AND PROTEOMIC ANALYSIS

Keun Yook Chung, Cheongju - Korea, Republic of

S01.01-P -10

ENVIRONMENTAL INTERPRETATION OF TWO HOLOCENIC FOSSIL SOILS IN SOUTHERN ITALY.

Antonio Carmine Dimase, Firenze - Italy

S01.01-P -11

FUNCTIONING OF PALEOCRYOGENIC SOIL COMPLEXES: STABLE PATTERN OF RELICT FEATURES DESPITE THE CHANGE OVER OF KEY CONTROL FACTORS

Tatiana Arkhangel'skaya, Moscow - Russian Federation

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GEOARCHAEOLOGICAL AND PEDOSTRATIGRAPHIC STUDY OF THE SAN MICHELE CAVE OF SARACENA, CALABRIA, SOUTHERN ITALY: RECONSTRUCTION OF LATE PLEISTOCENE TO MID-HOLOCENE PALEOENVIRONMENTAL CHANGES

Fabio Scarciglia, Arcavacata di Rende (CS) - Italy

S01.01-P -13

IMPACT OF ANTHROPEDOGENESIS ON TERRACED LANDSCAPES IN THE VALBELLUNA VALLEY (VENETO REGION, ITALY)

Andrea Ferrarini, Venice - Italy



S01.01-P -14

*INTERPRETING THE ASH PROFILE ALONG OMBROTROPHIC BOG PROFILES:
ATMOSPHERIC DUST DEPOSITIONS VS. MINERALIZATION PROCESSES*

Claudio Zacccone, Foggia - Italy

S01.01-P -15

IS THE CHERNOZEM SOIL RELIC OF STEPPE VEGETATION?

Barbora Vyslouzilova, Strasbourg - France

S01.01-P -16

*LATE HOLOCENE ENVIRONMENTAL CHANGE IN TEOTIHUACAN, MEXICO, BASED ON A
POLYGENETIC PALEOSOL*

Serafin Sanchez, - Mexico

S01.01-P -17

*PALEOENVIRONMENTAL IMPLICATIONS THROUGH THE STUDY OF AN EEMIAN PALEOSOL
IN NORTHWESTERN SARDINIA (ITALY)*

Claudio Zucca, Sassari - Italy

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PEREGLACIAL FEATURES IN SOILS IN THE NORTH OF EUROPEAN RUSSIA

Evgeniy Pogozev, Moscow - Russian Federation

S01.01-P -19

*RECENT STUDIES OF HISTORICAL AND CONTEMPORARY FIRES FROM ESTONIAN PEAT
BOG PROFILES*

Ülle Sillasoo, Tallinn - Estonia

S01.01-P -20

SHORT TIME DEVELOPMENT OF TECHNOSOLS IN MINING ENVIRONMENT

Emmanuel Joussein, Limoges - France

S01.01-P -21

*SOILS, VEGETATION AND CLIMATE OF THE PENULTIMATE INTERGLACIAL (MOIS 7) IN
UPLANDS TO THE NORTH OF THE CARPATHIANS*

Maria Lanczont, Lublin - Poland



S01.01-P -22

SPECTRA OF GRAIN SIZE DISTRIBUTION OF PEDOARCHIVES AS AN INDICATOR FOR CULTURAL LANDSCAPE DEVELOPMENT: THE NEOLITHIC BURIAL MOUND KÖNIGSGRAB (SACHSEN-ANHALT, GERMANY)

Svetlana V. Khamnueva, Kiel - Germany

S01.01-P -23

STUDY WITH N AND K FERTILIZATION OF SUGARCANE RATOONS HARVESTED WITHOUT BURNING

Fábio Luis Ferreira Dias, Piracicaba - Brazil

S01.01-P -24

THE EFFECT OF WOOD ASH FERTILIZATION ON SOIL CHEMICAL PROPERTIES AND GREENHOUSE GAS (GHG) EMISSIONS IN BOREAL PEATLAND FORESTS

Marja Maljanen, Kuopio - Finland

S01.01-P -25

TUBULAR CALCRETES. MORPHOLOGY AND GENESIS OF A NEW TYPE OF CARBONATE ACCUMULATION FOUND IN SOUTHWESTERN URUGUAY

Héctor J. M. Morrás, Castelar - Argentina

S01.01-P -26

ZINC UPTAKE EVALUATION BY MAIZE PLANT AND DETERMINATION OF CRITICAL LEVEL IN CALCAREOUS SOILS OF IRAN

Rasht - Iran, Islamic Republic of



S01.01-P -1

ASSESSING BIOCHEMICAL AND BIOMOLECULAR GRADIENTS ALONG AN OMBROTROPHIC PEAT BOG PROFILE

Puglisi Edoardo^{*[1]}, Cappa Fabrizio^[1], Zaccone Claudio^[2], Miano Teodoro^[3], Trevisan Marco^[4]

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Ombrotrophic peat bogs are not directly in contact with groundwater: since their genesis is related only to wet and dry deposition they are considered natural archives of extreme importance for the assessment of past ecological, environmental and climatic events. Etang de la Gruère is an ombrotrophic Swiss bog representing the longest continuous record of atmospheric deposition in continental Europe (corresponding to ca. 15,000 years of peat formation). Aim of the present study is to assess, in ca 20 samples along the peat bog profile, the presence and distribution of two very important classes of biomolecules: DNA and lipids. PCR-DGGE analysis of DNA targeting total bacteria and archaea allowed the identification of biodiversity patterns that clustered according to the profile depth and chemical analyses. It was found that the microbial communities changed significantly below ca 45 cm, where conditions are anoxic and molecules with higher molecular mass and degree of condensation are observed. Acidobacteria dominated the most superficial samples, while methanomicrobia were more common in the deepest samples. It was also found that the homologies scores decreased with depth, thus pointing to a less known microbial community composition in the oldest samples. Lipid analyses are now being carried out to integrate and extend the findings at DNA level. Specifically the analyses are focusing on phospholipid fatty acids (PLFAs) and tetraether lipids, which are respectively indicators of bacterial and archaeal microbial communities. In the case of tetraether lipids, their possible application as "paleo-thermometers" is also being tested.



S01.01-P -2

CLIMATIC RECONSTRUCTIONS AND ENVIRONMENTAL CHANGES RECORDED IN PEAT BOGS IN THE NORTH-EASTERN ITALIAN ALPS DURING THE HOLOCENE

Poto Luisa^[1], Gabrieli Jacopo^[2], Pini Roberta^[3], Cozzi Giulio^[2], Turetta Clara^[2], Ravazzi Cesare^[3], Zaccone Claudio^[4], Barbante Carlo^[1]

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Ombrotrophic peatlands are usually considered as a valuable repository of high-quality climatic signals because their only source of water is from precipitation. For this reason, they constitute an authentic record of information about past and present patterns in global climatic change and the impact of historical natural and human activity in causing trace element contamination. In the province of Belluno, bogs of major interest are located in Danta di Cadore (1400 m a.s.l.) and Coltrondo (1800 m a.s.l.). This study aims to sample these bogs for reconstructing past climate and environmental conditions. Prior to any expensive and time consuming chemical procedure and analysis, measurement of major and trace elements in peat profile using the non-destructive X-Ray Fluorescence core scanning was performed. This method provides high resolution geochemical data that helps to document the natural geochemical processes which occur in the peat profiles and their possible effect on the distribution of trace elements. The presence of trace metals, heavy metals and REE will be also detected in digested peat solution using ICP-MS and ICP-OES. Using appropriate age dating methods, suitable age-depth models and careful determinations of trace element concentrations, it is possible to reconstruct the changing rates and the predominant sources of a wide variety of atmospheric trace elements. In addition, the biological relevance of these processes are examined in particular using spatial relationships in pollen distribution and their correlations to modern climate as a guide to interpreting pollen patterns recorded in the past and to reconstructing vegetation history.



S01.01-P -3

**COMPLEX PEDOGENESIS IN THE EOPLEISTOCENE PALEOPEDOCOMPLEX OF THE
NORTHERN CISCAUCASIA: POLYGENETIC MODELS**

Shorkunov Ilya*^[1]

^[1]Institute of Geography Russian Academy of Sciences ~ Soil Geography and Evolution Dept. ~ Moscow ~ Russian Federation

Paleopedocomplex was investigated in the Temizhbeksky section which is located in the natural outcrop of the Kuban river and has a thickness of about 50 m. Paleopedocomplex was formed in the Eopleistocene, it consist's of six paleosoil horizons lying in five lithological layers. Paleosoil horizons belong's to four individual truncated paleosoil profiles. The upper profile lying in the single litho-layer and consist's of one horizon which has vertic, stagnic and calcic features. Temporal and spatial relations of these features could be explained by three evolution stage of pedogenesis. The second profile lying in the single litho-layer and formed by two horizons of stagnic luvisol which also has vertic and calcic features referred to the younger upper paleosoil. The third profile transfixing two different litho-layers by cambic and calcic horizons. Paleosoil also has weak vertic and stagnic features which could be explained by the soil self-development in a low-amplitude climate fluctuations. The lower profile lying in the single litho-layer and formed by the single calcic horizon with gleyic and vertic features. Pedogenesis could be explained by polygenetic model. Thus, investigated paleopedocomplex keeps information not less than twelve stages of litho- and pedogenesis. The term "polygenesis" has three different meanings in this case. The first – the pedocomplex polygenesis which is in a complex sequence of lithological layers and soil horizons. The second is in evolution of the individual paleosoil profiles in the pedocomplex which reflect a climate change. And the third is in inheritance of buried soil horizon by later pedogenesis.



S01.01-P -4

CONFRONTATION OF CARBONATE BEDROCK WITH POLYGENIC ALLOCHTHONOUS MATERIAL: WHICH PARENT MATERIAL PREVAILS IN SOIL EVOLUTION?

Martignier Loraine^[1], Adatte Thierry^[1], Verrecchia Eric^[1]

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The geological substratum of Swiss Jura Mountains is composed of Mesozoic limestones and marls. Therefore, it would be expected that pedogenesis follows an evolutionary pathway mostly affected by carbonate dynamics. Nevertheless, the study of a soil toposequence reveals that most of the soil profiles exhibit a clear lithological discontinuity between upper and lower soil horizons, the deepest ones arising from bedrock weathering. Acidic pH values are measured in surficial horizons. They enhance processes such as brunification and clay leaching. Consequently, the way in which lithodependence impacts soil development is questioned. Superficial deposits are identified along the studied toposequence in order to decipher the polygenic origin of the mineral phase. Their distribution records the succession and interactions of the different transport and deposition dynamics that modelled the landscape since the last glaciation. The in situ weathered material and the surficial allochthonous deposits are discriminated through multivariate statistical analyses of mineralogical data and grain size distribution of the soil mineral fraction. Results confirm the polygenic origin of the surficial deposits and demonstrate a contribution of allochthonous minerals in the upper soil horizons. Potential sources of this mineral phase are documented using soil micromorphology and scanning electron microscopy, combined with field observations. Provenance of allochthonous material is attributed to deflation of Alpine moraines situated on the Swiss Plateau during the late glacial period. These aeolian episodes formed loess deposits on the Jura crests. According to their depth, these deposits influence present-day pedogenesis and significantly lessen the contribution of the carbonate geological substratum.



S01.01-P -5

CORRESPONDENCE BETWEEN VERTICAL PROFILE OF SOIL COMPACTNESS AND INTENSITY OF LAND GRADING PROCESS IN URBAN GREEN PARKS, TOKYO METROPOLIS

Uoi Natsuko*^[1], Murata Tomoyoshi^[2], Watanabe Makiko^[1]

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Expansion of urban area causes specific environmental problems in metropolis, such as “urban heat island” and “urban flood”. Urban soils develop under such circumstances associated with intensive stress of human activities and their properties may further change by various processes of human activities. Nevertheless, soils in urban area may have miscellaneous functions to create sustainable urban environment such as mitigation of heated atmosphere, recovery of infiltration capacity, conservation of bio-diversity, storage of carbon, and so on. Two historical parks in Tokyo Metropolis, the Kitanomaru and the Shinjuku-Gyoen parks, were examined in this study to understand basic characteristics of soil development of urban soils in consideration with land use history, land creation method, current land coverage and management. In this study, we focused on soil physical properties to develop a convenient methodology for conducting soil survey in urban green parks. Vertical profiles of soil compactness were obtained using a 1 meter cone penetrometer at 134 and 80 points in Kitanomaru and Shinjuku-Gyoen parks, respectively. The obtained profiles were classified 18 groups in terms of the pattern of the soil compactness. Spatial analysis using GIS showed a significant correspondence between the characteristics of vertical soil compactness and land creation history. It could be concluded that vertical soil compactness is a useful index to understand the intensity of grading process in urban parks.



S01.01-P -6

DOES SPECIFIC PEDOGENESIS OCCUR IN TECHNOSOLS DEVELOPING ON IRON INDUSTRY WASTES DEPOSITS?

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Technosols include soils dominated or strongly influenced by human-made materials. But whether pedogenesis of Technosols is governed by specific processes in comparison to those occurring in natural soils remains unknown. With this aim in view, a Technosol derived from purely anthropogenic materials was investigated. It has formed on a former settling pond of sludge generated by iron industry. Probably abandoned in the mid-20th century, this pond has been covered by a diversified forest. The soil is composed of contrasted layers. An organic layer has developed at the surface. Composition and properties of the soil materials were studied in the first two meters of the profile under root influence. Elemental composition was dominated by Fe, Mn, Ca and Si and revealed very high contents in heavy metals, up to several percents for Pb and Zn. The soil was slightly alkaline (5-30 % carbonate). Mineralogy was characterized by poorly crystalline phases mainly aluminosilicates, Fe and Mn (hydr)oxides, Ca carbonates and sulfates. Bulk density was lower than 0.7 g cm⁻³. Porosity was higher than 75 % (v/v) with a majority of micropores. Water retention capacity and specific surface were high. Thus, despite its anthropogenic parent materials, this Technosol displays properties comparable to those developed in natural soils, such as volcanic, carbonated or manganese bearing soils. But conditions of formation of these soils are rarely concomitant in natural environments. This leads to wonder if human factor (nature of parent material, mixing) could create particular conditions allowing unusual combinations of natural soil-forming processes.



S01.01-P -7

EFFECTS OF THE ADDITION OF ALKALI-SOLUBLE ORGANIC MATTER EXTRACTS FROM TWO COMPOSTS MADE FROM OLIVE MILL WASTE ON CHEMICAL PROPERTIES OF A CALCAREOUS SOIL

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Calcareous soils, which are widespread in the Mediterranean basin, are characterized by a high chemical reactivity, due to calcium carbonate precipitation-dissolution processes, in which biological activity also plays an important role by means of CO₂ release. The application of liquid organic amendments has been proposed as a nutrient and organic matter source for agricultural purposes. The aim of this work was to study the influence of two different alkali-soluble organic matter (ASOM) extracts prepared from composted two-phase olive mill waste –also called ‘alperujo’, which is generated by the olive oil extraction industry– on several chemical characteristics of a calcareous soil, by using rates within the range of 200 to 6400 mg C kg⁻¹ soil. The ASOM materials were extracted with KOH 1M (compost:extractant proportion 1:3, w:v) during 24 hours at 70°C. The extracts exhibited high pH and electrical conductivity (EC) values. To study the immediate effects of the addition of ASOM extracts, they were mixed with the soil at the abovementioned rates and a short-term extraction (after two hours) with distilled water (soil:water extract 1:1, w:v) was carried out for pH, EC and water-soluble organic carbon determinations. These parameters were also studied after 6 months in order to know the influence of ASOM application on soil in a longer term. The results of these experiments showed that both pH and salinity increase was lower than it was theoretically expected, being these effects possibly related to cation exchange, CaCO₃ precipitation and organic carbon adsorption at the solid phase of the soil.



S01.01-P -8

ENHANCED GROWTH OF CORN AND IMPROVEMENT OF SOIL QUALITY ON THE APPLICATIONS OF CLAY MINERALS TO SOIL

Lee Sangseung^{*[1]}, Lee Seok Eon^[2], Chung Keun Yook^[2], Kim Deok Hyeon^[2], Kwon Sang Moon^[2], Woo Sun Hee^[3], Lee Moon Soon^[4]

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This study was initiated to evaluate the effect of the clay minerals, such as illite, phyllite, zeolite on the growth of corn and soil quality. The clay minerals were applied to the field soil at a rate of 6,000kg/ ha. pH in the soils treated with illite, phyllite, and zeolite, and measured once weekly, was increased, compared to untreated soils. The organic matter content were 31%, 34%, and 29% higher in the treatments of illite, phyllite, and zeolite, than in the untreatment, respectively. C.E.C. were 13%, 15%, 17% higher in the treatments of illite, phyllite, zeolite than in the untreatment, respectively. The cation K were 10%, 13%, and 12% higher in the treatments of illite, phyllite, and zeolite than in the untreatment, respectively. The bacterial counts(CFU/g) on NA media for soil samples from the rhizosphere soil were 2, 2.1, and 2.1 times higher in the illite, phyllite, and zeolite treatments than in the untreatment. The actinomyces counts(CFU/g) on a PDA media were 1.8, 1.7 and 2.5 times higher in the illite, phyllite, zeolite treatments than in the untreatment. The fresh weights of corn per one were 40%, 33%, and 28% higher in the treatments of illite, phyllite, zeolite, than in the untreatment, respectively. Based on the results obtained from the study, it appears that the application of clay minerals to soil also improve the soil quality.



S01.01-P -9

ENHANCED GROWTH OF RED PEPPER BY THE APPLICATIONS OF CLAY MINERALS TO THE BED SOIL AND PROTEOMIC ANALYSIS

Chung Keun Yook*^[1], Lee Seok Eon^[1], Kwon Sang Moon^[1], Woo Sun Hee^[2], Nam Ju Hyun^[3], Choi Jong Soon^[3]

^[1]Chungbuk National University ~ 1Department of Environmental Biology and Chemistry ~ Cheongju ~ Korea, Republic of ^[2]Chungbuk National University ~ Department of Crop Science ~ Cheongju ~ Korea, Republic of ^[3]Korea Basic Science Institute ~ Proteomics Team ~ Daejeon ~ Korea, Republic of

The use of bed soil has heavily been increased with the development of raising technology of good quality of seeding such as using plug tray since the development of horticultural industry of 1990. Requirement of bed soil for the raising of seeding should have good physical, chemical, and biological properties and consider economical aspect. Materials for raising of seeding in the Korea and foreign countries are inorganic materials, zeolite, vermiculite, perlite, organic materials, saw dust, peat moss, The objectives of the study were to evaluate the effect of clay minerals on the growth of red pepper in the bed soils and to perform the proteome analysis in involved in its growth. Four clay minerals such as, illite, phyllite, zeolite, and bentonite were used in this study. Red pepper was used as a model vegetable crop and grown in the green house. The treatments of four clay minerals such as illite, phyllite, zeolite, and bentonite to the bed soils enhanced the growth of red pepper. Compared to the untreated, the growth of red pepper were 29, 46, 37, and 32% higher in the treatments of illite, phyllite, zeolite, and bentonite than in untreated, respectively. Also, dry weight of root of red pepper were 13, 24, 11, 10% higher in the treatments of illite, phyllite, zeolite, bentonite, than in untreated, respectively. Dry weight of stem of red pepper were 116, 120, 131, 130% higher in the treatments of illite, phyllite, zeolite, bentonite, than in untreated, respectively



S01.01-P -10

ENVIRONMENTAL INTERPRETATION OF TWO HOLOCENIC FOSSIL SOILS IN SOUTHERN ITALY.

Dimase Antonio Carmine*^[1]

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In the Holocene, the hills adjacent to Ionian coast of Basilicata, S. Italy underwent to strong erosion. Recently, the spectacular forms of land degradation attracted many Italians and foreign geologists. The purpose of this pedological study is to identify the causes of the erosion, either climatic or anthropic, and to establish the chronology of these events. The two buried soils studied in a pedostratigraphic section, nearly 20 metres high, are both Inceptisols, the S1 is at about 10 metres from the surface, the S2 at 8 metres. The results of soil morphology, micromorphology, chemical analyses and radiocarbon dating of soil organic matter and charcoal lead to the following conclusions: 1) The pedogenesis of S1, started in the middle Holocene; the strong erosion/sedimentation phase that preceded the genesis of this soil is attributed to a climatic humid phase. For the S2 the erosion/sedimentation phase is anthropic, that occurred during the Greek-Roman time. 2) The 8 m of sediments over S2 are the consequence of human impact that took place between the end of XVII century and the beginning of XIX, due to the dramatic increase of population and the social and political changes of that time. Keywords: Fossil soils, climatic changes, human impact, radiocarbon dating.



S01.01-P -11

FUNCTIONING OF PALEOCRYOGENIC SOIL COMPLEXES: STABLE PATTERN OF RELICT FEATURES DESPITE THE CHANGEOVER OF KEY CONTROL FACTORS

Arkhangelskaya Tatiana*^[1]

^[1] Moscow State University ~ Soil Science ~ Moscow ~ Russian Federation

Paleocryogenic soil complexes were studied on gentle slopes 200 km east of Moscow. Ancient microrelief is now completely buried under agrogenically smoothed soil surface, but the sign of temperature differences between soils with different profiles is the same as it used to be long time ago, when these soils occupied different topographical positions. Lowest temperatures are typical for soils with low bulk density and high carbon content located in the areas of now buried paleomicrodepressions. Mathematical modeling proved that observed variability of soil properties is sufficient to explain lateral heterogeneity of soil temperature. Heterogeneity of soil temperature is accompanied by heterogeneity of soil moisture contents, which also resembles relict features: melted waters and rainwater are redistributed within the studied complexes in the direction of former microdepressions. And this lateral redistribution is also governed rather by internal factor, that is, lateral heterogeneity of soil properties than the external one, that is, microtopography of soil surface. It looks like there was a changeover of key factors governing the functioning of studied complexes: microtopography was the initial factor of lateral differentiation, but now this differentiation is supported by differences in soil properties. Positive feedbacks in “properties-functioning” chain are the slower rate of carbon decomposition within the areas rich in humus and lateral redistribution of carbon with melted waters. Mathematical modeling suggests that lateral transport is more important for preserving lateral heterogeneity in carbon content, and differences in decomposition rates have greater effect on the total amount of carbon stored in the system.



S01.01-P -12

GEOARCHAEOLOGICAL AND PEDOSTRATIGRAPHIC STUDY OF THE SAN MICHELE CAVE OF SARACENA, CALABRIA, SOUTHERN ITALY: RECONSTRUCTION OF LATE PLEISTOCENE TO MID-HOLOCENE PALEOENVIRONMENTAL CHANGES

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The San Michele Cave is an open hypogeal karst landform shaped in the dolostone-limestone bedrock of the Pollino Massif close to Saracena, in north Calabria (southern Italy). It was repeatedly settled and abandoned by men since Palaeolithic to Early Bronze Age. We focused on reconstruction of late Pleistocene to mid-Holocene paleoenvironmental changes recorded in the pedosedimentary infilling of the cave. We applied a multidisciplinary approach, based on geomorphological, pedological, geochemical and micromorphological analyses. Various stages of geomorphic stability and pedogenesis (with dominant humus accumulation, carbonate leaching and reprecipitation) alternated with sedimentary phases, which mainly emplaced thin-layered, (sandy-)loam deposits, with occasional very coarse debris related to rock-fall processes from the roof. Also important reworking processes from outside and/or inside the cave are evidenced by siliciclastic sediments, pedorelicts and/or papules, easily detected at the microscale in soil thin sections. Chronological constraints, obtained on the basis of archaeological findings and radiocarbon dates of charcoal fragments at different stratigraphic heights, permitted us to estimate approximate rates of sedimentary aggradation and soil formation. Moreover, the main soil features (e.g. CaCO₃ concretions, clay coatings or papules) and pedogenic iron indices were interpreted as indicators of the local response of pedogenetic processes, weathering degree and geomorphic dynamics to climatic changes, which presumably also interacted with effects of human activities both in the cave and in the surrounding external environment.



S01.01-P -13

IMPACT OF ANTHROPEDOGENESIS ON TERRACED LANDSCAPES IN THE VALBELLUNA VALLEY (VENETO REGION, ITALY)

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Man, with his activities, is currently considered the sixth factor of pedogenesis. Terracing is an ancient agrotechnical practice diffused in mountain areas, which created new anthropic landforms and anthropogenic soils. The objective of this study was to identify the impact of terracing on soil dynamic properties, and the related anthropogenic processes. The study area is located in the Valbelluna valley (Veneto, Italy), on the edge of the "Dolomites National Park". The soil survey concerned three terraced areas and one untterraced slope as term of comparing anthropic/natural soil properties. The anthropogenic soils analysed (Technic-Alloic Regosols (Escalic, Transportic, Skeletic)) showed a clear process of entisolization, with ^Ap-^C profile, the presence of Human-Transported Natural Materials (pebbles and earthy material as new parent material), artifacts, a coarser texture, a lower bulk density, C.E.C. and AWC, and a homogenization of organic carbon and carbonates along the profile. A correlation analysis between properties of natural and anthropogenic soils was, finally, made. The 56% of Pearson Coefficients, (ri), calculated for terraced soils, are significantly different in comparison to natural soils. If we take in consideration ri calculated between soil depth and each soil parameter, then the 80% of coefficients for terraced soils statistically differs ($p < 0,05$) from natural ones. The result of entisolization is a clear increase of disorder and entropy in the terraced systems, with a decreasing correlation between terraced soil properties in comparison to natural soils. The human impact determined an interruption of the anisotropic trend of soil evolution, making soil simpler (haploidization).



S01.01-P -14

**INTERPRETING THE ASH PROFILE ALONG OMBROTROPHIC BOG PROFILES:
ATMOSPHERIC DUST DEPOSITIONS VS. MINERALIZATION PROCESSES**

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Since the pioneering studies of Mattson and Koutler-Andersson (1954), peat cores from ombrotrophic bogs have increasingly been recognized as valuable archives of atmospheric dust particles such as minerals and amorphous materials derived from soils, and volcanic ash shards. The longest continuous record of atmospheric dust deposition in continental Europe has been provided by Etang de la Gruere (EGr), an ombrotrophic bog in the Jura Mountains of Switzerland, where 6.5 m of peat has accumulated during the past ca. 15,000 years. Recently, some authors argued that ash peaks along the EGr peat bog profiles are signs of previous periods of higher peat decomposition rather than an indication of periods of elevated dust inputs. Analyzing both the ash and the acid-insoluble ash (AIA) fraction along EGr cores, it is possible to observe that most of inorganic solids supplied to the EGr bog (i.e., 23-86%, mean 49%) consisted of atmospheric soil dusts derived from the weathering of crustal rocks. Thus, these ash peaks could not have been caused exclusively by processes such as organic matter decay, but they are either the result of an increase in the rate of supply of dust particles, changes in the rates of peat accumulation or both. Given the variation in dust deposition rates recorded since the Late Glacial, attributing peaks in ash content exclusively to variations in peat decomposition and humification seems to be a questionable, if not dangerous, practice.



S01.01-P -15

IS THE CHERNOZEM SOIL RELIC OF STEPPE VEGETATION?

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Chernozems and luvisols are the soil types developed on loess which are widely represented in Central Europe. Traditionally it is considered that the evolution of chernozems is connected to the open landscape with grassy steppe vegetation, by contrast luvisols are supposed to be developed under forests. However, Holocene chernozems have developed in the areas where the climate is favorable to the existence of forests. This fact is to be studied in order to understand the pedogenesis of these soil types. The main focus is to see which environmental conditions in Holocene lead to the evolution of chernozems. The properties of the soil before the Neolithic age were for sure different from the recent ones. Pedogenesis circumstances, the paleovegetation before all, are reconstructed by studying buried soils. The soil organic matter is analyzed by the near infrared spectroscopy (NIRS) in order to identify the types of ecosystems which successively occupied the soils. The C14 analysis is proceed to determinate the age of soil organic matter. The charcoal is extracted from soil and identified in order to see the forest disappearance



S01.01-P -16

LATE HOLOCENE ENVIRONMENTAL CHANGE IN TEOTIHUACAN, MEXICO, BASED ON A POLYGENETIC PALEOSOL

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Teotihuacan was one of the largest settlements of ancient Mexico, known for hosting one of the greatest pre-Hispanic urban civilizations, which flourished in the interval I-VII centuries A.D., reaching an extension of approximately 20 km² and 125,000 inhabitants. Soil is very important for the cultural development as it is part of the natural environment, the base of natural ecosystems as well as agriculture. This research focuses on a polygenetic paleosol in Teotihuacan that was identified as the soil cover during the time of settlement. The date obtained from soil organic matter from a buried AE horizon was 2 060 +/- 40 14C BP representing its minimum age. The paleosol is very well developed, with AE, AB, BCK horizons. The features of the horizons are the results of different stages of pedogenesis: AB horizon is dark, with strong vertic features (angular blocks, stress cutans, hard consistence), indicating seasonal climate; micromorphology shows illuvial clay in fractures, representing an increase of the humidity, which is identified by the Fe nodule, and illuvial clay in pale AE horizon. In this horizon there are also agrocultans, charcoal fragments and crust fragments indicating irrigation during cultivation. BCK horizon has also illuvial clay on carbonates, showing a previous dry phase.



S01.01-P -17

PALEOENVIRONMENTAL IMPLICATIONS THROUGH THE STUDY OF AN EEMIAN PALEOSOL IN NORTHWESTERN SARDINIA (ITALY)

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Sardinia is one of the main islands of the Mediterranean Sea where it occupies a central position. The Island has been considered tectonically stable since the last 2My and, therefore represents a key area to perform studies on climate and paleoenvironmental changes that have occurred during the Quaternary. Several studies conducted along the NW coast of the island have documented and precisely dated, by the Optically Luminescence Technique, a quasi continuous succession of sandy deposits (aeolian and shallow marine) referred to MIS5; in particular the substages MIS5e and 5c. Most of these deposits are interlayered with soils. The aim of this work is to define the paleoenvironmental changes related to a soil belonging to the studied succession, by means of an in-depth micromorphological study. In particular, the presence of this paleosol is associated to the fast climatic fluctuations that took place between MIS5e and MIS5c. Three main phases were highlighted. A wet period, with intense carbonate leaching, was followed by the establishment of very dry conditions and by the formation of a thick calcrete horizon. Finally, a warm and wet phase lead to the rapid weathering of the calcrete top layer and to the formation of reddish horizons showing moderate pedogenic development.



S01.01-P -18

PEREGLACIAL FEATURES IN SOILS IN THE NORTH OF EUROPEAN RUSSIA

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^[1]Faculty of Soil Science Lomonosov Moscow State University ~ General pedology ~ Moscow ~ Russian Federation

The primary minerals of coarse particle-size fractions comprise the bulk of the soil matrix. The specificity of their disintegration and weathering are important for the neoformation of secondary mineral phases, development of soil structure and chemical properties. The mineralogical composition of coarse fractions (1-0.01 mm) has been studied in the profiles of podzolic soils and podzols which developed on deposits of Valdai glaciation in the Kenozero National Park (Arkhangelsk region, Russia). The key plots were located in the area of geochemical junction of mixed moraines of Fennoscandian and Ural glaciations. The soils were quite rich by heavy minerals (2-17% by weight) that were mainly represented by hornblende, epidote and garnet. The distribution of primary minerals in the fractions of different particle-size fractions in all studied profiles was largely the result of minerals stability to mechanical disintegration. Quartz was the most stable mineral, grains of feldspars and hydrated biotite were easily broken down into smaller particles and concentrated in 0.05-0.01 mm size fraction. Epidote and garnet were characterized by relatively high physical and chemical stability in comparison with hornblende, which underwent intensive disintegration and weathering in the studied soils. Based on minerals distribution in the size fractions and surface morphology of the grains a following set of minerals stability in the soils of the middle taiga zone was done: quartz>garnets> epidote >feldspars>amphiboles(hornblende)>hydrated biotite. The specific morphological feature of the podzolised soils of the studied area was weakly pronounced by eluvial processes leading to weak color differentiation of these soils.



S01.01-P -19

RECENT STUDIES OF HISTORICAL AND CONTEMPORARY FIRES FROM ESTONIAN PEAT BOG PROFILES

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Studies on past climate changes from peat bog profiles have introduced newly the topic of palaeofires, since this is one of the possible source of errors when interpreting palaeohydrological records from boreal bogs. Many changes in past microtopes and their hydrological conditions inferred from plant macrofossil composition of peat can be related to the presence macroscopic charcoal in adjacent layers as the evidence of fires. The results of three case studies will be presented from bogs in Estonia: Männikjärve, Selisoo and Veskisoo. In first two bogs, 4.5 m cores were studied for plant macrofossils and charcoal, one core from each bog. In the third bog, a transect of five 35 cm top peat profiles was analysed. As for Männikjärve and Selisoo bog (NE Estonia), there is to do with a complex raised bog type with hummocks, hollows and pools. Veskisoo bog (N Estonia), instead, belongs to a non-complex Calluna-predominating bog type, near a lake in the region of extended Pinus forests on sandy soils with very high fire susceptibility. Long and short term fire histories (c. 4000 and 100 years, respectively) and changes in vegetation preceding and following fires are studied and compared. We argue that fire frequency in bogs depends on the surrounding vegetation; that shrub communities both cause and result from bog fires; and that in the lowened microtopes, the best conditions appear for dissemination of wider range of bog plant species post fire.



S01.01-P -20

SHORT TIME DEVELOPMENT OF TECHNOSOLS IN MINING ENVIRONMENT

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Soils developed from human-made substrates are of interest due to the increase of the anthropogenic activities. These soils are classically designate as technosols, (i) result generally from potentially contaminated materials, (ii) are mainly characterised by anthropogenic parent material of organic and mineral nature which origin can be either natural or technogenic. Moreover, the increasing number of sites affected by anthropogenic materials is important, and their impact on the environment is effective for plants and water resources. From these purposes, technosols require an understanding of their functioning and evolution. The aim of this study is to understanding the pedogenesis of young Technosols mine developed from a old gold mine settling basin abandoned since 1960. Wastes are highly contaminated in metals and metalloids (Pb, As and Sb). Technosols are naturally developed on it and accompanied by native vegetation. Results show clearly the soils development from short time range (40 years). Briefly, soils are weakly thick (up to 15 cm), acid with a little CEC. Geochemical behavior of various horizons is to a great extent similar between them but quite different to that of parental material. Clay minerals XRD investigations evidenced the formation of smectite in the upper horizons in a short time. Results has to be taken as an indication of a low degree of evolution of these young technosols, as already shown in the case of young volcanic soils (e.g. andosols). Discussion will be realised toward soil pedogenesis, mineralogical way (As, Sb, Pb-bearing phases, clay minerals) and physical chemical properties.



S01.01-P -21

SOILS, VEGETATION AND CLIMATE OF THE PENULTIMATE INTERGLACIAL (MOIS 7) IN UPLANDS TO THE NORTH OF THE CARPATHIANS

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Discussion whether the climate warming correlated with the MOIS 7 should be defined as cold interglacial or warm interstadial has lasted for years. In loess profiles located in 49-51°N parallel zone between 20°E and 35°E (southern Poland, north-western and central Ukraine), palaeosols occur between loess beds corresponding to the Odra and Warta glaciations. These are sets of two superimposed paleosols. In the western part of the area these soils are mainly of luvisol type in central one, the upper paleosol is podzolic chernozem, and lower - luvisol or cambisol. In the eastern part, both paleosols are chernozems. Pollen analysis of older soils indicates the plant succession from open country vegetation with spruce to loose pine-birch mixed forests. During the climate optimum, these mixed forests contained also oak, hornbeam, elm and shrubs in the western and central part of the area. In an eastward direction the number of trees was lower, and forests were replaced by forest-steppe or even steppe vegetation. The successive cooling is evidenced by the predominance of herb communities. Then forest-steppe communities developed, with an admixture of pine, birch and not numerous thermophilous trees. Both the character of paleosols and vegetation indicate that the discussed period can be defined as cold interglacial composed of two warmer periods. They were separated by the climate cooling when loess accumulation and/or slope processes were often active. The older warming was more humid and the younger one more dry. Continentality of climate increased in an eastward direction in the whole penultimate interglacial.



S01.01-P -22

SPECTRA OF GRAIN SIZE DISTRIBUTION OF PEDOARCHIVES AS AN INDICATOR FOR CULTURAL LANDSCAPE DEVELOPMENT: THE NEOLITHIC BURIAL MOUND KÖNIGSGRAB (SACHSEN-ANHALT, GERMANY)

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Buried soils and sediments (archaeosediments, colluvium, etc.) with traces of soil formation are defined as pedoarchives. They preserve information about evolution and transformation of soils and cultural landscapes. Spectra of grain size distribution (GSD) of pedoarchives, obtained by laser diffraction, are useful indicators for these processes, although methodological aspects of their application are not well developed. In present research, GSD of the embankment and modern soils was analyzed to identify mineral inputs, estimate stocks and accumulation rates of silt and sand, to identify sources of the material composing the embankment, and to relate GSD variation with land use changes. The embankment consisted of three phases: phase I (before 3650 BC), phase II (after 3650 BC) and phase III (after 3100-2700 BC). Modern soil, approximately 75 years old, has developed on the surface of the embankment and in its surrounding. GSD of modern soil horizons indicated erosional input of coarse sand and aeolian input of silt in the size range 26.3-62.5 μm . GSD of phase I showed that this material represented the remnants of Pleistocene soil, which was preserved due to specific landscape position and human activity. GSD variation within phase II pointed at aeolian accumulation of silt during its exposition. GSD of phase III suggested that deeper subsoil layers were used for its construction, implying that erosion occurred in the area approximately in the period between phases II and III. Therefore, GSD provided new information about the materials composing burial mound, about the initial state and transformation of palaeolandscapes' soils.



S01.01-P -23

STUDY WITH N AND K FERTILIZATION OF SUGARCANE RATOONS HARVESTED WITHOUT BURNING

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The harvest without burning , leaves on the soil a great amount of residues that as in other cultures protect the soil and recycle nutrients. This new condition of handling of the culture demands adjustments mainly in what concerns the more productive current varieties, also demanding more from the soil system. This way the aim is to study the answer curve of the sugarcane ratoon to the nutrients N and K in cultivation areas without burning in the third, fourth and fifth cut. The experiments were planted in factorial design with 16 treatments - four doses of nitrogen (0; 60; 120 and 180 kg/ha of N) and four potassium doses (0; 70; 140 and 210 kg/ha of K₂O) placed in randomized blocks with four replications. The portions with 75m² each. The obtained results on these three years of handling, allow to conclude that there was significant answer at the productivity due to the manuring with nitrogen and potassium. All the doses were economically profitable and doses between 120 and 140 kg/ha of the N and K were respectively more sustainable.



S01.01-P -24

THE EFFECT OF WOOD ASH FERTILIZATION ON SOIL CHEMICAL PROPERTIES AND GREENHOUSE GAS (GHG) EMISSIONS IN BOREAL PEATLAND FORESTS

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The use of energy wood harvested from forests is increasing rapidly in Finland and consequently larger amounts of wood ash is produced annually in power plants. As wood ash is alkaline and contains all the elements required for plant growth, except nitrogen, it can be utilized as fertilizer in forestry, especially in boreal peatland forests, which are naturally rich in nitrogen. The long-lasting effects of wood ash on the nutrient status and growth of conifers growing on peatlands have been reported in many studies. The use of ash excessively rich in cadmium and other heavy metals has been restricted in forestry. Improved nutrient availability and increase in soil pH can increase microbial activity and GHG emissions from ash fertilized soil. We studied the effect of wood ash fertilization on soil chemical properties, N₂O/CH₄ fluxes and ecosystem/soil respiration rates in three boreal peatland forests in Western Finland. Two of the sites were fertilized eight years before and one in the beginning of this two year- study. In addition to the field measurements, laboratory incubations were done to study the effect of variable ash doses on soil chemical properties and N₂O and CO₂ production rates. Ash addition increased e.g. soil electrical conductivity, SO₄²⁻ and PO₄³⁻ concentration, but it did not significantly change soil pH. Preliminary results show only minor effects on N₂O and CH₄ fluxes in situ but ash fertilization increased soil respiration at one site. Thus, wood ash application had minor effects on GHG fluxes even soil chemical properties were changed.



S01.01-P -25

TUBULAR CALCRETES. MORPHOLOGY AND GENESIS OF A NEW TYPE OF CARBONATE ACCUMULATION FOUND IN SOUTHWESTERN URUGUAY

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The Fray Bentos Formation, an Oligocene-Early Miocene calcareous loess-like silt deposit with paleosols and diverse pedogenic calcretes outcrops in southwestern Uruguay. A new type of tubular calcareous accumulation, apparently not referred by other authors, is here described. These calcretes consist of hard calcareous tubular units containing the silty groundmass in their cylindrical central part; the transversal section of the tubes is circular or pseudo-hexagonal about 10-30 cm in diameter and their vertical length is about 80-130 cm. These tubes are juxtaposed, frequently displaying a diagonal orientation, the whole developing horizontal levels with undulated upper and lower limits; two levels of these tubular structures are usually superposed, the vertical development of the calcrete thus reaching up to 350 cm. Observations made on exposed surfaces of the calcrete showed a circular or pseudo-hexagonal microrelief, about 300 cm in diameter, with a 20-30 cm difference in height between the microcrests and the center of the depressions. Several morphological features of this carbonate accumulation –particularly an upper limit related to a normal gilgai microrelief and tubular units deviated from the vertical related to deep cracks and argilliturbation- together with the mineralogical nature of the sediment suggest a previous development of Vertisols. The tubes are thus interpreted as calcareous infillings due to the carbonate solubilization from overlying deposits, thus fossilizing a fissure pattern of a pedogenic paleosurface. The paleoclimatic implications of these original pedogenic calcretes are discussed.



S01.01-P -26

ZINC UPTAKE EVALUATION BY MAIZE PLANT AND DETERMINATION OF CRITICAL LEVEL IN CALCAREOUS SOILS OF IRAN

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From the main families of calcareous soils , 25 points studied for determination of Zinc critical level and evaluation of zinc fertilizations effects on maize uptake with the goal of supply better nutrition conditions and balanced application of chemical fertilizers in this province. The main families of soils were Loam and clay-loam and in Inceptisol series. The pH of the soils obtained in the range of 7.5-8 and available Zn obtained at the range of 0.01-2.05 mg kg⁻¹. pot experiment of Singel Crass 704 maize plant was done in the complete randomized design with three replications and two treat of zero and zinc (20 ppm) and irrigation with distilled water. After harvesting, the zinc uptake and the amount of zinc in maizes were measured by dry ashing method. The average amount of zinc by maizes was 28.71 mg kg⁻¹ in blank treats and 84.02 in fertilized treats. The amounts of zinc uptake also obtained 49.8 in blank treats and 110.8 µg g⁻¹ of plant in fertilized traets. The critical level of zinc obtained 0.37 mg kg⁻¹ by Cate-Nelson method.



S01.02-P - WETLAND, FLOODPLAIN, RIPARIAN SOILS: PROPERTIES, PROCESSES AND ECOLOGICAL FUNCTIONS

Thursday 05 July 2012 from 17:00 to 18:30. Room Poster Areas

S01.02-P -1

BIOGEOCHEMISTRY OF METALS IN RIVER FLOODPLAINS AND CONSEQUENCES FOR BIOAVAILABILITY FOR PLANTS AND SOIL ORGANISMS

Sjoerd Van Der Zee, Wageningen - Netherlands

S01.02-P -2

CARBON DYNAMICS IN SOIL AND FINE ROOT BIOMASS OF RIPARIAN FORESTS

Isaak Rieger, Berlin - Germany

S01.02-P -3

CATEGORIZING BASIC FACTORS DRIVING SOIL GENESIS, PEDOVARIABILITY AND PLANT ASSEMBLAGES IN MEDITERRANEAN TEMPORARY WETLANDS (TWS)

Gian Franco Capra, Nuoro - Italy

S01.02-P -4

DRAINAGE EFFECTS ON LABILE ORGANIC CARBON FRACTION IN TOPSOIL OF PEATLANDS

Barbara Kalisz, Olsztyn - Poland

S01.02-P -5

HIGH-RESOLUTION MONITORING OF THE AIR- AND WATER BALANCE IN A CALCARIC GLEYSOL OF THE MARSH IN SCHLESWIG-HOLSTEIN, NORTHERN GERMANY

Kristof Dorau, Cologne - Germany

S01.02-P -6

HOT ZONES OF SOIL NITROGEN CYCLING IN FLOODPLAINS OF A PERIALPINE RIVER

Joerg Luster, Birmensdorf - Switzerland

S01.02-P -7

IMPACT OF RIVER RESTORATION ON CARBON STORAGE IN SWISS FLOODPLAINS

Geraldine Bullinger-Weber, Lausanne - Switzerland



S01.02-P -8

IMPACTS OF SURFACE MINING ON PEATLAND FUNCTIONS AND RECONSTRUCTION OF NEW ECOSYSTEMS IN THE OIL SAND DEVELOPMENT AREA OF NORTHEASTERN ALBERTA.

Felix C. Nwaishi, Waterloo - Canada

S01.02-P -9

INFORMATIVENESS OF THE COMPOSITION OF LYSIMETRIC WATER

Galina Motuzova, Moscow - Russian Federation

S01.02-P -10

INVESTIGATION OF THE ENVIRONMENTAL CHANGES PRODUCED BY HUMAN ACTIVITY ON EXAMPLES OF A SODIC LAND AND A KARST LAND

Tünde Nyilas, Szeged - Hungary

S01.02-P -11

LAND USE DURATION DIFFERENTIALLY AFFECTS WETLAND SOIL PRODUCTIVITY IN EAST AFRICA

Christian Dold, Bonn - Germany

S01.02-P -12

RESTORATION OF ECOLOGICAL FUNCTIONS IN A WET MEADOW ON PEAT SOIL: A 3 YEARS POST OPERATION SURVEY IN THE ESTUARY OF SEINE RIVER (FRANCE).

Chockri Mchergui, Rouen - France

S01.02-P -13

SOIL CARBON AND NUTRIENT CYCLING IN SOUTHEASTERN AUSTRALIAN RIPARIAN ZONES

Timothy Cavagnaro, Melbourne - Australia

S01.02-P -14

SOIL PROPERTIES AND WATER DISCHARGE NO₃- UNDER INTENSIVE IRRIGATED AGRICULTURE IN A DEGRADED SEMI-ARID MEDITERRANEAN CATCHMENT

Juan José Jiménez, Jaca - Spain

S01.02-P -15

USE OF CONSTRUCTED WETLANDS FOR TREATING RUNOFF FROM PEAT EXTRACTION AREAS

Heini Postila, Oulu - Finland



S01.02-P -16

WATER EXTRACTABLE ORGANIC MATTER IN A RECENTLY RESTORED FLOODPLAIN: THE CASE OF THE THUR RIVER IN NORTHERN SWITZERLAND

Hans-Rudolf Pfeifer, *Lausanne - Switzerland*



S01.02-P -1

BIOGEOCHEMISTRY OF METALS IN RIVER FLOODPLAINS AND CONSEQUENCES FOR BIOAVAILABILITY FOR PLANTS AND SOIL ORGANISMS

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Dutch river floodplains are, just as in many other countries, contaminated with metals. Usually, contamination levels for heavy metals are such that interactions with the solid soil phase is predominantly in the form of sorption, rather than chemical precipitation. The biogeochemistry of heavy metals, and others such as Al, Fe, and Mn, is strongly affected by the seasonal sequence of droughts and flooding and the associated redox potential Eh changes. However, depending on soil properties, such seasonal changes cannot always be simply translated into those of Eh. In a field scale experimental monitoring effort in combination with advance modeling, it was possible to show quite good agreement between measured and modeled heavy metals' concentrations in soil solution. More importantly, it revealed important and not yet understood discrepancies for certain components such as Pb and As. Considering bioavailability of different metals for plants and ecosystems, usually at non-lethal levels, reveal that aerenchymic wetland plants may react quite differently from others that require aerobicity in the root zone. Heavy metal uptake by soil organisms such as nematodes, which are often considered to well represent soil health, may be described with relatively simple models. Alternatively, experimental research on uptake by Collembola requires assays that must be well thought through, to avoid artefacts. Some gaps in experimental data that are perceived as critical are identified in this presentation.



S01.02-P -2

CARBON DYNAMICS IN SOIL AND FINE ROOT BIOMASS OF RIPARIAN FORESTS

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Riparian forests are characterized by high organic carbon stocks in soil and vegetation. At the same time, floodplain ecosystems are subjected to human alterations such as dike construction which may have profound impact on carbon cycling. In this study, we studied historic and current carbon dynamics in river sediments and fine root biomass of riparian forests in Donau-Auen National Park, Austria. Overall, 96 trees of four dominant tree species and adjacent soils were sampled for dendrochronologic and dendrogeomorphologic analyses along a lateral gradient from the Danube main channel at both sides of the Marchfeld dike. Tree age and depth of the stem base below ground were used to estimate historic carbon sedimentation rate. Actual sedimentation rate was determined in 48 sediment traps. In addition, we measured the carbon pool of fine root biomass in soil samples and carbon growth rate of fine root biomass using ingrowth cores. First results indicate that historic sedimentation rates of organic carbon significantly decreased with greater distance from the next river channel. Moreover, historic annual carbon sedimentation rates of soil in inactive floodplain ($1.5 \text{ t ha}^{-1} \text{ a}^{-1}$) areas were significant lower than in active floodplain forests ($2.9 \text{ t ha}^{-1} \text{ a}^{-1}$). Also, current carbon pool of fine root biomass in inactive floodplain (3.6 t ha^{-1}) was significant lower than in active floodplain (6.5 t ha^{-1}). Our study highlights the role of river dynamics for soil and fine root carbon accumulation as dike construction proved to reduce allochthonous carbon input through sedimentation and fine root biomass.



S01.02-P -3

CATEGORIZING BASIC FACTORS DRIVING SOIL GENESIS, PEDOVARIABILITY AND PLANT ASSEMBLAGES IN MEDITERRANEAN TEMPORARY WETLANDS (TWS)

Capra Gian Franco^[1], Caria Maria Carmela^[1], Buondonno Andrea^[2], Seddaiu Giovanna^[3], Vacca Sergio^[1], Bagella Simonetta^[1]

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A research was carried out in six Temporary Wetlands (TWs), located in north-western Sardinia (Italy), with the aim to categorize the basic factors driving and linking soil genesis and plant assemblages in Mediterranean basin. In order to satisfy such purpose the main hydrologic parameters as well as soil properties, pedogenic features and vegetation patterns were deeply investigated. Within each TW a central (CB, located on the toe slope), intermediate (IB, on foot/back slope), and outer (OB, on summit) belt was recognized. Soil morphology and pedovariability changed clearly along each OB/IB/CB transect, highlighting evidence of a distinctive soil micro-catena, i.e. from the poorly developed Entisols at the summit to the more evolved Alfisols at the toe slope. Indeed, CB and OB were very clearly defined pedo-environments, with soils belonging either to strongly developed Alfisols or poorly evolved Entisols, respectively, while, the IB seems represents a sort of pedo-transitional environment from OB to CB. The statistical analyses (ANOVA and ANOSIM) performed on the investigated soil physical-chemical parameters showed no significant differences between belts. On the opposite, the ANOSIM analyses of the contribution of each plant species to vegetation cover showed significant differences between belts. The overall correlation (managed by PCA), of the investigated parameters, i.e. topography, hydrology, soils and vegetation reasonably indicates that the combined effect of topography and hydrology acted as primary factors governing soil and vegetation in a complex relationships/feed-backs network, thus combining soil evolution and the subsequent vegetation assemblage, and finally determining belt differentiation.



S01.02-P -4

DRAINAGE EFFECTS ON LABILE ORGANIC CARBON FRACTION IN TOPSOIL OF PEATLANDS

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Labile organic carbon compounds are easily oxidizable and degradable, i.e. are cycling up to several years in the environment. One of labile organic carbon compounds is carbon extracted with hot and cold water. Water-extractable organic carbon fractions contain a wide spectrum of organic compounds such as aminoacids, saccharides, aminosugars and hemicelluloses. Although it does not include complete labile fraction (only water-soluble organic compounds) it is a good indicator of organic matter quality as it corresponds with microbial biomass, total organic carbon and carbon dissolved in peatland waters. Hot and cold water-extractable organic carbon fractions were analysed in field moist and air-dried soil samples taken from topsoils of peatland drained 150 years ago. As all organic soils after drainage, the peatland had undergone the process of organic matter transformation, known as muck-forming process. During this process, intense mineralization and secondary humification of organic matter took place. The contents of cold and hot water-extractable organic carbon fractions did not exceed 1% and were correlated with total organic carbon. The amount of water-soluble organic compounds was higher in air-dried samples than in field moist soil samples. The obtained results confirmed earlier studies that although water-extractable carbon accounts for a small part of organic matter, it is a good indicator of changes.



S01.02-P -5

HIGH-RESOLUTION MONITORING OF THE AIR- AND WATER BALANCE IN A CALCARIC GLEYSOL OF THE MARSH IN SCHLESWIG-HOLSTEIN, NORTHERN GERMANY

Dorau Kristof^[1]

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The interactions between the atmo-, hydro-, bio- and pedosphere affect the dynamics of the air- and water balance in soils at a small temporal and spatial scale. Because of high costs there are only few high-resolution measurements. This study was conducted to identify the key-processes of water balance and movement in the marsh of Schleswig-Holstein, Northern Germany. With HYDRUS-1D a soil hydraulic model was parameterized and validated. For this purpose, some meteorological parameters, soil matric potential and water table depth were recorded hourly in a non-cultivated calcaric Gleysol developed from marine sediments from April 2010 to March 2011. Matric potential was measured in 10, 20, 30, 60, 100 and 150 cm depth with newly constructed pF-meter and converted to water contents using van Genuchten equation. Our results show that besides seasonal changes in water content specific event (movement of wetting front after rainfall event) and cyclic processes (scheme of capillary rise due to diurnal temperature differences) takes place. High reference evapotranspiration (711 mm) results in capillary rise from shallow groundwater which causes strong annual variations from 5 cm to below 200 cm water table depth. However, it can be seen that in dry years plant available water is sufficient within the profile but oxygen is the limiting factor for plant growth. With a Nash-Sutcliffe coefficient ranging from 0.82 in 10 cm depth to 0.99 in 150 cm depth the model was successfully applied. Hence, HYDRUS-1D can be used at sites with high groundwater dynamic to predict water- and air balance.



S01.02-P -6

HOT ZONES OF SOIL NITROGEN CYCLING IN FLOODPLAINS OF A PERIALPINE RIVER

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Evaluating ecosystem services of river floodplains such as provision of drinking water and climate regulation needs to consider soil properties and processes. Although many studies have addressed denitrification in floodplain soils, comprehensive assessments of nitrogen cycling are rare. The floodplains of the perialpine Thur River in NE Switzerland are characterized by a flood pulse regime with short floodings and long base-flow conditions during which soils are mostly unsaturated. We characterized N pools, transformation rates and fluxes in soils of different parts of adjacent channelized and restored river sections. The results revealed two zones within the restored section with often increased N cycling when compared to the rest of the floodplain: (i) an alluvial forest where fine soil texture probably favors the preservation of anaerobic conditions in micro sites during generally unsaturated conditions, and (ii) a gravel bar zone characterized by frequent flood disturbance with high sediment deposition. Here, deposition of unstructured sediments and litter production linked to a flooding event appear to be responsible for temporary increases in available organic matter which in turn trigger an acceleration of N turnover. As a consequence of this and of a large small-scale heterogeneity in terms of geomorphology, soil properties and environmental conditions, concurrent hot spots of mineralisation, nitrification and denitrification (including related N₂O efflux) can occur. With respect to their filter function, our results emphasize that nutrient rich floodplain soils which are unsaturated most of the times have to be considered both a sink and a source of potentially harmful nitrogen species.



S01.02-P -7

IMPACT OF RIVER RESTORATION ON CARBON STORAGE IN SWISS FLOODPLAINS

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Floodplain restoration is becoming more important worldwide and in Switzerland several projects have been implemented to maintain or recreate their ecological functions, in particular flood protections and biodiversity. At present time little is known about the potential of floodplain soils to release or to accumulate carbon that are strongly influenced by fluvial dynamics and land use. The aim of this study is to quantify and better understand carbon storage within alluvial soils according to a pedological gradient (in situ pedogenesis duration) in more or less deeply human-impacted floodplains. We hypothesize that in near-natural floodplains, this pedological gradient lead to i) an increase of organic carbon concentration and stocks in the topsoil ii) a stabilization of organic carbon in the smallest granulometric fraction (<0.25 mm). A successful river restoration should recreate such a carbon storage gradient. We tested these hypotheses using three different sites, a near-natural floodplain along the Rhine River and two restored floodplains along the Thur and Emme Rivers. Preliminary results show that in near-natural floodplain, organic carbon concentration increases along the pedological gradient. For the Emme floodplain, the same trend is noticed whilst for the Thur, no statistical difference is found among soil types composing this gradient. These different patterns can be explained by both physico-chemical pedological parameters and fluvial dynamics resulting from the river restoration characteristics (length and width of the widening).



S01.02-P -8

IMPACTS OF SURFACE MINING ON PEATLAND FUNCTIONS AND RECONSTRUCTION OF NEW ECOSYSTEMS IN THE OIL SAND DEVELOPMENT AREA OF NORTHEASTERN ALBERTA.

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^[1]Wilfrid Laurier University, Cold Regions Research Centre ~ Geography and Environmental Studies ~ Waterloo ~ Canada ^[2]University of Waterloo ~ Department of Geography and Environmental Management ~ Waterloo ~ Canada

Peatlands represent more than 45% of the landscape in northeastern Alberta, Canada. These peatlands provide vital environmental services such as carbon sequestration and water cycling within the Boreal Plain ecozone. Extraction of oil (bitumen) through surface mining forms a major disturbance to peatland ecosystems in this region and could lead to irreversible damage on the functions of these ecosystems. As the persistence of this disturbance remains certain, this study focuses on its impact on peatland ecosystem functions and the feasibility of engineering a new ecosystem in the post-mined landscapes. The vital environmental services provided by peatlands in this region and the footprints of the disturbance from oil sand extraction are discussed and major components of current research on the reconstruction of the disturbed landscapes to a functional ecosystem are highlighted. The discussion from this study presents an overview of the disturbances perpetrated by oil sand development projects, and provides preliminary information on reclamation projects being implemented by the energy sector to reduce the environmental impacts of their activities on peatland ecosystem functions.



S01.02-P -9

INFORMATIVENESS OF THE COMPOSITION OF LYSIMETRIC WATER

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Soil lysimetric waters are informative indicator of the status of any landscape. The results of the investigation of water of Ivankovsky reservoir, ground water and lysimetric water of soddy soils from the coastal zone have served as the evidence of the correctness of this thesis. Content of SO₄²⁻ in lysimetric water decreased in comparison with atmospheric precipitation due to their sorption by soil; of NO₃⁻ - because of their involving in biological turnover. Lysimetric waters have relatively high concentration of phosphates and potassium, mainly due to the past agricultural use of soils. Water-soluble organic substances reach ground waters in limited quantities. Concentration of trace elements in soil lysimetric water is low because of the poverty of parent rocks by them. Migration of metals in soil is limited mainly because of neutral reaction. The greatest concentration of ions Fe³⁺ is observed in lysimetric waters, because of formation of complexes with organic substances. Zinc and copper concentration in ground water is higher than in lysimetric water. It can be consequence of coastal filtration of metals from water reservoir, where their concentration often is rather high. Concentration of Ca²⁺, Mg²⁺ in water from reservoir is higher than in lysimetric water. In spring they are enriched by Na⁺, Cl⁻, SO₄²⁻, that have technogenic origin. These results have shown that lysimetric waters characterize the flows of substances which bind together atmospheric precipitation, soil solutions and ground waters.



S01.02-P -10

**INVESTIGATION OF THE ENVIRONMENTAL CHANGES PRODUCED BY HUMAN ACTIVITY
ON EXAMPLES OF A SODIC LAND AND A KARST LAND**

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^[3]SoilChem Agricultural and Environmental Laboratory ~ - ~ Mórahalom ~ Hungary ^[4]Museum of the Three Rivers Land ~ - ~ Oradea ~ Romania

Nowadays natural habitats are imperilled because of human landscape-transformer processes and negative effects of climate change. Watery habitats belong to the most vulnerable lands because low rate of anthropogenic effects can lead to significant and fast changes in these places. Lake Nagyszéksós (sodic lake, Mórahalom, SE Hungary) and Püspökfürdő (karst lake with thermal spring-water, Oradea, NW Romania) are two examined areas with different environmental conditions. In contrast with 'Püspökfürdő' Lake Nagyszéksós is influenced by anthropogenic effects in lower degree. Conditions of two watery habitats and anthropogenic effects in dynamics of environmental and ecological processes are examined in the project. Paleoecological analysis, soil- and water-chemical measurements and geological examinations are carried out in the areas. Based on laboratory measurements and field studies we are able to do comparative analysis and examine the evolution of the areas. Aims of our work are to classify ecological potential, to define the rate of degradation and to determine ecological function of the natural habitats. Using results of this research, numerous ecological changes can be forecasted. These forecasts can promote the development of a sustainable land use concept in case of Lake Nagyszéksós. Results give possibility to sustainable development of tourism investments and operation in case of Püspökfürdő. The international realization of the project is supported by the Hungary-Romania Cross-Border Co-operation Programme of the European Union in 'Exploration and Comparative Analysis of the Effects of Regional Climate Change at Watery Habitats' project (HURO/0901/207/2.2.2). Some measurements was supported by the Hungarian Scientific Research Found (K 81181).



S01.02-P -11

LAND USE DURATION DIFFERENTIALLY AFFECTS WETLAND SOIL PRODUCTIVITY IN EAST AFRICA

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In the face of land shortages, progressing upland degradation and climate change effects, the agricultural potential of wetlands has recently been recognized in East Africa. As a result, pristine wetlands are increasingly cleared from vegetation and converted into sites of production. If production levels can be sustained is likely to depend on environmental factors, the wetland type and the land management. We assessed crop production potential and parameter changes in the solution and solid phase of wetland soils under different types (unused, grazed, cropped) and durations (0-30 years) of land use in floodplains, inland valley swamps and littoral lakesides of East Africa between 2008 and 2011. Most dramatic changes in solution phase parameters (ion exchange resins) and crop production (maize/rice/forage grass biomass in potted soil) were observed from lowland sites and in the coarse-textured soils of floodplains, starting seven years after drainage and/or use. Heavy clay soils from highland valley swamps and sites where anaerobic conditions were maintained (rice / taro) appeared to be more resilient to land use changes but also show distinct declines in total C and N pool sizes after 20-30 years of use. In the littoral region of the rift valley lakes, both maize and forage grass appeared to be affected by soil pH and EC than by land use duration. We conclude that agriculturally used wetlands differentially respond to conversion and use and that wetlands' vulnerability or resilience depends on wetland type, soil texture, and the soil aeration status.



S01.02-P -12

RESTORATION OF ECOLOGICAL FUNCTIONS IN A WET MEADOW ON PEAT SOIL: A 3 YEARS POST OPERATION SURVEY IN THE ESTUARY OF SEINE RIVER (FRANCE).

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The restoration of biodiversity and its functions in human-disturbed wetlands is an important ecological topic. We surveyed the ecological restoration of a sandpit in the low valley of the Seine River (France) in order to (i) recreate a wet meadow and (ii) study dynamics of restored soils and associated ecological functions. The sandpit was filled with Seine River sediment and covered with alkaline peat by hydraulic way. Several ecological parameters were assessed and more specifically structural parameters (soil physico-chemical properties, plants, collembola and earthworms communities) and functional parameters (plants biomass, C and N mineralization, denitrification process). This communication focuses on the comparison of C and N dynamics in restored peat soils. The restoration of the sandpit leads to the formation of two types of peat soils: (i) hemic Histosol and (ii) interstratified hemic Histosol. This result is related to the variability of sediment and the peat deposition by hydraulic way. These soils show differences in their functioning in relation with C and N dynamics: (i) C mineralization is always lower in the restored meadow than in a reference meadow, (ii) a strong response of denitrification process since to the beginning of inundation gradient controlled by topography, (iii) denitrification in the Hemic Histosol was greater than in the interstratified hemic Histosol. The initial heterogeneity in terms of soil physico-chemical properties and flood frequency level seems determinant on C and N dynamics. Initial soil properties and actual soil functioning can be therefore factors controlling the future dynamics trajectories.



S01.02-P -13

SOIL CARBON AND NUTRIENT CYCLING IN SOUTHEASTERN AUSTRALIAN RIPARIAN ZONES

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Riparian zones represent the last point in the landscape to intercept nutrients and sediments before they enter water bodies. The cycling of nutrients in these sites is, therefore, important. Here we present results of a series of field based experiments. In the first experiment we undertook a detailed survey of soil C sequestration and nutrient cycling at 18 riparian sites that were restored, un-restored or in remnant condition. We found that riparian restoration not only resulted in a build up in soil C, but that the nature of adjacent land use was a major determinant of nutrient dynamics in these sites. In the second experiment we investigated in detail the nature and properties of a soil and nutrient dynamics at the riparian - agriculture interface. Soil physicochemical and vegetation properties were spatially heterogeneous along the gradient sampled. Importantly, both stocks and forms of soil C (measured using ¹³C NMR) varied considerably along this gradient. Furthermore, easily measurable soil and vegetation properties that could be used to predict soil C concentrations at this site were identified using a Bayesian modelling approach. The present paper highlights the dynamic nature of soil processes, the importance of changes in soil properties at interfaces in the landscape, and the need for spatially explicit studies of soil nutrient cycling.



S01.02-P -14

SOIL PROPERTIES AND WATER DISCHARGE NO₃- UNDER INTENSIVE IRRIGATED AGRICULTURE IN A DEGRADED SEMI-ARID MEDITERRANEAN CATCHMENT

Jiménez Juan José^[1], Pedrocchi César^[1], Navarro Enrique^[1], Causapé Jesús^[2], Comín Francisco A.^[1]

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Semi-arid lands are being transformed to irrigated agriculture to increase crop production and improve rural livelihoods, but also impacting soil (salinization) and aquatic ecosystems (fertilizer and pesticide water runoff to natural water streams). Changes in the diversity of specific soil and aquatic communities can affect delivery of impair ecosystem services. In this study, soil and water related variables were measured along a gradient within a small catchment in the Lerma valley (Zaragoza, NE Spain). Soil pH, texture, soil organic carbon (SOC), soil inorganic carbon (SIC), organic matter fractionation, near infrared spectra (NIRS), elemental analysis, and the presence of terrestrial arthropods were assessed. Ecotoxicological tests were performed with algae to assess irrigation impact of NO₃- excess from adjacent agricultural fields on aquatic ecosystems. SOC concentration was lowest in sediments and highest under natural vegetation. NIRS signals allowed differentiation of mineral soil samples and invertebrate biogenic structures. NO₃- concentration in the lower zone of the catchment has increased during the period 2004-2010 at a yearly rate of 6 mg l⁻¹ and currently has stabilized at 80 mg l⁻¹. Specific conductivity and dissolved NO₃- increased from the uppermost non-irrigated areas (200-400 µS cm⁻¹; 0.1-14 mg L⁻¹) to the intensively irrigated zones (1,800-5,000 µS cm⁻¹; 15-130 mg L⁻¹). Soil arthropod composition differed between sites and dates, and algae growing in the bank-gully showed an increased tolerance to pesticides. These results led to the identification of degradation hotspots related to ecological functions, allowing us to propose corrective measures to reduce nitrate discharge, and biodiversity loss.



S01.02-P -15

USE OF CONSTRUCTED WETLANDS FOR TREATING RUNOFF FROM PEAT EXTRACTION AREAS

Postila Heini^{*[1]}, Karjalainen Satu Maaria^[2], Heikkinen Kaisa^[2], Saukkoriipi Jaakko^[2], Kuoppala Minna^[2], Visuri Mika^[2], Ihme Raimo^[2], Klöve Björn^[1]

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The aim of the study was to find out how wetlands established to ditched peatland areas, can be used for treating runoff from peat extraction areas. Peat extraction result in harmful loads of phosphorous, nitrogen and suspended matter. The study included six drained wetlands, which were examined for e.g. the hydraulic properties of peat, vegetation, peat thickness, the degree of humification of peat, and the mineral concentrations of peat. The wetlands were also monitored for their capability to remove e.g. nutrients, iron and suspended solids from the runoff. Sampling was carried out by taking water samples from incoming and outgoing water. The results showed that wetlands established to ditched peatland areas, can purify peat extraction runoff. The wetlands retained inorganic nitrogen from the runoff, but some of them leached especially phosphorus, iron and humic substances. When planning wetlands for water purification purposes to ditched peatland areas, attention should especially be paid to the properties of peat (e.g. the concentrations of P, Fe, Al, Mg, Ca, Mn), and the peat thickness in relation to the depth of the ditches.



S01.02-P -16

WATER EXTRACTABLE ORGANIC MATTER IN A RECENTLY RESTORED FLOODPLAIN: THE CASE OF THE THUR RIVER IN NORTHERN SWITZERLAND

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This work was undertaken to determine the effects of bed restoration on the alluvial ecosystem of the river Thur. Water extractable organic matter (WEOM) was used as a potential tracer of the degree of stability of the organic matter of the restored river bed. Nine soil cores of 40 cm length were collected along a 200 m traverse perpendicular to the river, covering the various habitats and including a reference soil corresponding to the situation before restoration. Major and trace metals, total organic and inorganic carbon (TOC/TIC), and total nitrogen TN were analysed. WEOM was obtained from each 10 cm thick soil by a water extraction in the laboratory (water/soil ratio = 1 : 2.5) and then studied with UV/Vis absorption and 3D-fluorescence spectroscopy. Results showed a decrease of WEOM concentrations with depth, especially in undisturbed habitats, such as mixed forest and pasture. A relatively low, almost constant C/N ratio of about 10 was observed. 3D-UV/vis fluorescence results showed a dominance of protein-like fluorophores close to the active river bed, and a humification index HI close to 3 and fulvic-like fluorophores, as well as an increase of humification (HI= 4 to 5) in the habitats farther away. However there is only little variation with depth (HI oscillating +/- 1), indicating that highly reactive organic matter with a rapid turnover dominates and that the system is far from stability. Nevertheless, this type of study allows to delimit the active section of the restored floodplain.



S01.03-P - EVOLUTION AND PROPERTIES OF PADDY AND WETLAND SOILS

Thursday 05 July 2012 from 17:00 to 18:30. Room Poster Areas

S01.03-P -1

CHANGES IN THE IRON MINERAL ASSEMBLAGE UPON 2000 YEARS OF PADDY CULTIVATION

Vanessa Vogelsang, Halle - Germany

S01.03-P -2

DOES CROP RESIDUE MANAGEMENT INFLUENCE FERTILIZER USE EFFICIENCY IN IRRIGATED RICE?

Dario Sacco, Grugliasco - Italy

S01.03-P -3

DRIVING FACTORS OF SOIL FERTILITY IN MOUNTAIN TERRACED PADDY FIELDS OF YUANYANG (CHINA)

Colinet Gilles, Gembloux - Belgium

S01.03-P -4

EFFECT OF WATER MANAGEMENT ON DYNAMICS OF RECENTLY FIXED C IN PLANT-SOIL SYSTEM AND MICROBIAL COMMUNITY AT DIFFERENT STAGES OF PLANT GROWTH

Jing Tian, Göttingen - Germany

S01.03-P -5

EVOLUTION OF MAGNETIC PROPERTIES AND THEIR PEDOGENETIC IMPLICATIONS FOR THE PADDY SOIL CHRONOSEQUENCES FROM DIFFERENT PARENT MATERIALS IN SOUTH CHINA

Gan-Lin Zhang, Nanjing - China

S01.03-P -6

INCREASED CO₂ FLUXES UNDER WARMING TESTS AND SOIL SOLUTION CHEMISTRY IN A HISTIC CRYOSOL FROM SALLUIT, NUNAVIK (QC, CANADA)

Julien Fouché, Aix en Provence - France



S01.03-P -7

LIMITATION OF MECHANICAL ANALYSIS OF SHRINKAGE AND SWELLING OF PADDY SOIL - FROM THREE YEARS MONITORING OF WRC IN A PADDY FIELD-

Shuichiro Yoshida, Tokyo - Japan

S01.03-P -8

MAGNESIUM SULPHATE VERTIC PADDY SOILS IN THE NIGER RIVER VALLEY (KOLLO, NIGER)

Issifou Adam, Rennes - France

S01.03-P -9

MECHANISMS OF PADDY SOIL CRACKS GENERATION AND ITS CONSEQUENCES ON PREFERENTIAL FLOW

Xinhua Peng, Nanjing - China

S01.03-P -10

MODELING THE FATE OF PESTICIDES IN PADDY RICE – FISH POND FARMING SYSTEMS IN NORTHERN VIETNAM

Marc Lamers, Stuttgart - Germany

S01.03-P -11

NITROGEN AVAILABILITY IN FERTILIZED PADDY SOILS AS A FUNCTION OF REDOX CONDITIONS AND RICE STRAW INCORPORATION

Maria Alexandra Cucu, Grugliasco - Italy

S01.03-P -12

ORGANIC CARBON ACCUMULATION IN A 2000-YEAR CHRONOSEQUENCE OF PADDY SOIL EVOLUTION

Livia Wissing, Freising - Germany

S01.03-P -13

PHYSICO-CHEMICAL PROPERTIES OF PEAT SOIL AT DIFFERENT DEGREE OF ORGANIC MATTER DECOMPOSITION IN DEEP SOIL PROFILES

Anna Szafranek-Nakoneczna, Lublin - Poland

S01.03-P -14

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S01.03-P -1

CHANGES IN THE IRON MINERAL ASSEMBLAGE UPON 2000 YEARS OF PADDY CULTIVATION

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More than 9% of the world's arable land is used for rice production (IRRI, 2002), mainly under temporarily submerged conditions (paddy soils). In consequence, distinct redox cycles cause redox-related transformations of Fe hydrous oxides and Fe-bearing clay minerals. We studied changes in the Fe mineral assemblage as evoked by long-term reduction–oxidation cycles along a chronosequence of paddy soils (100, 700 and 2000 year old paddy soils) developed in comparable parent material in the province of Zhejiang, China. Quantitative speciation of Fe mineral phases in top- and subsoil was accomplished by Mössbauer spectroscopy at room temperature and 4.2 K, in combination with x-ray diffraction and selective chemical extractions (DCB, NH₄-oxalate). We found ferrous and ferric iron in silicates, nano- to microcrystalline goethite and haematite, as well as a ferrihydrite-type phase. Prolonged paddy cultivation resulted in an overall loss of Fe hydrous oxides in the topsoil, whereas the Fe mineral assemblage in the subsoil was dominated by increasing contents of microcrystalline goethite. Losses of silicate Fe were slightly higher in the top- than the subsoil. We conclude that long-term submerged rice cultivation leads to re-distribution of Fe mineral phases, obviously resulting from the decoupling of top- and subsoil processes.



S01.03-P -2

DOES CROP RESIDUE MANAGEMENT INFLUENCE FERTILIZER USE EFFICIENCY IN IRRIGATED RICE?

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Although nitrogen (N) supply drives productivity, poor N fertilizer-use efficiency (FUE-N; 40–60% recovery of applied N) is characteristic of irrigated rice systems. N availability over the cropping season depends on N fertilizer management as well as mineralisation, microbial immobilisation and losses, affected, in turn by agricultural practices such as water and crop residue management. In this work, N uptake by irrigated rice under different crop residue management practices have been compared with the aim of defining best management practices able to enhance FUE-N. The experiment carried out on an ongoing long-term trial in Vercelli (NW Italy), involved comparison between: (i) incorporation of residues in autumn after harvest; (ii) incorporation of residues in spring; (iii) burning of residues after harvest and incorporation in spring; (iii) incorporation of residues in spring and delayed flooding (dry seeding). Fertilizer-N uptake and efficiency during the growing cycle was evaluated by ¹⁵N isotope dilution and difference methods. Early incorporation of crop residues fosters the capability of soil to supply fertilizer- and soil-derived N, essential for increasing N uptake. This was facilitated by the faster and more consistent decomposition of the crop residues during the fallow period, thus limiting fertilizer N immobilisation during the growing season. Burning of crop residues adopted when early incorporation is difficult due to rainfall and/or snow precipitations, will avoid the reduced N availability and consequent reduction in crop growth and N uptake resulting from spring incorporation. Dry seeding did not result in greater N availability for crop uptake, as expected.



S01.03-P -3

DRIVING FACTORS OF SOIL FERTILITY IN MOUNTAIN TERRACED PADDY FIELDS OF YUANYANG (CHINA)

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In order to assess the sustainability of agrosystems in the famous Hani terraces in Yunnan Province, our research activities focus on the assessment of the soil fertility levels and the discrimination between natural and anthropic determinism of soil nutrient status. As a first step, the soil organization in the landscape, according to geology and relief, was studied after a geomorphopedological approach. The main soil types were identified and classified according to the most recent FAO international classification standards. The soil potentiality and edaphic constraints were assessed by laboratory analysis. Soil fertility diagnosis appears homogeneous in space. Soils are acid, cation exchange capacity and nutrient reserves are low. However, the agrosystem developed by the Hani population has succeeded in maintaining a relatively efficient dynamic of element circulation. Future prospects should focus (i) on the evaluation of the representativeness of the studied area compared to the whole terraced system, (ii) on the measurements of nutrients flows at field scale, (iii) on the effects of soil properties on yields of cultivated crops, and finally (iv) on the up-scaling of field levels results to broader spatial units.



S01.03-P -4

EFFECT OF WATER MANAGEMENT ON DYNAMICS OF RECENTLY FIXED C IN PLANT-SOIL SYSTEM AND MICROBIAL COMMUNITY AT DIFFERENT STAGES OF PLANT GROWTH

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Water management in rice field is becoming more and more important because more than 2/3 of water will be used for irrigation worldwide. We used $^{14}\text{CO}_2$ and $^{13}\text{CO}_2$ pulse labelling to investigate the effect of water conditions on the distribution of carbon (C) recently assimilated by rice within the plant-soil system and its influence on the soil microbial community under paddy soils. Rice plants were grown under three water treatments: flooded (4-5 cm water level), unflooded (80-85% WHC), and alternating (dry period: 75% WHC; wet period: 4-5 cm water level). The flow of assimilated C from plants to soil C pools was studied at two stages of plant growth: tillering and booting. To distinguish between those stages, plant shoots were pulse labelled with $^{14}\text{CO}_2$ at tillering and with $^{13}\text{CO}_2$ at booting. The ^{14}C activity and ^{13}C content in different C pools were determined 4 times within 14 days after each pulse. Furthermore, microbial community for each treatment was analyzed phospho-lipid-fatty acids (PLFA). The transport of the fixed C from shoots to belowground C pools was very fast for the flooded treatment: ^{14}C decrease in the shoots exponentially within 14 days after the labeling. Comparison of ^{14}C and ^{13}C fluxes showed different partitioning and allocation of recently assimilated C at tillering and booting. Flooding regimes have strong effects on the turnover rates of root-derived C in soil. High proportions of fungal PLFAs were observed for the alternating treatment.



S01.03-P -5

EVOLUTION OF MAGNETIC PROPERTIES AND THEIR PEDOGENETIC IMPLICATIONS FOR THE PADDY SOIL CHRONOSEQUENCES FROM DIFFERENT PARENT MATERIALS IN SOUTH CHINA

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The transformation and translocation of iron oxides are phenomenal during the formation and development of paddy soils (Hydragric Anthrosols). Our study of the paddy soil chronosequences from quaternary red clay (QRC), red stone residues (RSR) and purple shale residues (PSR), with different cultivation ages in South China indicates that the magnetic susceptibility (MS), saturation isothermal remanent magnetization (SIRM) and soft isothermal remanent magnetization (IRMs) of all non-paddy soils (original soils) vary significantly with parent materials and obviously decrease with depth. The synchronous decrease of MS, SIRM and IRMs remarkably occur in anthrostatic epipedon at the initial cultivation stage and they will be soon reduced to extreme low values and tend to maintain at a stable level with increasing paddy cultivation age. In contrast, there are no notable decreases of these magnetic parameters and even they increase obviously in hydragric horizons of the young paddy soil profiles derived from PSR and RSR. Nevertheless, these magnetic parameters in hydragric horizons of the paddy soils derived from QRC decline gradually with the increasing of cultivation age with smaller range than those in anthrostatic epipedons. The variation characteristics of MS, SIRM and IRMs is related to the differentiation of the redox condition between anthrostatic epipedon and hydragric horizon which favors the ferrimagnetism minerals formation and represents one kind of mechanism of magnetic enhancement in the soils. Our observation also indicates that magnetic enrichment generally occurs in the clay fractions and the ferrimagnetic minerals of clay are more easily damaged in paddy soils.



S01.03-P -6

INCREASED CO₂ FLUXES UNDER WARMING TESTS AND SOIL SOLUTION CHEMISTRY IN A HISTIC CRYOSOL FROM SALLUIT, NUNAVIK (QC, CANADA)

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Permafrost-affected soils under tundra ecosystems contain large stocks of organic carbon. Global warming could induce an Arctic ecosystems positive feedback on global C release. Instrumentation was installed in Salluit (Nunavik; 62°14'N, 75°38'W) to monitor respiration of a Histic Cryosol in a polygonal peatland under current and warmer conditions and its relationship with variations in soil solution composition. C and N mean contents in topsoil were respectively 280 and 14 g/kg DW. An open top chamber was installed to modify thermal conditions in the active layer. All samples, measurements and analyses were performed in both normal (N) and transformed (T) conditions from mid July to end of August 2010. The profile temperature was monitored hourly and soil respiration (SR) was measured daily every second day with a respiration chamber linked to a portable IRGA. Soil solutions were sampled every two days using tension-free lysimeters installed at 10 and 30 cm depths and analysed for dissolved organic carbon (DOC), total dissolved nitrogen (TDN) and major elements. In natural conditions, average SR was 0.96 $\mu\text{molCO}_2\cdot\text{m}^{-2}\cdot\text{s}^{-1}$. An increase of the surface temperature of 2.5°C was observed and led to an 80% enhancement of SR at the T station (1,73 $\mu\text{molCO}_2\cdot\text{m}^{-2}\cdot\text{s}^{-1}$). The soil solution is weakly mineralized and there were no differences in composition between the two stations. Mean DOC and TDN contents were 36 and 1.5 mg.L⁻¹ respectively. The induced warming increased CO₂ fluxes. This impact appears to be striking in Histic Cryosols despite low SR values in natural conditions.



S01.03-P -7

LIMITATION OF MECHANICAL ANALYSIS OF SHRINKAGE AND SWELLING OF PADDY SOIL - FROM THREE YEARS MONITORING OF WRC IN A PADDY FIELD-

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Paddy soil, which is puddled and submerged, shows remarkable shrinkage when it dries. However the soil cannot swell up to the original volume when it is submerged again. This cyclic change in paddy soil structure is partly modeled by elasto-plastic mechanics coupled with the pore water movement. However the shrinkage and swelling under the drastic change in redox condition is more complicated than the simple mechanical deformation. Present study observed cyclic shrinkage and swelling of clayey paddy soil with regard to the water management during the cultivation of rice and precipitation in fallow periods. The change in soil structure is monitored by a Water Retention Characteristics (WRC). Undisturbed soil samples were taken repeatedly at same locations and depths of a clayey experimental paddy at submerged condition (mid-summer), dried condition (mid-summer) and before tillage (early spring). The samples were saturated first, then drained to -80kPa (1st desorption), saturated again, and finally drained to -80kPa again (2nd desorption) in a pressure chamber. Compression index, representing plastic shrinkage, and swelling index, representing elastic swelling, were evaluated from the 1st and 2nd desorption curves. The results shows the pores subject to the plastic deformation largely decreased after the desiccation of the field, but they were partly recovered by wet condition such as much precipitation and snow accumulation in winter. Because the observed recovery of plastic pores cannot be explained by elasto-plastic mechanics, it suggests existence of change in the WRC due to time-dependent redox condition induced by the variation in water regime.



S01.03-P -8

MAGNESIUM SULPHATE VERTIC PADDY SOILS IN THE NIGER RIVER VALLEY (KOLLO, NIGER)

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Paddy Vertisols located in the irrigated scheme of Kollo (Niger) have distinct characteristics from other irrigated paddy soils observed along the Niger River valley. They present some properties diagnostic to acid sulphate soils, never described before in a continental alluvial valley. This study aims to characterize in detail these Vertisols in order to infer the underlying pedogenetic processes. Each soil horizon from 4 profiles was analysed to identify: i) physicochemical properties; ii) mineralogy of clays, oxides and salt efflorescence, iii) hydrodynamic and structural properties and cracks distribution in dry conditions. The soil profiles studied were characterized by clay content higher than 80%, pH in water between 3 to 5 and high salinity with an electrical conductivity of saturated paste ranging from 13 to 29 dS.m⁻¹ from the surface to 1.2 m depth. Mg and Na were dominant cations and S the main anion. Moreover Ca et Mg were the dominant exchangeable cations with a ratio Ca/Ma lower than 0.6. DRX showed the occurrence of kaolinite, smectite, illite and goethite. Salinity appeared controlled by the precipitation or the dissolution of magnesium and calcium sulphates: hexahydrate, epsomite and gypsum. In water saturation conditions, the hydraulic conductivity of horizons was lower than 2.10⁻⁸ m.s⁻¹. The coefficient of linear extensibility derived from shrinkage curve ranged from 0.22 to 0.24 showing that these soils are very deformable. Paddy soils studied at Kollo were identified as vertic Solontchak or salic Vertisol.



S01.03-P -9

MECHANISMS OF PADDY SOIL CRACKS GENERATION AND ITS CONSEQUENCES ON PREFERENTIAL FLOW

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In this paper we selected two paddy soils (one has been cultivated for 20 years and the other one for >100 years) to investigate Fe/Al leaching and soil organic matter accumulation on cracks generations. Wetting and drying intensity and frequency on soil shrinkage will be also presented. Pore rigidity will be proofed by aggregate pores changes using synchrotron radiation x-ray micro-CT method. We wish to find the agreement between pore change at microscale and bulk soil shrinkage at soil core scale. We also wish fill the gap between shrinkage of soil core determined in the laboratory and cracks in the field. Finally the consequences of cracks on water infiltration will be discussed.



S01.03-P -10

MODELING THE FATE OF PESTICIDES IN PADDY RICE – FISH POND FARMING SYSTEMS IN NORTHERN VIETNAM

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During the last decades, high population growth and export-oriented economics in Vietnam have led to a tremendous intensification of rice production, which in turn has significantly increased the amount of pesticides applied in cropping systems. In Vietnam, there is concern that paddy rice production systems are the major non-point sources for pesticide pollution of surface- and groundwater. The quantification of pesticide losses from paddy rice fields to rivers and the assessment of associated risks are hampered by the limited availability of field data. One potential way out is the use of simulation models. Therefore, we developed a new, process-based model to simulate short-term pesticide dynamics in integrated paddy field - fish pond farming systems under the specific environmental conditions of south-east Asia. State of the art approaches and algorithms to describe the fundamental physical-chemical processes were combined and numerically solved using the ordinary differential equation (ODE) solver Berkeley Madonna (Version 8.0.1). The model was automatically calibrated for two pesticides (fenitrothion, dimethoate) by means of the Levenberg-Marquardt algorithm and validated against data measured in 2008 in a typical paddy rice – fishpond system in northern Vietnam. In our presentation we will introduce the basic structure of our model and present simulation results indicating that the model is a useful tool for simulating the fate of pesticides in paddy rice farming systems.



S01.03-P -11

NITROGEN AVAILABILITY IN FERTILIZED PADDY SOILS AS A FUNCTION OF REDOX CONDITIONS AND RICE STRAW INCORPORATION

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Nitrogen (N) availability in fertilized rice paddies is the result of a balance of processes mainly the gross rates of N mineralization, microbial immobilization and N losses. Water and crop residue management practices often confound these established relationships making N the most difficult nutrient to manage in rice cropping systems. Detailed information on the driving processes and factors controlling N availability in paddies is therefore highly necessitated. This study aims at investigating and quantifying the interactive effects of soil redox conditions and straw incorporation on fertilizer-N availability in paddy soils. A paddy soil was treated with enriched ammonium-15N and incubated for 160 days under flooded or non-flooded conditions, with or without the addition of rice straw. Changes in total and fertilizer-derived inorganic N forms as well as immobilized N and dissolved organic C with incubation time were determined. The addition of straw significantly reduced N availability under oxic conditions, probably due to the microbial immobilization of the added N in the presence of straw (C/N = 60). In contrast, in anoxic soils straw incorporation resulted in a significant increase in net N supply. Nonetheless, the immobilization of about 47 and 32% of applied N was observed in straw-amended and non-amended anoxic soils, respectively. These results suggest that under anoxic conditions, soil or straw-derived organic matter mineralization could contribute to N availability, partially compensating for the immobilized fertilizer-N. Higher DOC concentrations in straw-amended anoxic soils further point to the supply of labile organic matter for microbial mineralization.



S01.03-P -12

ORGANIC CARBON ACCUMULATION IN A 2000-YEAR CHRONOSEQUENCE OF PADDY SOIL EVOLUTION

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Large proportions of the terrestrial carbon are accumulated in wetland rice soils. The stabilization of organic carbon (OC) is often accompanied by the presence of iron (Fe) oxides and fine mineral particles. The study aimed to allocate the OC distribution within the soil fractions and to assess the OC stabilization by interactions with surfaces of Fe oxide and other fine mineral particles during pedogenesis. A paddy chronosequence of six age groups was chosen in the Zhejiang Province, ranging from 50 to 2000 years of rice cultivation. A physical fractionation was applied to the topsoils in order to isolate medium, fine silt and coarse, fine clay fractions. Fractions were analyzed for their OC concentrations and dithionite (Fed) and oxalate (Feo) extractable Fe oxides. The specific surface area (SSA) was determined by using BET-N₂ (before and after removal of organic matter) to estimate the OC coverage of the different surfaces. Results showed a low SSA and high accretions of OC with pedogenesis in medium silt fraction. Clay fractions were characterized by the highest Feo content, a high SSA and low OC accretions during pedogenesis. The results lead to the assumption that OC stabilization in clay and medium silt fractions seems to be caused by different processes. We assume that formation of stable microaggregates is a relevant process for OC stabilization in silt fractions, whereas the formation of organo-mineral associations by a reactive mineral surface of Feo oxides seems to be the major mechanism for OC stabilization in clay fractions.



S01.03-P -13

PHYSICO-CHEMICAL PROPERTIES OF PEAT SOIL AT DIFFERENT DEGREE OF ORGANIC MATTER DECOMPOSITION IN DEEP SOIL PROFILES

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Peatlands are one of the most common landscape elements of the Lublin Polesie Region, which cover about 25% of its area. A small percentage of this peatland are transitional bog, usually occur near eutrophic lakes. One of them is transitional bog, 30–150 m wide belt surrounding Moszne Lake. The vegetation is composed of peatmosses and sedges and peat accumulation in this region is reported in the range from 1 to 0.3 mm/year. Mineral substratum of organogenic deposits is composed of the Late Vistulian sandy silts and limnic sands. Thickness of peat varied between 3.5 and 7.0m. Slow rate of peat accumulation causes that the deepest layer of that profile might be formatted about 3500 and even 23000 years ago from different species of plant. The aim of present work was to examined how physico-chemical properties of peat changes in peat profile, from the surface, poorly decomposed plant remains, across well decomposed peat and gytja layers up to mineral substrate. For that reason two outcrop by Eijkelpkamp drill were made and soil samples were taken. In laboratory peat material was exterminated in terms of: pH, Eh, EC, moisture, and content of bioavailable forms of nitrogen and phosphorus. This analysis allowed us to found gradients of physico-chemical parameters in peat profile in relation to carbon accumulation and water level.



S01.03-P -14

**PROCESS AND AMOUNT OF GASEOUS EMISSION FROM A TROPICAL PEATLAND FIRE
OBSERVED IN A FIELD EXPERIMENT IN CENTRAL KALIMANTAN, INDONESIA**

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Fire is the most radical form of carbon emission, especially in peatlands where soil itself is burnt away. Few studies have conducted a field scale fire experiment in tropical peatland. In this study a small scale field experiment of peat burning was conducted to evaluate the process and amount of gaseous emission by fire. A 3-m by 4-m plot was prepared in Central Kalimantan, Indonesia. The topsoil was plowed and exposed for a week. Concentrations of CO₂, CO, CH₄, N₂O, and PM were observed at heights of 1.0, 0.5, 0.0, -0.1 and -0.2 m. Soil temperature at -0.1 and -0.2 m was recorded every 10 minutes. Twelve iron pipes were installed to measure the depth of peat loss. After ignition, flaming stage of peat burning was ceased within 2-3 hours. The following smoldering stage continued for a week. The averaged burnt depth was 7.5 cm. Based on bulk density of 0.22 g/cm³ and carbon content of 55.5%, the amount of carbon lost from the plot was 110.2 kg. In the flaming stage, soil temperature at -0.1 m increased tentatively. After the smoldering stage began, the temperature rapidly increased to 350–450°C. Response of soil temperature at -0.2 m was less prominent; it reached 50–100°C at the maximum. Concentrations of gaseous components became maximal in the flaming stage. During the smoldering stage, the concentrations gradually decreased. The influence of burning on CO₂ and PM was prominently remained at -0.1 m, whereas those at -0.2 m were not so much.



S01.03-P -15

SHIFTS OF NITROGEN TRANSFORMING MICROBIAL COMMUNITIES DURING PADDY SOIL EVOLUTION

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In many areas of China, tidal wetlands have been converted into agricultural land for rice cultivation. However, the consequences of land-use changes for soil microbial communities are poorly understood. Therefore, we investigated bacterial and archaeal communities involved in inorganic nitrogen turnover (nitrogen fixation, nitrification, and denitrification) based on abundances and diversity pattern of the corresponding functional genes along a soil chronosequence ranging between 50 and 2,000 years of paddy soil management compared to findings for a tidal wetland. Changes in abundance and diversity of the functional groups could be observed, reflecting the different chemical and physical properties of the soils, which changed in terms of soil development. The tidal wetland was characterized by a low microbial biomass and relatively high abundances of ammonia-oxidizing microbes. Conversion of the tidal wetlands into paddy soils was followed by a significant increase in microbial biomass. While relative abundances of nitrogen fixation genes as well as diversity pattern changed soon after tidal wetland conversion, gene abundance pattern of denitrification showed only after 300 years of paddy soil development significant shifts. With ongoing rice cultivation, copy numbers of archaeal ammonia oxidizers did not change, while that of their bacterial counterparts declined. In general, changes in diversity patterns were more pronounced than those in functional gene abundances.



S01.03-P -16

SPATIAL DISTRIBUTION OF SOIL ORGANIC CARBON DURING PADDY SOIL EVOLUTION

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In the Zhejiang province (Yangtze River Delta, PR China), consecutive land reclamation by construction of protective dikes during the past 2000 years led to a unique chronosequence of soil formation. Parts of the land are used for paddy rice production. These soils document the effect of paddy soil management on the amount and spatial distribution of soil organic carbon (SOC) during pedogenesis. We hypothesised that the spatial pattern of SOC change with increasing duration of paddy soil use, leading to spatial homogenisation of topsoils due to frequent puddling, but increased spatial heterogeneity of undisturbed subsoils due to ongoing transport and relocation processes. Three plots of the chronosequence (50, 300 and 1000 years of paddy cultivation) were sampled on the basis of regular, orthogonal grids. Samples were taken from puddled topsoils, plough layers, and mixed subsoil layers. Beside SOC concentrations, soil lightness was measured to check if colour measurements allow predicting the amount and distribution of SOC. The results showed no spatial dependence of SOC at the youngest paddy plot, underlining the homogeneity of the parent material. With increasing duration of paddy soil use, an increasing degree of spatial dependence was observed. Different spatial patterns in all soil depths indicate that the compacted plough layer decoupled the SOC distribution between topsoil and subsoil. Soil lightness measurement was not sufficient to predict the amount and distribution of SOC. To conclude, paddy soil evolution is strongly associated with the development of spatial dependencies of SOC even in intensively managed topsoil layers.



S01.03-P -17

STABILIZATION OF ORGANIC MATTER UNDER DIFFERENT REDOX CONDITIONS

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Stabilization of organic matter (OM) is crucial to soil functions and carbon cycling. Stabilization by interactions with soil minerals has been studied mainly under oxic conditions while effects of different redox conditions have not been investigated so far. We coated three minerals (ferrihydrite, goethite, nontronite) with OM derived from decomposed rice straw. The OM-coated minerals were incubated either suspended in water or in an extract of fresh rice straw for one year, exposed to solely anoxic, solely oxic and alternating redox conditions. Stabilization of adsorbed OM under oxic and alternating conditions was similar and more efficient under anoxic conditions. Carbon mineralization was largest for ferrihydrite and nontronite (39-43% and 40-56% of initial total organic C) and smallest for goethite (20-38%), indicating best stabilization by goethite. The availability of easily degradable DOM had only a small negative effect on OM stabilization (0-8% additional mineralized C of initial TOC). Considering the smaller specific surface area (SSA) of goethite (48 m² g⁻¹) than of ferrihydrite (290 m² g⁻¹), the better stabilization by goethite might result from fractionation of OM during adsorption, where highly competitive and stable compounds such as phenolic acids adsorbed preferentially. We conclude that stabilization of OM by interactions with minerals was less dependent on redox conditions than expected. Fractionation of OM during adsorption strongly affected stabilization. Type of the mineral and SSA are no straight forward indicators for OM stabilization.



S01.03-P -18

SUBSOIL CARBON DYNAMICS UNDER PADDY MANAGEMENT

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Paddy and non-paddy soils from a chronosequence of 50 to 2000 years of agricultural use, developed on former estuarine sediments of the Yangtze River, were sampled near Cixi, Zhejiang Province, China. In addition samples of Yangtze River estuarine sediments were obtained. ^{14}C documents a replacement of "old" carbon by "modern" carbon in both paddy and non-paddy topsoils within 50 to 100 years. Different ^{14}C and organic carbon (OC) depth gradients develop in the subsoil of paddy and non-paddy sites due to the reduced transport of OC through the plough pan into the paddy subsoil. Our results reveal two pathways for OC transport into the (deep) subsoil. The first is fresh plant material. Rootlets and plant material with modern ^{14}C concentrations (range 101 % to 128 % of the modern standard) were found far below the plough pan. Fresh root material and root exudates provide a subsoil input of organic carbon derived from the recent atmosphere. The second pathway of "young" carbon into the subsoil is transport as DOM. Fractionation of the humus into insoluble humin, alkali soluble humic acids, and acid soluble fulvic acids reveals a fulvic acid OC content around 50 % of the bulk TOC and 10 to 20 % humic acids with ^{14}C concentrations up to 40 percent modern higher than the ^{14}C concentration of the bulk soil. Therefore this soluble fraction is of importance for the relocation of young OC into paddy subsoils.



S01.03-P -19

THE CONTRIBUTION OF MINERALIZATION TO GRASSLAND N UPTAKE ON PEATLAND SOILS WITH ANTHROPOGENIC A HORIZONS

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Peatland soils contain large amounts of nitrogen (N) in the soil and mineralization can contribute substantially to the annual mineral N supply of grasslands. We investigated the contribution of N mineralization from peat with respect to the total annual N uptake on grasslands with anthropogenic A horizons and submerged tile drains. The study included i) a pot experiment to determine potential N mineralization from the topsoil and the subsoil, ii) a 1-year field experiment to study herbage yields and N uptake under fertilized and non-fertilized conditions and iii) a 3-year field study where herbage yield and N uptake from the top 30 cm and the entire soil profile were monitored. The 3-year field study yielded an average N uptake of 342 kg ha⁻¹ under non-fertilized conditions but the contribution of subsoil peat N mineralization to the total N uptake was found to be negligible. Our calculations demonstrate that peat N mineralization contributed only 10% to 30% to the total N-uptake, mainly coming from the top 30 cm. Most of the N uptake under unfertilized conditions appears to be largely the result of mineralization from long-term inputs of dung, ditch sludge, farmyard manure, cow slurry and non-harvested herbage.



S01.03-P -20

THE FATE OF PESTICIDES IN A RICE PADDY WATERSHED IN NORTHERN VIETNAM

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During the past decades, paddy rice production in Vietnam has undergone a major intensification due to population growth and increasing export-market orientation. As a consequence, the amount of applied pesticides has been tripled during the last decade.. Recent studies from the major rice cultivating regions in Europe and Japan indicate, that a considerable fraction of applied pesticides are lost from the target area to surface water compartments, such as lakes or rivers. For south-east Asia in general and Vietnam in particular studies on the fate of pesticides in paddy rice cultivating regions are limited. The aim of the present study is to assess and evaluate the fate of widely applied pesticides in paddy rice watersheds in northern Vietnam. In 2009, we installed gauging stations at an upstream, midstream and downstream position of a watershed. At each station we measured discharge and we automatically sampled water for pesticide analyses. . Furthermore, we conducted field surveys among 140 rice farmers to gain knowledge on the application practices. Key results indicate that according to their physico-chemical properties a significant fraction of the applied mass of pesticides is lost from the paddy fields to the receiving stream. In our presentation we will focus on the experimental setup and key results indicating that, under the current management practice, pesticide use in paddy fields poses a serious environmental problem in northern Vietnam.



S01.03-P -21

VERTIC PROPERTIES AND RELICS OF GILGAI MICRORELIEF IN STAGNIC CHERNOZEMS ON THE SILESIAN LOWLAND, SW POLAND

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Soils with a specific lithological discontinuity are widespread in eastern part of the Silesian Lowland, where the Neogene swelling clays (smectite-illite) are covered with eolian silts or silt loams of the Pleistocene age. Unusual Stagnic Chernozems (or Mollic Planosols), found within a shallow land depression close to the archaeological site near Tyniec, have deep humus horizon with wavy-shaped lower boundary extending from 50 to 100-110 cm below soil surface. In a cross section, these forms resemble "cavities" filled with homogenous material, silt-loamy and rich in humus, surrounded by "embankments" of clay material extending from the subsoil. Within the clay material, wedge-shaped aggregates are abundant, all having glossy surfaces (slickensides), both on top and bottom sides. Longer axes of wedge-shaped aggregates are aligned under smallest angle below the "cavities" and the largest (up to 60o) within "embankments" separating the caves. In the course of studies, successively was rejected possibility of an anthropogenic or cryogenic origin of the subsurface forms. More than 300 "cavities", revealed after removing of upper 50 cm of humus horizon, form the basis for former gilgai microrelief, today invisible due to ground leveling and ploughing. Present-day activity of sub-surface clay swelling and shrinkage is unknown, but probably low due to dense drainage pipe system installed at the depth of 60-70 cm below soil surface. This is probably the first finding of such a well preserved relic of a gilgai microrelief and wedge-shaped structure in Poland, where the vertic properties in soils are reported in general not often.



S01.03-P -22

WORLD ATLAS OF ORGANOC SOILS IN PEATLAMDS

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The European Commission's Joint Research Centre is planning to launch a new title in its popular Soil Atlas series. Focusing specifically on organic soils of peatlands, this new publication aims to present an overview of the nature and importance of these soils. Targeted at the non-specialist reader, the atlas will introduce the concept of organic soils, their formation, properties, functions and services performed and potential threats. The atlas will present a global perspective showing the occurrence various ecozones (polar, boreal, temperate and tropical). The presentation will outline the initial structure and contents and identify data needs, areas of collaboration sought and timetable and roadmap for completion. On completion, such an atlas will be a valuable tool for policy maker, the education sector and the public to help them understand the value of this particular soil type.



S01.03-P -23

ZINC DYNAMICS ASSOCIATED WITH REDOX-ACTIVE SPECIES IN SELECTED PADDY SOILS

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Zinc dynamics in paddy soils plays an important role in rice productivity and, more extensively, in human nutrition, as zinc-deficient rice affects the zinc intake of humans who depend on rice as their staple food. We studied the reductive dissolution of iron and manganese and the formation of sulfide under varying redox conditions, using a stirred soil slurry microcosm system that could be made anaerobic by continuous flushing with nitrogen. As the soil redox potential decreased from +200 mV to –300 mV, the following parameters were measured: water-soluble zinc, iron and manganese; sulfate in soil solution; and sulfide in slurry and in soil solution. Geochemical modeling of soil solution data from two contrasting soils using Visual Minteq indicated that sulfide reactions controlled Fe²⁺, Mn²⁺, and Zn²⁺ solubility, even at relatively high redox potential in a high-sulfate soil, while sorption of metals onto iron and manganese oxides, in addition to sulfide formation, was the predominating redox-active process affecting zinc availability at relatively low redox potentials in the soils. This study provides new insights on how zinc availability could vary in different soil types and how adsorption and precipitation mechanisms could affect the release of zinc in the soil.



S01.04-P - SOIL RESEARCH FOR EUROPEAN CITIES

Wednesday 04 July 2012 from 17:00 to 18:30. Room Poster Areas

S01.04-P -1

BRICKS IN URBAN SOILS

Thomas Nehls, Berlin - Germany

S01.04-P -2

CONTAMINATION AND TRANSFORMATION OF TOPSOIL HORIZONS IN URBAN PARKS ON THE BASIS OF MAGNETIC SUSCEPTIBILITY MEASUREMENTS

Adam Lukasik, Zabrze - Poland

S01.04-P -3

HEAVY METALS CONTENT IN EDIFISOLS - SOILS FORMING ON THE BUILDINGS

Charzynski Przemyslaw, Torun - Poland

S01.04-P -4

HOW TO RECYCLE WASTES FOR SOIL CONSTRUCTION IN URBAN AREAS ?

Sarah Rokia, Vandoeuvre-lès-Nancy - France

S01.04-P -5

HYDRAULIC PROPERTIES AND AIR SUPPLY IN CEMETERY SOILS

Iris Maria Zimmermann, Kiel - Germany

S01.04-P -6

LET'S CULTIVATE OUR TOWN! INCREASING CITIZEN AWARENESS OF FOOD AND THE ENVIRONMENT THROUGH ORGANIC CULTIVATION OF ALLOTMENTS

Francesca Bretzel, Pisa - Italy

S01.04-P -7

MANAGING THE FUNCTIONALITY OF ANTHROPOGENIC SOILS

Andreas Lehmann, Stuttgart - Germany

S01.04-P -8

NEW DIAGNOSTIC CRITERIA FOR ANTHROPOGENIC SOIL CLASSIFICATION IN SLOVAKIA

Jaroslava Sobocka, Bratislava - Slovakia



S01.04-P -9

POLLUTED SOILS IN CLOSE CONTACT WITH URBAN POPULATION OF A SEMI-ARID REGION, EXAMPLE CITY OF THERAN

Mohammad Baharvand, Essen - Germany

S01.04-P -10

SOIL ORGANIC CARBON STORAGE IN URBAN AREAS: UNDERESTIMATION OF STOCKS AND VARIATION AT A REGIONAL SCALE

Jill Edmondson, Sheffield - United Kingdom

S01.04-P -11

SUBSURFACE URBAN HEAT ISLAND INVESTIGATIONS IN OBERHAUSEN, GERMANY

Helene Püllen, Essen - Germany

S01.04-P -12

TYPES, AMOUNT AND POTENTIAL OF URBAN SOILS FOR ORGANIC MATTER ACCUMULATION

Wolfgang Burghardt, Essen - Germany

S01.04-P -13

WHAT POTENTIAL OF BY-PRODUCTS FOR AGRONOMIC USE IN URBAN AREAS?

Sarah Rokia, Vandoeuvre les Nancy - France



S01.04-P -1

BRICKS IN URBAN SOILS

Nehls Thomas^[1], Sarah Rokia^[2], Beate Mekiffer^[1], Gerd Wessolek^[1]

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Bricks are regularly reported to contribute to an important amount of the coarse fraction in urban soils. Bricks are produced, used and finally dumped into soils for more than 2000 years now. Surprisingly little is known about their functions in urban soils. Blume & Runge (1978) quantified brick contents in coarse fractions of Rendzinas from rubble in Berlin and found up to 56% (m/m) of the subsoil material are bricks. Trinks et al. (2007) showed that bricks from coarse fractions have high porosities of up to 45% (v/v) which might enhance the water availability of a soil depending on the fine earth texture. Blume & Runge (1979) as well as Trinks et al. (2007) hypothesized that due to the discontinuous pore system the exchange of water between coarse bricks and fine earth may be hindered. There is no information available on the brick contents in the fine earth fraction, nor on their chemical features like cation exchange capacity (CEC) or exchangeable cations. It was hypothesized, that because of the porosity of the bricks their CEC is not depending on their particle size. Rooting of bricks, similar to rooting of Granites (Jongmans et al., 1997) has not been observed so far but can be expected. It's the goal to (i) discuss bricks and brick particles as markers for an urbanisation impact on soils and (ii) to study the chemical characteristics of bricks in soils and to (iii) analyse, whether resources supplied by bricks are accessible for plants.



S01.04-P -2

CONTAMINATION AND TRANSFORMATION OF TOPSOIL HORIZONS IN URBAN PARKS ON THE BASIS OF MAGNETIC SUSCEPTIBILITY MEASUREMENTS

Lukasik Adam^{*[1]}, Strzyszcz Zygmunt^[1], Szuszkiewicz Marcin^[1]

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Urban parks are integral and stable elements of town architecture, that underwent continuous changes accompanying agglomeration development. Soils of those areas through their contamination and transformation of uppermost horizons reflect direct and indirect influence of human activity on environment. Vegetation of urban parks (mainly trees) significantly modifies distribution of air pollutions into soil surface. Urban-industrial dusts of various origins (steelworks, power plants, coking plants, traffic pollutions, low emission) besides heavy metals contain ferromagnetics. Their presence in soils can be detected by magnetic susceptibility (MS) measurements. Topsoil horizons featuring elevated contents of ferromagnetics (magnetic anomaly) as well as heavy metals (geochemical anomaly) indicate to strong anthropopression on the environment. The study were conducted in four urban parks in Upper Silesia (Poland) large conurbation. Field measurements have been conducted in dense grid on open space areas (lawns, meadows) and under tree canopies. Magnetic susceptibility measurements both volume (?) and specific (?), covered in situ campaign (surface measurements of ?) and ex situ (soil core measurements of ? and soil sample analysis for ?). Heavy metal contents in soil samples from A horizons have been determined by ASA method after extraction in aqua regia. Obtained data indicate on presence of ferromagnetics and heavy metals in topsoil horizons as results of dust deposition and presence of artifacts. Spatial diversity of magnetic and geochemical anomalies is a result of direct human activity (dust imissions, presence of artifacts in soil) and specific features of individual urban park (tree species content, architecture, and distance to emitters).



S01.04-P -3

HEAVY METALS CONTENT IN EDIFISOLS - SOILS FORMING ON THE BUILDINGS

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Soil sampling was carried out in the three countries: Poland, Romania and Spain. Samples were taken from 21 sites separated into three types: top of the building (roof), wall of the building and gutter. Aim of the studies was to determine the concentrations of selected heavy metals in edifisols. In the soil samples the content of lead, copper, zinc and cadmium was determined using Atomic Absorption Spectrophotometry. The concentration of lead in the analyzed soils ranges from less than 16 mg · kg⁻¹ to 365 mg · kg⁻¹. The differentiating factor may be distance of the study sites to the traffic routes, where, despite the downward trend in recent years, the concentration of this element in the air is still elevated, what is confirmed by monitoring carried in Torun. The concentration of copper ranges from less than 7 to 110 mg · kg⁻¹. This element pollution originating mainly from the corrosion of copper wiring or roof elements. The zinc content in the analyzed samples is the highest among all the identified trace element and ranges from 61 to 677 mg · kg⁻¹. The main source of that metal contamination is the widespread use of zinc carbonate coated steel. This is confirmed by the results for samples located in the gutters for which the concentration of zinc reaches a value of 500-677 mg · kg⁻¹. The content of heavy metals in edifisols could be mainly explained by their inflow from construction materials and the impact of pollutants from the atmosphere.



S01.04-P -4

HOW TO RECYCLE WASTES FOR SOIL CONSTRUCTION IN URBAN AREAS ?

Rokia Sarah^[1], Schwartz Christophe^[1], Vidal-Beaudet Laure^[2], Cannavo Patrice^[2], Guimont Sophie^[3], Renat Jean-Christophe^[3], Séré Geoffroy^[1], Damas Olivier^[4]

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The development of green areas in cities requires the use of large quantities of imported agricultural soil. Furthermore, in the context of increasing urbanisation, high amounts of wastes and by-products are produced and are not systematically recycled as a resource. To preserve natural soil resources, we propose a strategy to use wastes and by-products as soil substitution materials during soil engineering. If organic wastes such as compost or sludge have already been studied in regard to their effects on soil properties, they have rarely been mixed together or with other by-products to get a fertile substrate. We have selected 10 contrasted materials i) representative for european wastes and ii) with physico-chemical characteristics adapted for fertile soil construction. This approach is developped in a national research program (Siterre) funded by the French Environmental Agency (ADEME). The wastes are characterised for their potential nutrient storage (C, N, P, K, Ca, Al, Mg, CEC), water storage and physical characteristics (bulk density). Among the 10 materials investigated, the organic ones (e.g. compost, paper mill sludge, green wastes) have contrasted characteristics - organic matter content ranging from 28.1 to 69.5 (w/w), and high water content. These characteristics being complementary to those of the mineral ones (e.g. rubble, bricks, track ballasts), we hypothesise that the mixture of both can produce a fertile substrate. Mixtures of wastes are determined with a decision support system to construct Technosols optimised for plant growth.



S01.04-P -5

HYDRAULIC PROPERTIES AND AIR SUPPLY IN CEMETERY SOILS

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Air supply and soil moisture have significant impact on the decay time necessary for complete decomposition of an interred body. Lack of oxygen may cause adipocere formation conserving the body and making the reuse of the grave after the regular resting time impossible. A study on cemetery soils in Germany was carried out, investigating the soil properties of 20 cemeteries and developing a quality rating system for cemetery soils. Special interest was taken in the changes in soil functions caused by excavation and refilling during the burial process. Air and water conductivity measurements in grave soils and monitoring of soil redox and moisture conditions in original graves on four cemeteries of different soil quality was realized. In order to test the effect of the application of quicklime on soil structure reamelioration and improvement of hydraulic as well as air permeability within the grave, moisture and redox conditions in newly excavated and refilled pits were measured continuously. Concerning the general structure and hydraulic as well as pneumatic conditions, very often a permeable refilled soil material overlaying the more compacted soil horizon at the bottom of the grave results in water ponding, less aerated conditions and lower redox potential values which reduce the decomposition speed or even prevent it. The improvement of the restructuring can be seen by a better aerated and more unsaturated soil if quicklime was added and a minor soil settling. Both the results and the rating system will be presented.



S01.04-P -6

LET'S CULTIVATE OUR TOWN! INCREASING CITIZEN AWARENESS OF FOOD AND THE ENVIRONMENT THROUGH ORGANIC CULTIVATION OF ALLOTMENTS

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The research aims to promote the sustainability of towns and cities through the awareness of the use of the soil in the cultivation of allotment gardens. The local council in Pisa provides all citizens that have allotments with guidelines for using organic techniques as best practices. "Gardeners" participate in training courses on nutrient cycles and soil fertility, vegetable varieties and organic cultivation, as well as how to make compost. Gardeners are surveyed through a specific questionnaire which is aimed at promoting such practices throughout the town of Pisa. We support gardeners in comparing their usual techniques with sustainable cultivation. Some local varieties of vegetable are cultivated both to promote knowledge of the local heritage and to preserve horticultural biodiversity. The administration departments of Tuscany and Pisa are co-funders of the projects.



S01.04-P -7

MANAGING THE FUNCTIONALITY OF ANTHROPOGENIC SOILS

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Questions about the performance of technogenic soils could be motivated by at least three reasons: 1. How do urban or industrial soils contribute to the environmental quality in city regions 2. How could the relocation (digging and placing) of soils done without loss of functionality or even with increased functionality 3. How could the functionality of constructed soils be improved The processes taking place in disturbed soils with relevance to the functionality will be highlighted. The common praxis of creating urban soils, of relocating soils of constructing soils will be reported. Strategies to improve soils functionality by slight changes in soil management will be developed. Criteria to evaluate the loss, resp. the profit in soil functionality by relocation or construction of soils will be given.



S01.04-P -8

NEW DIAGNOSTIC CRITERIA FOR ANTHROPOGENIC SOIL CLASSIFICATION IN SLOVAKIA

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Anthropogenic soils can be found mostly in urban areas. Problem of adequate and correct description and classification of these soils occurs very often and results can be doubtful. In the new prepared version of anthropogenic soil classification in Slovakia some new diagnostics criteria were involved and applied for the anthropogenic soil classification. First two groups of anthropogenic soils were distinguished following reference groups in WRB 2006 (Anthrozem and Technozem). Both groups are differentiated by cultivated horizon(s) ("in-situ" developed soil material) and by anthropogenic horizon(s) ("ex-situ" developed soil material). Cultivated horizon is well-known described horizon in many scientific references. Anthropogenic horizon for Technozem is developed from the human transported material which origin is from the other ecological locality that adjacent area. Material can consists of various material (natural, technogenic or their mixing) with thickness = 50 cm. Artefacts are the second diagnostic property which presence authenticates the "artificial origin" of the soil. Natural material contains = 10 % artefacts; natural-technogenic 10-50 % artefacts; and technogenic = 50 %. If the surface horizon is e.g. arable land, we can distinguish the subsurface horizon. Most of such soils are appeared in urban areas due to building activities (machinery, recultivation processes, etc). In the soil survey anthropogenic transported layer is very simply recognizable in soil profile compared to natural horizons. In the contribution, there will be illustrated graphically individual basic soil types of Technozems with their subtypes. Also the basic schema of classification units in Slovakia will be involved.



S01.04-P -9

POLLUTED SOILS IN CLOSE CONTACT WITH URBAN POPULATION OF A SEMI-ARID REGION, EXAMPLE CITY OF THERAN

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Polluted Soils in Close Contact with Urban Population of a Semi-arid Region, Example City of Theran Mohammad BAHARVAND¹, Wolfgang BURGHARDT¹ ¹University Duisburg-Essen, Fk. Biology, Soil Technology, Essen, Germany; email: mo_baharvand@yahoo.com As example for soil investigations of a mega-city in Asia Teheran was chosen. It has a population size of 8, during the day of 10 millions inhabitants. The climate is arid to semi-arid. Due to the warm and dry climate public green areas, parks, and sidewalks are used by the population extreme intensively inside the city during most time of the year. From the way of life results an intensive contact of humans with the city soils. To get an idea of the characteristics and pollution with heavy metals of the soils involved park areas, children playgrounds, sidewalks and roadsides were sampled. The sampled soil profiles were 40 cm deep. Soil samples were taken from different depth and as volume samples In addition dust samples from sidewalks and streets were collected. The results showed a clear accumulation of pollutants in the southern and south eastern part of the city of Theran. We ascribe this to the prevailing direction of wind from the west and north, and the flow direction of sewage waters from north to south. Furthermore appear relationships between pollutants loads on streets, sidewalks and green areas.



S01.04-P -10

SOIL ORGANIC CARBON STORAGE IN URBAN AREAS: UNDERESTIMATION OF STOCKS AND VARIATION AT A REGIONAL SCALE

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Soils are the foundations of the services provided by terrestrial ecosystems, and play a vital role in the storage of three quarters of the organic carbon sequestered from the atmosphere by plants. However, soil carbon stocks are being depleted by land-use changes globally, mainly through increased disturbance and cultivation. Urbanisation is an important contributor to land-use change, but its effects on soil organic carbon (SOC) have received little attention, particularly in densely built cities such as those in Western Europe. We present the first citywide SOC budget in Europe, for a typical mid-sized UK city (Leicester), including carbon storage to 1m depth based on measurements under the major greenspace areas and capped land under roads and paving. We found, contrary to assumptions currently applied to urban areas in national ecosystem carbon stocks recorded as part of the Kyoto Protocol obligations, the quantities of SOC in urban soils (13kg m⁻² over the entire city surface to 1m depth) exceeds that in adjacent agricultural landscapes. We are currently extending these studies across a 340km latitudinal gradient (55°46'N to 52°41'N) through the UK to establish (a) SOC storage variation across different urban areas (b) variation in urban SOC storage in relation to soil type and (c) variation in urban SOC storage in relation to latitude. These data will help to refine national scale estimates of SOC for urban areas, which to date appear to have been seriously underestimated, particularly in highly urbanized areas.



S01.04-P -11

SUBSURFACE URBAN HEAT ISLAND INVESTIGATIONS IN OBERHAUSEN, GERMANY

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The role of soils in the urban environment is manifold, concerning the thermal aspect ambivalent: on the one hand soils with sufficient moisture content possess a natural cooling potential, on the other hand they are energy reservoirs replenished by human activity. The well known urban heat island (UHI) therefore is not only a phenomenon of the atmospheric boundary layer of cities but also exists in the near and far underground of sealed areas. Dependent on the time of year subsurface urban heat island intensities in depths of one to two meters can reach up to 7 K (daily mean) in comparison to the same depth in the rural environment. In the city of Oberhausen, NRW, Germany, spatially and temporally highly resolved measurements of soil temperature, soil moisture and ground heat flux (01.08.2010 – 31.07.2011) allow a good insight into the temperature- and heat storage distribution in dependence of urban thermal climate zones and soil types. It is shown that heavily modified and sealed sites in proximity of the city center display greater energy content than natural sites most of the year. Using this additional energy serves as adaptation and mitigation strategy at the same time: on the one hand the existing heat will be used on the other hand energy savings contribute to mitigating climate change. Calculations of using this underground energy will be given for different urban climate zones. Also the importance of soil moisture for cooling efficiency will be stressed.



S01.04-P -12

**TYPES, AMOUNT AND POTENTIAL OF URBAN SOILS FOR ORGANIC MATTER
ACCUMULATION**

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The accumulation of organic carbon in urban soils is only marginal described (Burghardt 2001, Burghardt and Niggemeyer 2002). Compared to rural areas soils of urban areas have a wide spectra of types of soil formation and morphology which have are characterized by very distinct distribution of carbon contents in the profile and distinct amounts of stored carbon. The presentation will show the carbon enrichment types and the amount of stored carbon of (1)mainly on the surface occurring carbon accumulation of urban soils of different age and land use, (2)the deep accumulation by compost management of Hortisols, Nekrosols and deposited (allochthonous) materials Technosols, (3) soils from buried horizons with several carbon accumulation layers, and (4) soils developing from dust rich in carbon such as sand and gravel layers with voids filled with dust. Carbon storage in soils is a long lasting process starting with zero carbon content until its maximum is achieved after many years. Urban soils are mostly young soils. That means that they have a high capacity to store organic carbon with time. This effect can be observed even in relictic already organic matter containing soils. This knowledge about the way of organic matter accumulation can be used for targeted organic matter management in urban soils. It should be part of the environmental policy of city administrations.



S01.04-P -13

WHAT POTENTIAL OF BY-PRODUCTS FOR AGRONOMIC USE IN URBAN AREAS?

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The development of green areas in many cities requires the import of soil in large quantities. Besides, in the context of urbanization increase, by-products get to be produced in high amounts and do not always present re-use opportunities. As a result, the strategy is to recycle by-products for a use as soil substitution materials and to preserve the soil resource. If some organic materials such as compost or sludge have already been studied in regard to the effects of their addition on soil properties, they have rarely been mixed together or with other by-products to get a fertile substrate. Therefore, in this study, we focus on five organic materials and five mineral ones. The potential nutrient storage (C, N, pH, CEC, Al, Ca, K, Mg, P₂O₅) of each material has been evaluated and measurements of water storage and physical characteristics, are also in acquisition. Among the materials investigated the organic ones such as compost, paper mill sludge and green wastes show high organic matter content ranging from 28.1 to 69.5 (w/w), and high water content ranging from 40 to 80 % at field capacity. When mixed with the organic ones the mineral materials like bricks are expected to enable the achievement of a mechanical stable mixed substrate. Thus the aim is to complement the low potential of materials from demolition with the high agronomic potential of organic wastes. Ultimately, this characterization will help to produce a modelling tool to lead the suitable mixture of materials for urban plantations.



S02.01-P - INITIAL SOILS – FORMATION, PROPERTIES AND THE ROLE OF STRUCTURES

Thursday 05 July 2012 from 17:00 to 18:30. Room Poster Areas

S02.01-P -1

2012 NATIONAL COOPERATIVE SOIL SURVEY WORK PLANNING CONFERENCES –
NATIONAL COLLABORATIVE RESEARCH AGENDA FOR EMERGING ISSUES

Maxine Levin, Washington DC - United States

S02.01-P -2

CHARACTERISTICS AND CLASSIFICATION OF URBAN SOILS IN THE CITY OF SISAK,
CROATIA

Stjepan Husnjak, Zagreb - Croatia

S02.01-P -3

CLAY MINERALS IDENTIFICATION IN SOIL PROFILES DEVELOPED ON RHYODACITE AND
BASALTE IN SOUTHERN BRAZIL

Leopoldo Radtke, Poitiers - France

S02.01-P -4

COMPARISON OF SOIL TAXONOMY AND WRB FOR DESCRIPTION OF SOIL PROPERTIES IN
ARID AND SEMIARID REGIONS OF CENTRAL IRAN

Mohammad Hassan Salehi, Shahrekord - Iran, Islamic Republic of

S02.01-P -5

CRYSTALLINE IDIOMORFISM LIKE NEOFORMATION SIGN OF QUARTZ GRAINS IN
MEDITERRANEAN SOILS

Jaume Bech, Barcelona - Spain

S02.01-P -6

DEVELOPMENT OF SOIL EVOLUTION AFTER AFFORESTATION OF AGRICULTURAL LANDS
IN GLACIGENIC TILL SOILS OF BOREAL-NEMORAL AREA

Raimonds Kasparinskis, Riga - Latvia

S02.01-P -7

ENDOLITHIC PEDOGENESIS AND ROCK VARNISH ON GRANITOIDES IN EAST ANTARCTICA

Nikita Mergelov, Moscow - Russian Federation



S02.01-P -8

EUROPEAN HUMUS FORMS REFERENCE BASE

Augusto Zanella, Padova - Italy

S02.01-P -9

FORMATION AND EVOLUTION OF INITIAL SOILS IN A LANDSLIDE TERRAIN – A CASE STUDY FROM THE SUDETES (SW POLAND)

Andrzej Kacprzak, Kraków - Poland

S02.01-P -10

GLOBAL AND LOCAL PEDODIVERSITY- RESULTS FROM ARID REGIONS OF SOUTHEAST IRAN

Hossein Khademi, Isfahan - Iran, Islamic Republic of

S02.01-P -11

INFLUENCE OF CYANIDE ON GRANITE DISSOLUTION

Nuttakan Wongfun, Zurich - Switzerland

S02.01-P -12

INITIAL HUMUS ACCUMULATION ON THE EARLY EARTH – COULD LICHENS BE RESPONSIBLE?

Anna Zavarzina,- Russian Federation

S02.01-P -13

INNER OUTWASH PLAINS OF NORTH-EASTERN POLAND – THE SPECIFICITY OF SOILS AND FORMATION CONDITIONS

Arkadiusz Bieniek, Olsztyn - Poland

S02.01-P -14

LATE QUATERNARY PALAEOECOLOGICAL CHANGES IN EASTERN ISFAHAN, IRAN, AS REVEALED BY STABLE ISOTOPE GEOCHEMISTRY OF PEDOGENIC CARBONATES

Omid Bayat, Isfahan - Iran, Islamic Republic of

S02.01-P -15

LONG-TERM EFFECTS OF ORGANIC AMENDMENTS ON PLANT AND SOIL MICROBIAL COMMUNITY DEVELOPMENT FOLLOWING OPEN PIT MINING IN THE CANADIAN BOREAL FOREST

Aria Hahn, Edmonton - Canada



S02.01-P -16

PHYSICAL, CHEMICAL AND MINERALOGICAL CHARACTERISTICS OF VERTISOLS OF THE OCEANIC ISLAND OF FERNANDO DE NORONHA – BRAZIL

Regilene Angélica Da Silva Souza, Recife – Pernambuco - Brazil

S02.01-P -17

PROPOSAL FOR AN INTERNATIONAL SOIL PARENT MATERIAL CLASSIFICATION AS A BASIS FOR RE-INTERPRETING DIGITAL GEOLOGICAL DATA FOR SOIL MAPPING

Ulrich Schuler, Hannover - Germany

S02.01-P -18

RECOVERY OF BIOLOGICAL SOIL CRUSTS AFTER DISTURBANCE ALONG A RAINFALL GRADIENT IN THE TRANSITION ZONE BETWEEN THE NW NEGEV, ISRAEL AND THE PALESTINIAN GAZA STRIP

Daniel Steckenmesser, Giessen - Germany

S02.01-P -19

RELICS OF TERTIARY WEATHERING IN SOILS OF THE SWABIAN ALB, CARSTIC PLATEAU

Karl Stahr, Stuttgart - Germany

S02.01-P -20

SOIL AGGREGATION IMPROVEMENT DUE TO SOIL MANAGEMENT ON SUGARCANE

Carolina Fernandes, Jaboticabal - Brazil

S02.01-P -21

STUDYING THE TEXTURE AND CEC PROPERTIES OF SOILS DEVELOPED ON KARAJ GREEN TUFF

Esmail Saberi Moghadam, Karaj - Iran, Islamic Republic of

S02.01-P -22

SURVEY SEMIDETAILED SOIL OF THE FARM SCHOOL ST LOUIS - FESL/UEMA

Oliveira Sá Sandra Maria , Sao Luis - Brazil

S02.01-P -23

THE NATURE OF PARENT MATERIALS IN ITALIAN MOUNTAIN SOILS: A NATIONWIDE STUDY

Simona Vingiani, Portici (NA) - Italy



S02.01-P -24

THE SPECTROHOTOMETRIC ANALYSIS OF THE SHIRVAN STEPPE (AZERBAIJAN) SOILS

Ali Jafarov, Baku - Azerbaijan

S02.01-P -25

TPOLOGY AND DIRECTIONS OF EVOLUTION OF BRUNIC ARENOSOL FROM PUSZCZA BIALA

Józef Chojnicki, Warsaw - Poland

S02.01-P -26

UPGRADING OF FINE LEONARDITE FROM THRACE REGION

Vedat Taylan Engin, Izmir - Turkey



S02.01-P -1

2012 NATIONAL COOPERATIVE SOIL SURVEY WORK PLANNING CONFERENCES – NATIONAL COLLABORATIVE RESEARCH AGENDA FOR EMERGING ISSUES

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The US National Cooperative Soil Survey (NCSS) National Conferences convene to discuss and develop solutions to issues of national concern to the National Cooperative Soil Survey. Participants of the NCSS include representatives from the land-grant universities experiment stations, NRCS, USFS, BLM, BIA, EPA, USFWS, SSSA, and tribal colleges. Other interested foreign and domestic groups such as lead scientists from Canada, Mexico and other cooperative countries are invited to participate. Committees convene each year at the regional and national meetings to establish a collaborative work plan to address grassroots issues as well as national priorities under the national umbrella of the NCSS. The Research Agenda Committee has established a collaborative work plan to address emerging issues. Priorities are divided into 3 categories: Short-Term Priorities, Global Priorities and National Applications. Short-Term Priorities are focused on soil change, new technology, ecological site descriptions, subaqueous soils, landscape hydraulic function and hydrogeology, gypseous and salt-affected soils and NCSS database harmonization. Global Priorities are focused on scaling/extrapolation, landscape-scale carbon processes and accounting, integration of soil organic carbon and land use, adaptation and prediction of soil CO₂ sequestration, soil ecosystem services, soil function, and development and testing of decision support tools. The final category of Application of Soil Survey Data includes the integration of carbon and land use data into conservation planning and related activities, data validation and urban/suburban interpretations. This paper briefly overviews highlights of the 2012 NCSS research agenda with specific examples



S02.01-P -2

CHARACTERISTICS AND CLASSIFICATION OF URBAN SOILS IN THE CITY OF SISAK, CROATIA

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City of Sisak is characterized by continuity of urban living for more than 2000 years. Significant portion of its urban area is occupied by land used for parks, playgrounds, smaller agricultural plots, etc. The aim of this paper was to present the characteristics and classification of urban soils in Sisak, according to Croatian Soil Classification (CSC) and WRB, on the basis of three soil profiles. Urban soils in Croatia were mainly systemized into the class of Technogenic soils, as Deposol soil type. However, in some of those soils, it is possible to detect evidence of ongoing pedogenetic processes, resulting in further soil development. In two of the three investigated soil profiles, pedogenesis led to formation of a humus accumulative horizon. Since in CSC this horizon is diagnostic for the class of Humus accumulative soils, we classified these soils as Rendzinas on deposited land material. According to WRB, one of these soils was classified as Urbic Technosol (Calcaric, Humic, Skeletic) and the other as Endostagnic Regosol (Hypereutric, Siltic, Transportic). In only one of the three investigated soil profiles, the organic matter in the surface horizon has not accumulated mainly as a result of natural pedogenesis. This profile featured a nylon film below the artificially formed humus rich surface layer, and was classified as Deposol on land material, according to CSC, or as Linic Technosol (Calcaric, Ruptic, Siltic), according to WRB. Finally, the recommendations for division of Deposols, as well as Rendzinas on land material, to lower level units are given.



S02.01-P -3

CLAY MINERALS IDENTIFICATION IN SOIL PROFILES DEVELOPED ON RHYODACITE AND BASALTE IN SOUTHERN BRAZIL

Radtke Leopoldo*^[1], Caner Laurent^[1], Inda Junior Alberto^[2], Vignol-Lelarge Maria Lidia^[3], Mexias André^[3], Edson Campanhola Bortoluzzi^[5]

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The Rio Grande do Sul state in southern Brazil is intensively cultivated due to its subtropical climate. Clay mineralogy and especially 2:1 clay minerals plays a key role in soil fertility by contribution to cation retention in these soils with low cation exchange capacity. Two soil profiles developed on basalt and on rhyo-dacite were sampled for their different horizons from the surface to the bedrock. Total element analysis, physico-chemical properties and clay mineralogy identification were performed. X-ray diffraction of Ca-saturated clay samples was performed on air-dried state (AD) at room temperature and following ethylene glycol solvation (EG). K-saturated clay samples were recorded at AD, 110°C, 300°C and 550°C. Samples were also treated with sodium tricitrate (Tamura treatment) in order to identify hydroxy-interlayered clay minerals. The soils present a low CEC and the exchangeable cations are dominated by Al. The clay mineral assemblage is formed with kaolinite and a non-swelling 2:1 clay mineral in the surface horizons. Gibbsite is also present in the soil derived from rhyo-dacite. The incomplete collapse following Tamura treatment, K-saturation and heating allowed identifying this clay 2:1 mineral as hydroxy-interlayered vermiculite (HIV). The presence of HIV in the surface horizons can be linked to acidic conditions favoring the accessibility of Al to interlayer space of 2:1 clays minerals. The proportion of interlayer Al in the 2:1 clay minerals controls at least partly the CEC of the soils and thus cation retention (K, Ca). This study shows that despite strong weathering these soils present 2:1 clay minerals.



S02.01-P -4

COMPARISON OF SOIL TAXONOMY AND WRB FOR DESCRIPTION OF SOIL PROPERTIES IN ARID AND SEMIARID REGIONS OF CENTRAL IRAN

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One of the main reasons of soil classification systems is to identify the differences of soil properties for management purposes. In this study, the efficiency of American and WRB soil classification systems were compared in order to describe soil physical, chemical and mineralogical properties in arid and semiarid regions of central Iran. Khatoon Abad and Mobarekeh plains as arid regions and Koohrang and Shahrekord plains as semiarid regions were selected. Then, representative pedons of each plain were chosen from 16 excavated pedons and soil samples were taken from genetic horizons to determine soil classification. Results showed that soil orders of both Koohrang and Khatoon Abad plains are vertisols according to American soil classification system whereas these soils are classified as cambisols and calsisols, respectively based on WRB system. On the other hand, both Mobarekeh and Shahrekord soils are classified as calcisols in WRB system whereas these soils are classified as aridisols and inceptisols, respectively according to American soil taxonomy. None of soil classification systems could show the existence of gypsum in horizons lower than 100 cm for Mobarekeh soil. Clay mineralogy indicates that smectite is the dominant clay mineral in Koohrang soil as explains well at family level of American soil classification system. Results of soil classification at lower levels suggest that WRB has somewhat higher efficiency than American soil classification system for description of the soils in the study area.



S02.01-P -5

CRYSTALLINE IDIOMORFISM LIKE NEOFORMATION SIGN OF QUARTZ GRAINS IN MEDITERRANEAN SOILS

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In studies with scanning electron microscopy (SEM), of the light fine sand fraction of selected Mediterranean soils (Chromi-Leptic Luvisol, Delgado et al., 2003; Typic Calcixeroll and Fluventic Haploxeroll, Márquez-Crespo, 2003), we have recognized quartz grains that can be described as near-idiomorphic crystals. They show crystalline forms with faces, edges and vertices, well defined. In quartz crystals is common the association of two rhombohedra faces, $r \{1011\}$ and $z \{0111\}$, which generate a pseudobipyramid, and the prism face $m \{1010\}$. In some of these quartz grains have even been observed growth striations and some fine granular films on its surface, possibly of colloidal silica (Delgado et al., 2003). It is an unequivocal symptom of the process of crystal growth. The soil solution of some of the horizons of these soils (for example Ah, Typic Calcixeroll), where appear the described morphologies of quartz grains, has a concentration of dissolved silica that exceeds the saturation levels to mean annual soil temperature (Rimstidt, 1997). These evidences allow establishing the mineral neoformation as a plausible hypothesis in these soils. Thus, quartz grains grow to develop the near-perfect crystalline forms observed. The detected process has been classically described in highly developed soils like tropical soils (Whitehouse, 1940; Eswaran, 1970; Flageollet, 1981) and in some mediterranean soils (Torcal Tello-Sainz and Ripa, 1992). With our results the paradigm of the quartz stability in Mediterranean environments is questioned.



S02.01-P -6

DEVELOPMENT OF SOIL EVOLUTION AFTER AFFORESTATION OF AGRICULTURAL LANDS IN GLACIGENIC TILL SOILS OF BOREAL-NEMORAL AREA

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Land use history determines the soil-forming processes, morphology, physical and chemical properties. Considering that afforestation of agricultural lands is taking place in Europe, it is important to clarify development of soil-forming processes after afforestation. This information is significant for the interpretation of land use history, improvement of soil mapping and modelling of its spatial distribution, as well as to develop proposals for land management. The afforestation impact on soil properties and processes were investigated in glacial till soils in the central part of Latvia. Development of podzolization process is observed in first 70 years after afforestation, as indicated by morphological features (genesis of secondary E and B horizons), decrease of pH_{KCl} value, changes of amorphous aluminium (Al_o) and iron (Fe_o) content in soil horizons. Afforestation also affects the content of soil organic carbon. The major part of organic carbon accumulates in O horizon of forest soils. In investigated forest soils the thickness of O horizon (mull and moder type) differs from 1 to 10 cm, and this thickness does not depend on the age of forest land, but is affected by predominant vegetation as well as chemical composition of mineral topsoil. In general, more intensive biological cycle of organic matter and relatively slow development of podzolization are observed in afforested agricultural lands in comparison to older forest lands in glacial till deposits.



S02.01-P -7

ENDOLITHIC PEDOGENESIS AND ROCK VARNISH ON GRANITOIDES IN EAST ANTARCTICA

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Rock varnish and endolithic organisms being quite widespread phenomena on Earth are very well studied apart however their interaction and possible cogenesis had never been particularly explored. Endolithic organisms – are important primary producers in the ice-free areas (oases) of Antarctica (Friedmann, 1982) inhabiting structural cavities in the superficial rock interior. The other common feature of Antarctica oases is the red-brownish colour of solid rocks (granites, gneisses etc.) which is traditionally attributed to the presence of Fe-Mn-coatings on the surface (rock varnish). Our explorations showed that such system as “endolithic organisms-granitoid rock-weathering products” has all features to be denominated as soil: (1) rock layer exposed to external abiotic factors; (2) this layer is inhabited by living organisms synthesizing and decomposing organic matter (OM); (3) induced by biotic and abiotic factors initial lithomatrix is transformed in situ, transformation products are retained and/or taken away, vertical heterogeneity (microprofile) is formed. Organo-mineral horizons of endolithic soil contain 0,2-3,3% C and 0,02-0,47% N. ¹⁴C mean residence time of OM reaches 480±25 BP. Major pedogenesis products – numerous Fe-C-Si-Al-S-Cl-Ca-Mg-containing bio-coatings which cover cavities inside the rock. Main binding material – amorphous silica and Al with incorporated bio-mineral detritus. C content – 10-50%. SEM morphology and elemental composition of coatings correspond very well to those observed in varnish on rock day surface. Thus, certain types of rock varnish could be the products of endolithic pedogenesis exposed after exfoliation and transformed by external factors. This hypothesis doesn't claim to explain all rock varnishes (e.g. formed by accretion).



S02.01-P -8

EUROPEAN HUMUS FORMS REFERENCE BASE

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From 2003 on, a panel of experts in humus and humus dynamics (Humus group) has been working on a European Humus Form Reference Base. It roots deeply in national humus form classification systems, while a lot of work had to be done in order to standardize definitions and approaches. Some important goals have been reached, in order to share data and experiences: a) the definition of specific terms; b) a description of 15 types of diagnostic horizons and c) of 10 basic humus forms references; d) the subdivision of each main reference in 2-4 subunits; e) the elaboration of a general European Humus Form Reference Base(http://hal-agroparistech.archives-ouvertes.fr/docs/00/56/17/95/PDF/Humus_Forms_ERB_31_01_2011.pdf); f) the publication of the scientific significance of this base of classification as an article [A European morpho-functional classification of humus forms. *Geoderma*, 164 (3-4), 138-145]. The classification will be updated every 2 years and presently the Humus group is assessing biological (fungi, bacteria, pedofauna), physical (air temperature, rainfall) and chemical (pH, nutrients, quality and quantity of humic compounds...) factors which characterize basic humus forms and their varieties. The principles of the classification, the diagnostic horizons and humus forms main references are presented at the 4th International Congress of ECSSS with the aim to stimulate the participants' curiosity. Interested people are invited to test the classification system in various environments and collaborate with the Humus group. Critical observations and field data/assessments are welcome as every other suggestion which can help in elaborating the 2013 version of the European humus forms classification.



S02.01-P -9

FORMATION AND EVOLUTION OF INITIAL SOILS IN A LANDSLIDE TERRAIN – A CASE STUDY FROM THE SUDETES (SW POLAND)

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Due to its specific geological structure i.e. interbedding of Paleozoic volcanic rocks and sedimentary sandstones and shales the area of Góry Kamienne (Central Sudetes) is susceptible to mass-wasting processes. A large number of forms resulting from a range of processes (landslides sensu stricto, flowslides, rockfalls) and of supposedly various age can be observed. Mass wasting activity can be a factor directly controlling the structure of soil cover at certain locations. Depending on the bedrock (crystalline or sedimentary), age and nature of mass movements different soils and structures of soil cover have developed in the investigated area. However, the main characteristic is a large variability of soils in a relatively small area. Most mapping units, even at large mapping scales, are complex associations of soil units with unique properties. The most typical and widespread are various units of Leptosols and Regosols, undergoing further evolution towards specific units of Histosols, Umbrisols and Cambisols. Analysis of soil properties such as the content and distribution of organic carbon, development of soil structure and profile horizonation may be used as a useful tool to estimate the relative age of different generations of mass movements. To a limited degree it may also be used to infer absolute age of landslides ranging from inactive Pleistocene forms, through early Holocene to those which may have formed as recently as a few hundred years ago.



S02.01-P -10

GLOBAL AND LOCAL PEDODIVERSITY- RESULTS FROM ARID REGIONS OF SOUTHEAST IRAN

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A geomorphic hierarchical downscaling method was used to decompose the forms and processes forming the landscapes and their subdivisions in an arid region of southeast Iran. This paper discusses the study of pedodiversity in two ways (1) based on the global scale using the digital soil map and (2) the local pedodiversity based on geomorphic hierarchical downscaling method. The calculation of diversity indices were carried out according to taxonomic categories of order, suborder, great group, and subgroup. Using the feed forward back-propagation algorithm, a neural network was trained for prediction of the digital soil map in each category level. The results showed that the diversity indices increase from soil order to soil subgroup at global and local scales. Therefore, the greater number of soil units or higher density of the soil map, the higher diversity at the subgroup category. An increase in K-entropy of soil and landscape confirms the hypothesis of soil divergence evolution, whereby differences in initial conditions or local perturbations, and dynamic in stability appear to have produced more variable soils and landscapes in the study area. The global diversity obtained based on soil map, so diversity measures depend on the density of the soil map. Therefore, higher soil diversity was achieved with greater density of different soil units. It was observed that areas with more detailed soil mapping units exhibit the largest pedodiversity and it was concluded that the measure of pedodiversity depends amongst others on the detail of the soil survey in an area.



S02.01-P -11

INFLUENCE OF CYANIDE ON GRANITE DISSOLUTION

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*In the course of glacier retrieval and loss of permafrost, rocks become loose and are subjected to erosion. This development can be limited or prevented only if soil and vegetation cover is developed rapidly. Weathering is seen as provision of nutrients that are required by the pioneering life in deglaciated alpine areas, where soil development is at its initial stage. Living organisms modify their local environment by various exudates, including cyanide. Cyanide formed in the prebiotic soup is considered as the oldest lixiviant. Several cyanide-producing bacteria enhance elemental release by extensive colonisation of granite surfaces. We studied the effect of cyanide on granite dissolution in batch experiments under controlled conditions. Rocks, weathered stream sediments and bacterial strains were obtained from the Damma glacier area (Central Alps, Switzerland). Abiotic experiments in absence of cyanide show an increase of released Fe with decreasing pH (0.02 $\mu\text{mol/L}$ at pH 7 and 2.56 $\mu\text{mol/L}$ at pH 5). Cyanide, conversely, appears to enhance dissolved Fe concentration in particular with increasing pH (3.96 $\mu\text{mol/L}$ at pH 5 and 32.62 $\mu\text{mol/L}$ at pH 7). This suggests that elevated concentration of deprotonated cyanide become more important for the formation of Fe-cyanide complexes. Biotic influence of granite dissolution was studied under nutrient-limited conditions. Preliminary results show that *Pseudomonas* species exhibit a relatively high potential to dissolve granite material, in particular *P. fluorescens*, which is known as an effective cyanide producer.*



S02.01-P -12

INITIAL HUMUS ACCUMULATION ON THE EARLY EARTH – COULD LICHENS BE RESPONSIBLE?

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Soil development is a major process in transformation of land surface into habitable environment. Most soils in the modern biosphere are the product of higher plants. But what was before their appearance on land? Which vegetation on the early Earth could produce first humified soils? About 90% of soil humus is represented by recalcitrant humic substances (HS) and their complexes with dispersed minerals. HS are mainly formed from various polyphenols which undergo oxidative transformation in presence of fungal laccases and peroxidases or soil minerals and then spontaneously couple with nitrogenous compounds, carbohydrates etc. Thus, ultimate precondition for the formation of modern-type organic-mineral soils is presence of biota which serves as a source of phenolic compounds. The earliest steps in land colonization might be linked to the algo-myco-bacterial communities which moved from inland freshwater bodies to the porous wet ground (GA Zavarzin, in press). Representatives of algo-myco-bacterial world formed lichenized consortia as adaptation to severe conditions on the unshaded land surface. Algae and cyanobacteria lack phenolic compounds. In present work the role of lichens as possible organisms responsible for the early humification process will be discussed. Lichens are often pioneers on rocky surfaces and are well known for their high stress-tolerance and participation in mineral weathering. We have recently discovered that lichens produce laccases and tyrosinases as well as noticeable amounts of soluble phenolic compounds. Thus lichens can contribute to primary accumulation of soil organic matter via products of thalli decomposition, leached-off phenolic compounds and enzymes that catalyze humification.



S02.01-P -13

INNER OUTWASH PLAINS OF NORTH-EASTERN POLAND – THE SPECIFICITY OF SOILS AND FORMATION CONDITIONS

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Scandinavian ice sheet had the maximum reach in Poland remaining young glacial relief. Its scope is marked mainly by geomorphologic criteria: “freshness” of the relief, lake channels, frontal moraines and outwash plains. Inner outwash plains (interglacial) were formed as a combined glacifluvial system or a closed area in a following combination: flow through channel, outwash plain, area of ice dammed lakes origin. The research was carried out on a route of outwash plains in Lyna river valley as well as forested and agriculturally used closed outwash plains areas. The route of outwash plains begins near Sepopol and runs south-west. Near Laniewo, its origin is different. It was formed as a result of discharge of glacial streams to the south. Its width reaches 12 kilometers and the most narrow part is approximately 500 meters. It finishes its run near Olsztyn making a wide fan in the south. It is a marginal zone of Pomeranian phase of Vistulian glaciation. The study comprises site conditions as well as analyses of pedo- and lithogenetic processes in these areas. Soil-forming processes occurring in homogenous lithogenetic area, which is closed by waters flowing from melting glacier were also analysed. The specificity of formed soils, including morphology, physical and chemical properties and forms of iron, enabled to estimate the soil-forming processes. Particularly important are the contact zones between the outwash plain, moraines and area of ice-dammed lakes origin. Moreover, the differences in trophism of soils of outwash plains were studied.



S02.01-P -14

LATE QUATERNARY PALAEOECOLOGICAL CHANGES IN EASTERN ISFAHAN, IRAN, AS REVEALED BY STABLE ISOTOPE GEOCHEMISTRY OF PEDOGENIC CARBONATES

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Only a few studies have been carried out on the relationship between geomorphic surfaces, isotope geochemistry of pedogenic carbonates and Quaternary palaeoecological changes in arid lands of Iran. The aims of this study were to investigate the pedogenic carbonates properties in different geomorphic surfaces of an alluvial fan in eastern Isfahan and ecologicological and climatic conditions during evolution of this surfaces. Three pedons on geomorphic surfaces of an alluvial fan were selected and studied. Paleovegetation of study area was identified using signals from carbon isotopes in pedogenic carbonates. The results indicate that the expansion of C4 plants occurred during periods with low $d18O$ (glacial periods). It seems that the decrease in atmospheric carbon dioxide concentration during glacial periods was the main factor responsible for the expansion of C4 plants in the region. These results are in corroboration with palynological investigations in western Iran. It also appears that the changes in atmospheric carbon dioxide and other climatic factors significantly influenced the palaeoecology, landscape stability, soil erosion and pedogenic development of studied pedons. This is particularly important because of an increase in greenhouse gases and global warming in recent years that can affect ecological changes, desertification and soil erosion in arid regions of central Iran.



S02.01-P -15

LONG-TERM EFFECTS OF ORGANIC AMENDMENTS ON PLANT AND SOIL MICROBIAL COMMUNITY DEVELOPMENT FOLLOWING OPEN PIT MINING IN THE CANADIAN BOREAL FOREST

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In natural areas, forest floor layers overlying mineral soils contribute to ecosystem recovery after disturbance. The application of forest floor materials as an organic amendment to reclaimed areas has been shown to result in a greater native revegetation response compared to sites reclaimed with a peat amendment. However, the influence of native vegetation on early stage soil microbial community development is not yet fully understood. This study describes the combined effects of organic amendment, moisture, and plant cover on soil microbial community development in a long-term (seven year) field experiment. Phospholipid fatty acid analysis was used to characterize and compare soil microbial community composition and development on reclaimed and natural forest sites. Additionally, we conducted a laboratory moisture manipulation experiment. The use of salvaged forest floor material as an organic amendment resulted in a greater percent cover of upland vegetation and placed the soil microbial community on a faster trajectory towards ecosystem recovery than did the use of a peat amendment salvaged from nearby lowlands. The soil microbial composition within the reclaimed sites exhibited a greater response to changes in moisture than did the soil microbial communities from natural forest sites. Our research shows that the use of native organic amendment (forest floor) on reclaimed sites, and the associated establishment of native vegetation, promotes the development of soil microbial communities more similar to those found on natural forest sites. Additionally, natural soil microbial communities may be more resistant to changes in soil moisture than those found on reclaimed sites.



S02.01-P -16

PHYSICAL, CHEMICAL AND MINERALOGICAL CHARACTERISTICS OF VERTISOLS OF THE OCEANIC ISLAND OF FERNANDO DE NORONHA – BRAZIL

Adriano Marques Flávio^[1], Rosas Ribeiro Mateus^[2], Severino De Souza Júnior Valdomiro^[2], Da Silva Souza Regilene Angélica^{*[2]}, Wanderley Fernandes Lima José Fernando^[2], Santos De Sousa Juliet Emilia^[2]

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The oceanic islands due their geographical isolation, often show a unique biodiversity, which have received great attention from the scientific community because of their environmental importance. In Brazil, due the extent of its coastline, several oceanic islands can be found, among them, the Fernando de Noronha (FN) archipelago, located at 345 km far from the Brazilian coast. The Vertisols developed in FN are strongly influenced by the parent material of volcanic or sedimentary origin, and by the dry tropical climate with great oceanic influence, but were still little studied. This work aimed to study Vertisols of common occurrence in FN, formed from different parent materials, emphasizing their physical, chemical and mineralogical characteristics. The study was performed in five soil profiles, representatives the soil mapping units, reflecting changes in parent material and topography. Physical, chemical and mineralogical analyses were carried out in the collected soil profiles. The Vertisols were developed on the main island central plateau, related with slightly depressed areas and have poor drainage, and are characterized by very clayey texture. Sum of bases and base saturation were high, with increasing the values of exchangeable sodium in subsurface horizons, showing sodic or solodic character, according to Brazilian System of Soil Classification. The available phosphorus values were very high. The mineralogy of the silt fraction was uniform in all horizons, indicating similarity of the parental materials. The dominant minerals in this fraction were: kaolinite, feldspar, mica and pyroxene. In clay fraction, the dominant minerals were: smectites, micas and kaolinite.



S02.01-P -17

PROPOSAL FOR AN INTERNATIONAL SOIL PARENT MATERIAL CLASSIFICATION AS A BASIS FOR RE-INTERPRETING DIGITAL GEOLOGICAL DATA FOR SOIL MAPPING

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In the frame of the eSOTER project new methods for soil science relevant delineation of terrain units using GIS models are developed. This is largely based on digital terrain and lithology data. Emphasis is here on the development of a lithological classification thought to revise the existing FAO one, in order to ease subsequent digital soil mapping. With these activities, the BGR also supports the global environmental monitoring system GEOSS (task "global soil data"). The existing parent rock classification systems have several shortcomings in the way that they are often inconsistent, only locally applicable, incomplete, and contain not defined terms. The proposed classification consists of two parts. In the first part the parent rock properties are described according to the consolidation degree, the geochemical character, and the major rock type which serve as indicators for direction and extent of soil formation. In the second part, surface processes related to the genesis of the parent rock are described. These processes are specified into ongoing and relictic ones. The reason for the latter distinction is that it allows for a separation of rather young and more developed soil formation. The proposed classification can be used to generate a harmonized soil parent material map for Europe, which in turn can serve as an important data layer in digital soil mapping.



S02.01-P -18

RECOVERY OF BIOLOGICAL SOIL CRUSTS AFTER DISTURBANCE ALONG A RAINFALL GRADIENT IN THE TRANSITION ZONE BETWEEN THE NW NEGEV, ISRAEL AND THE PALESTINIAN GAZA STRIP

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Sandy soils of the semiarid dune fields of the Palestinian Gaza Strip and the Israeli western Negev are covered by biological soil crusts (BSC), which stabilize the surface and prevent desertification. Landuse of these fragile ecosystems induces destruction of the BSC and initiates desertification. To investigate the recovery of BSC after disturbances recovery plots were monitored for a 3 year period along a rainfall gradient (90 mm a⁻¹ to 170 mm a⁻¹). The BSC was sampled in two depths (0 – 2 mm, 2-30 mm) and the underlain topsoil up to 10 cm was collected. Samples were analysed on their concentrations of calcium carbonate, water soluble nitrogen, cations and anions and particle size distribution. The amount of salts was calculated based on Simon et al. (1995). After one year of recovery a stabilized crust was obvious, showing higher concentrations in salts and soluble nitrogen fractions than the unstabilized dune sand. The recovery of the active BSC topcrust induced an enrichment of fine particles and nitrogen at the soil surface. We conclude that an enrichment of nutrients is linked to BSC recovery.



S02.01-P -19

RELICS OF TERTIARY WEATHERING IN SOILS OF THE SWABIAN ALB, CARSTIC PLATEAU

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The so called Hamocky Swabian Alb is one of the oldest land surfaces, which does occur in Southwest Germany. In the upper Jurassic period this landscape felt dry and was never subsided under water since then. However, the time sequence of influence was different, as in the early period of Cretaceous and throughout the Paleogene it seemed to be that the groundwater level was still rather high in the area of 20 to 50 m below the surface. Only in the Neogene and Pleistocene period, the plateau raised due to alpine orogenesis and following tilting of the tectonic landscapes of south Germany it rose up to 500 to 1000 m. Also the climate development has influenced the soil cover as it was till the end of Paleogene period a warm tropical climate and then it became Mediterranean and later temperate with some periglacial periods included. In places on this plateau the formation of silicatic limestone residue has continued over millions of years. However, erosion transport of soil material and addition of Pleistocene loess has modified the soil cover. Several processes, which took place in Paleogene and Neogene period have overprinted the soil cover and are still observable as relic features. This Kaolinitization/ desilification/ rubefication / clay illuviation of layer charged clays and the formation of plinthitic concretions as well as a Neogene calcrete formation.



S02.01-P -20

SOIL AGGREGATION IMPROVEMENT DUE TO SOIL MANAGEMENT ON SUGARCANE

Fernandes Carolina*^[1], Truber Priscila Viviane^[1], Silva Roniram Pereira Da^[1], Marcelo Adolfo Valente^[1], Corá José Eduardo^[1]

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Soil aggregation is an important soil physical quality indicator, because it can be changed by soil use and management over time. The objective of the present work was to evaluate the soil aggregation of two clayey Red Oxisol (RO1 = 700 g kg⁻¹ and RO2 = 450 g kg⁻¹), submitted to two soybean (Sb) growing seasons, having different crops (sunnhemp (Sh) and millet (Mi)) between them, during two sugarcane (Sc) growth periods interval. The experiment took place in Brazil (21°14'05" S, 48°17'09" W). The randomized block design was used with three treatments (Sc/Sb/Sh/Sb/Sc, Sc/Sb/Mi/Sb/Sc and Sc/Sb/fallow/Sb/Sc) and five replications. Soil samples were taken from 0 - 0.10, 0.10 - 0.20, 0.20 - 0.40 and 0.40 - 0.60 m depths, at four different times: before the first soybean growing season (October/2008), before the second soybean growing season (October/2009), before planting sugarcane (February/2010) and after first sugarcane harvest (June/2011). The treatments did not affect the soil aggregation (aggregates 2.0 - 1.0 mm). However, soil aggregation on June/2011 was significantly ($p < 0.01$) higher when compared to those obtained on October/2008. The results indicated that the soil management adopted increased soil aggregation over time.



S02.01-P -21

STUDYING THE TEXTURE AND CEC PROPERTIES OF SOILS DEVELOPED ON KARAJ GREEN TUFF

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Soils formed in volcanic materials have many distinctive physical, chemical, and mineralogical properties that are rarely found in soils derived from other parent materials. The goal of this research was to examine the properties of soils developed on Karaj green tuff. Because of Mountainous, steep and Semi-arid Climate in this region, soils were in primary levels of development and classify in entisols and inceptisols orders. The results showed that clay percentage changes between 7 to 36 and CEC changes between 14 to 32.7 cmol+/kg. the CEC/clay ratio was in range 0.78 to 4.52. high contents of CEC/clay ratio shows clay content is lower than real clay content. texture analysis of volcanic soils is challenging due to poor colloidal dispersion resulting from the presence of allophan and extremely stable aggregates. Consequently, it's important to Subtilize texture interpretation of volcanic soils.



S02.01-P -22

SURVEY SEMIDETAILED SOIL OF THE FARM SCHOOL ST LOUIS - FESL/UEMA

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The semidetailed soil survey is an important tool for management and planning of land use. The main objective of the research was to identify, classify and map soils in semi detail of the Farm School St. Louis, seeking more subsidies to the activities of experimental research, planning, planning and sustainable land use. This work constitutes a soil survey on the scale 1:25,000, held in St. Louis School Farm - FESL/UEMA, located at the State University of Maranhão in St. Louis - MA, covering an area of 67.08 ha. For this purpose, we used the method of the free way in which, 7 were georeferenced points for sample collection. For the initial delimitation of physiographic units was used 1:5,000 scale aerial photographs and topographic contour lines with equal distance in meters underground. The morphological, physical and chemical profiles have identified two classes of soils in the 1st level categorical: Ultisol and Entisols, and free mapping units: PVAd, and PACd RQo. About 95% of the classes found correspond to the Ultisols and Entisols to only 4.5%. they are soils of low fertility, well drained, sandy to sand frank, with high susceptibility to erosion. The identification of these soils give greater support to the diagnosis of land use, as well as the work of research, teaching and testing throughout the academic community.



S02.01-P -23

THE NATURE OF PARENT MATERIALS IN ITALIAN MOUNTAIN SOILS: A NATIONWIDE STUDY

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Recent observations in Italian mountain ecosystems indicated the presence of homogeneous soils, frequently andic, on different rock substrates and in areas of high primary productivity. Despite their distribution over large areas of the Italian mountains and their importance for ecosystems, very little is known about their genesis. It is unknown if these soils developed from i) different parent materials, in similar pedo-climatic conditions, or ii) volcanic ashes of the largest plinian eruptions (Phlegrean and Aeolian like), or iii) re-distributed eolic sediments (loess) produced by the Quaternary ice ages. Then, the aim of this work was to investigate the relationship between these particular soils and their underlying bedrock, that means to understand if/how the bedrock represents the soil parent material. In the case of volcanic parent materials occurrence, the origin district was also investigated by chemical analysis of volcanic shards. To achieve this goal, 41 soil profiles in various Italian non-volcanic mountain ecosystems were described, sampled and analyzed for the main chemical and physical properties. Moreover, the particle size distribution curves (by laser) were assessed, as well as the magnetic susceptibility and the geochemistry of 38 elements (by ICP-MS). On selected soils, mineralogy (by XRD) and volcanic glass composition (by SEM-EDS) were also evaluated. Results highlighted the importance of this integrated analytical approach to i) face the complexity of the Italian mountain areas, ii) verify frequent marked differences between soil and substrate, iii) find windblown sediments in soils, iv) assess geochemical diversity bedrock-soil between north and south of Italy.



S02.01-P -24

THE SPECTROHOTOMETRIC ANALYSIS OF THE SHIRVAN STEPPE (AZERBAIJAN) SOILS

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The object of the research was selected in the soil of the step of Shirvan (Azerbaijan), distinguishing by a diversity of the ancient and temporary deposits of the different historical period, including different conglomerations, sand, grain of sand, silt, limestone, loam, gravel and etc. The soil samples are ready for an analysis, situated in the special curette entering the complete of spectrophotometer SF-18. Thus on the basis of spectrophotometric analysis of the different types of the soil in limits of the Shirvan steppe, the influence of the component composition of this soil is established on character and form of the curve light reflecting coefficient. In this work the spectral curve reflections on a profile of soils are investigated, transfer functions of communication between data of the top and bottom horizons are made, that is allowing at remote measurements to extrapolate the distantly obtained soils properties for the horizon data on deeper horizons. The ancient and modern sediments of the various historical period including various conglomerates, sands, sandstones were objects research, or lime-stones, loams etc. The irrigated agriculture here is from time immemorial conducted, the processes of salinization, erosion and pollution are widely developed. Here are carbonate, sulfate-hydro-carbonate, chloride-hydro-carbonate and sulfate-carbonate types of salinization. The received spectrograms on a profile of the investigated soils have shown distinction not only depending on type of soils, but also within their profile. All distinctions have been compared from structures and a condition of soils and have received corresponding explanations.



S02.01-P -25

TYPOLOGY AND DIRECTIONS OF EVOLUTION OF BRUNIC ARENOSOL FROM PUSZCZA BIALA

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^[1]University of Life Sciences - SGGW ~ Department of Soil Environment Sciences ~ Warsaw ~ Poland

Puszcza Biala (White Forest) is a forest complex covering an area of almost 51,000 ha between the Bug and Narew rivers (nearly 50 km to the northeast of Warsaw). Following the WRB Soil Classifications [2006], Brunic Arenosols developed from fluvioglacial sands predominate in the area. The studied soils have the following sequence of genetic horizons in the soil profile: humus, sideric, and parent rock. In the sideric horizons an insignificant increase of the free iron content in comparison to the humus horizons was noted, whereas a considerable 2 to 3-fold increase of the contents of different forms of aluminium (free, extractable by acid ammonium oxalate and sodium pyrophosphate) was observed. Part of the soil was classified as Brunic Albic Arenosol, which indicated considerable enrichment of the sideric horizons in all studied forms of aluminium (2 to 3-fold), as well as iron (near 2-fold) in comparison to the humus horizons. XRD analysis of the clay fraction indicated the occurrence of vermiculite and kaolinite in all horizons of the studied soils and illite only in the humus horizons and parent rock. In the humus horizons of both soil subtypes occur also mixed-layered minerals, whereas the presence of mixed-layered illite-vermiculite with the superiority of the illite package was determined only in Brunic Albic Arenosol. Probably the studied Brunic Arenosol will be transformed into Brunic Albic Arenosol and further into podzol soils. The podzolization process of the soils is promoted mainly by their cover by coniferous vegetation (the Quercus robur-Pinetum plant association).



S02.01-P -26

UPGRADING OF FINE LEONARDITE FROM THRACE REGION

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Farming is the most important source of income for the people living in the Thrace region of Turkey. However, the extensive use of chemical fertilizers in farming has caused some deleterious impacts on the soil and human health today. Leonardite is commonly used as a nutrient for the soil and it is very important for the agricultural activities. For this reason, characterization and concentration of the Thrace region leonardites have a great deal of importance for Turkey's economy. This study aims to define and upgrade the headsamle. For this purpose, full chemical coal, fractional ash and humic acid analyses were applied to the headsamle. Then this sample, with 47.82% total humic acid and 47.25% free humic acid, was divided into four size fractions namely, 9.51/4.75, 4.75/2, 2/0.710, 0.710/0.355 and 0.355/0 mm. The washability characteristic of 0.355/0 mm was determined by laboratory sink-float analysis according to the standard testing procedures. Its upgrading properties was investigated using a Mozley MGS concentrator. Consequently, comparing the float sink test and MGS (Mozley) concentrator test results of the study, the most suitable concentration parameter for the subjected sample was examined.



S02.02-P - EARLY ECOSYSTEM AND SOIL DEVELOPMENT

Thursday 05 July 2012 from 17:00 to 18:30. Room Poster Areas

S02.02-P -1

A GUIDELINE FOR THE DEVELOPMENT OF AN INTEGRATED AND DYNAMIC MODEL OF SOIL-PLANT SYSTEM EVOLUTION

Sophie Leguédais, Nancy - France

S02.02-P -2

ACCUMULATION OF CARBON IN POST MINING SOILS A QUANTITATIVE REVIEW

Olga Vinduskova, Prague - Czech Republic

S02.02-P -3

CHEMICAL AND BIOLOGICAL GRADIENTS ALONG THE DAMMA GLACIER SOIL CHRONOSEQUENCE (SWITZERLAND).

Stefano M. Bernasconi, Zurich - Switzerland

S02.02-P -4

DEVELOPMENT OF SOIL CARBON POOLS AND SOIL PROPERTIES OF RESTORED BIRCH WOODLAND SITES IN SOUTHERN ICELAND

Matthias Hunziker, Basel - Switzerland

S02.02-P -5

DROP ON STONE - A NEW TOOL FOR THE QUANTIFICATION OF BIOAVAILABLE ELEMENTS FROM WEATHERED ROCK SURFACES

Natascha Torres, Kastanienbaum - Switzerland

S02.02-P -6

EXTRACELLULAR SOIL DNA: A DRIVING FORCE OF MICROBIAL LIFE IN INITIAL STAGES OF SOIL DEVELOPMENT?

Judith Ascher, Florence - Italy

S02.02-P -7

INFLUENCE OF SOIL HETEROGENEITY ON THE SPECIES COMPOSITION OF PLANT COMMUNITIES IN LANDS MINED FOR COAL IN SPAIN

Daphne López Marcos, Palencia - Spain



S02.02-P -8

INITIAL SOILS AND SOIL SOLUTION COMPOSITION IN AN ARTIFICIAL CATCHMENT

Wolfgang Schaaf, Cottbus - Germany

S02.02-P -9

MOVING FORWARD WITH UNIVERSAL SOIL CLASSIFICATION

Jonathan Hempel, Lincoln - United States

S02.02-P -10

PRIMARY COLONIZATION AND SOIL NEO-GENESIS IN DEGLACIATING ENVIRONMENTS AT HIGH ALTITUDE AND LOW LATITUDES: THE CASE OF THE LOBUCHÉ GLACIER (EVEREST MOUNTAIN - NEPAL).

Barbara Scaglia, Milan - Italy

S02.02-P -11

ROLE OF CARBOXYLATES RELEASED BY MICROORGANISMS AND ROOTS OF ALPINE PIONEER PLANTS IN MOBILISING P AND METAL CATIONS DURING EARLY SOIL FORMATION

Joerg Luster, Birmensdorf - Switzerland

S02.02-P -12

THE CONTRIBUTION OF BACTERIAL CELL WALL FRAGMENTS TO THE FORMATION OF SOIL ORGANIC MATTER - A CASE STUDY FROM A GLACIER FOREFIELD

Christian Schurig, Leipzig - Germany

S02.02-P -13

UNDERSTANDING THE FLUVIAL CRITICAL ZONE

Nico Bätz, Lausanne - Switzerland



S02.02-P -1

A GUIDELINE FOR THE DEVELOPMENT OF AN INTEGRATED AND DYNAMIC MODEL OF SOIL-PLANT SYSTEM EVOLUTION

Leguédou Sophie^[1], Morel Jean-Louis^[1], Cortet Jérôme^[1], Ouvrard Stéphanie^[1], Séré Geoffroy^[1], Watteau Françoise^[1], Schwartz Christophe^[1]

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The interactions between soil and vegetation (e.g. root exudation, weathering and uptake or root growth, bioturbation and biomass production) are significant in the initial development of terrestrial ecosystems. Quantitative modelling of such interactions is needed to better understand and predict ecosystem evolution, especially in the context of derelict land restoration. However, in the current models of soil evolution, plant feedbacks on soil are still poorly taken into account. Numerous models have already been developed to reproduce individual processes involving soil and plant but they are not able to simulate the whole as a global, interactive, and complex system. Our objective is to propose a general guideline for a global dynamic model by integrating existing sub-models of individual processes. The focus is on soil under human-controlled vegetation as it is an important issue in ecosystem reclamation. The suggested guideline is based on a review of around 20 existing profile-scale quantitative sub-models which reproduce soil-plant processes. The sub-models are mainly based on a physical approach with laws of mass conservation but some rely on statistical and energy-conservation laws. At first a global soil-plant evolution model could be devised by integrating existing mass-conservation sub-models. However, adaptations are needed to reproduce interactions between processes as well as soil-plant feedbacks. Statistical and energy-based approaches could be proposed respectively for calibration and as a general metric combining various chemical or physical stresses. We assess our modelling guideline by confronting it to studies on rehabilitated ecosystems, particularly constructed Technosols as they are relevant experimental models.



S02.02-P -2

ACCUMULATION OF CARBON IN POST MINING SOILS A QUANTITATIVE REVIEW

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In this study we performed a quantitative statistical evaluation of data from 17 studies covering 93 sites of various age reporting changes in C stock in post mining soils. Studies cover temperate sites of the Northern Hemisphere after coal mining revegetated by forest or grassland either as a consequence of reclamation or natural succession. The rate of SOC accumulation decreases with the age of sites, but follows a different trend among vegetation types. Under deciduous forest the maximum is reached after 5 to 10 years and then the rate decreases. Under coniferous forest initial values are lower but slightly increase with age reaching a maximum between 30 and 40 years. No significant trend was found under grasslands, probably because the dataset included only relatively young sites. Using only sites younger than 30 years grassland and deciduous forests seems to sequester C faster than conifers. The rate of accumulation is inversely related to temperature under coniferous forest, increased with temperature in grassland. It seems to be that conifers sequester C more in cold climate while meadows peak in warmer climate with deciduous tree being between them. Also, compared to conifers, deciduous tree species may support sequestration of SOC deeper into the soil profile which may have a positive effect on stability of this carbon stock. Topsoil application accelerates the restoration of soil organic matter content to pre-disturbance level, but it's effect can be overrated due to coal carbon present in topsoil.



S02.02-P -3

CHEMICAL AND BIOLOGICAL GRADIENTS ALONG THE DAMMA GLACIER SOIL CHRONOSEQUENCE (SWITZERLAND).

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Soils are the product of a complex suite of chemical, biological and physical processes. In spite of the importance of soils for society and for sustaining life on earth, our knowledge of soil formation rates and of the influence of biological activity on mineral weathering and geochemical cycles is still limited. In this contribution we will present a first synthesis of our multidisciplinary studies of the 150-year Damma glacier soil chronosequence. The aim of our research was to improve our understanding of ecosystem development on a barren substrate, of the early evolution of soils and to evaluate the influence of biological activity on weathering rates. Soil pH, cation exchange capacity, biomass, bacterial and fungal populations and soil organic matter show clear gradients related to soil age, in spite of the extreme heterogeneity of the ecosystem. The bulk mineralogy and inorganic geochemistry of the soils, in contrast, are independent of soil age and only in older soils (>100 yrs) incipient weathering is observed, mainly as a decreasing content in albite and biotite in the clay fraction by coincidental formation of secondary chlorites. Further, we document the rapid evolution of microbial- and plant-communities along the chronosequence and discuss the processes controlling carbon accumulation in these soils.



S02.02-P -4

DEVELOPMENT OF SOIL CARBON POOLS AND SOIL PROPERTIES OF RESTORED BIRCH WOODLAND SITES IN SOUTHERN ICELAND

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Following a period of land degradation lasting more than one thousand years, Iceland has been undertaken ambitious restoration and afforestation efforts for one century now. Yet, currently little is known on how key ecosystem factors develop effectively in afforested Icelandic woody ecosystems. In order to fill this knowledge gap the “KolBjörk” (CarbBirch), a three year (2008-2011) Icelandic ecosystem chronosequence research project, was launched. The present study which is part of “KolBjörk” aims to characterize the change of various carbon pools and associated soil properties at different old sites and their influence on soil development. Thus an eroded barren control site, five different old restored birch sites and an old native birch forest were tested in summer 2011. The soil profiles contained four sampling depth (0-5, 5-10, 10-20, 20-30 cm). In detail every depth layer per age class was represented by three samples which enclose five sub-samples each. In addition to the analysis of common pedogenetic parameters, soil organic carbon was analyzed by infrared spectroscopy. The results show that parameters changed significantly within the upper centimeters (0-5cm). In deeper horizons these observations cannot be verified for the restored sites. In comparison to old native birch forest initial ecosystems, which develop after restoration on Icelandic soils, showed a higher capability to sequester atmospheric carbon. In conclusion, it seems that restoration on degraded Icelandic soils induce specific initial ecosystems.



S02.02-P -5

DROP ON STONE - A NEW TOOL FOR THE QUANTIFICATION OF BIOAVAILABLE ELEMENTS FROM WEATHERED ROCK SURFACES

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The surface reactivity of rocks depends on its weathering state and controls the bioavailability of elements, which serve as nutrients for organisms and are essential for initial soil formation. Therefore, a quantitative determination of mineral-derived elements on rock surfaces is crucial. So far, most studies aiming for the quantification of weathering rates focused either on the small-scale weathering kinetics or on catchment studies of dissolved mineral components in the runoff or in soil profiles. Here we present a new method for the detection of readily available ions from granitic rock surfaces in an aqueous solution that has been spread onto those surfaces (drop on stone). The analysis is performed with a portable capillary electrophoreses (CE) instrument with capacitatively coupled contactless conductivity detection, which is suitable for analyzing very small sample volumes and suitable for on-site applications in the field. We tested the method on rock surfaces exposed along the chronosequence of a glacier forefield in the central Swiss Alps. The study was focused on the continuous increase of the granitoid rock surface's weathering state and the differences in the availability of cations and anions. Particular attention was given to the subaerial biofilms covering most rock surfaces in the sampling area. The CE measurements were complemented by the quantification of extractable adenosine triphosphate (ATP) revealing interesting relationships between the two parameters.



S02.02-P -6

EXTRACELLULAR SOIL DNA: A DRIVING FORCE OF MICROBIAL LIFE IN INITIAL STAGES OF SOIL DEVELOPMENT?

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Proglacial areas represent unique model-systems for monitoring soil formation processes. We correlated biotic and abiotic factors of the Morteratsch Glacier forefield (Switzerland) to characterize initial stages of soil formation (0-150 yrs). To improve the sensitivity of the assessment of primary microbial succession along the chronosequence (2 km), routine molecular analysis of soil microbial community structures and biomass based on intracellular soil DNA (iDNA) were extended to the extracellular soil DNA fraction (eDNA). Soil eDNA has to be considered a driving force of microbial life due to its features as i) quantitatively relevant portion of the soil metagenome; ii) mobile component of the soil mobilome with evolutionary implications (horizontal gene transfer via natural transformation); iii) important component of soil biofilm (physical structure; soil metagenome stability); and iv) source of microbial nutrients. Comparative sequential extraction and DGGE fingerprinting of soil eDNA and iDNA provided evidences that eDNA is a quantitative and qualitative important fraction of the soil metagenome, containing information about microbial communities that were not revealed by iDNA-fingerprinting. As the actively extruded portion of eDNA by specific bacteria along with eDNA from lysed cells constitutes the 'mobile soil mobilome', our eDNA/iDNA approach is suggested to be capable to detect rare species as well. The eDNA/iDNA ratio was further evaluated as index of microbial activity (turn-over rate of microbial biomass), in comparison to principal soil enzyme activities, and to give insight into the concept of r/K strategy in microbial primary succession as function of proceeding pedogenesis.



S02.02-P -7

INFLUENCE OF SOIL HETEROGENEITY ON THE SPECIES COMPOSITION OF PLANT COMMUNITIES IN LANDS MINED FOR COAL IN SPAIN

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Waste-dump slopes created by mining extraction are a challenge for restoration practitioners. A clear and ecological understanding of environmental constraints is a requirement for successful revegetation. This study was conducted to evaluate the effects of the spatial variability of some physico-chemical soil parameters on plant establishment on coal-waste slopes after hydroseeding herbaceous plants. For this, a wide south-facing dump-slope with steepness of 12-35°, topsoiled and hydroseeded in October 2000 was selected for study. Two different plant communities (grassland and shrubland) were distinguished within the dump-slope and they were compared with the adjacent natural forest edge plant community. Three transects were established along the topographic gradient in each one of grassland and shrubland communities, as well as one transect in the forest community, for vegetation and soil characterization. As expected, high differences in species composition were found between forest and the other two communities, being sand content, bulk density, total nitrogen and the ratio easily oxidable carbon to total carbon the main responsible soil parameters; the two first soil parameters increasing towards the coal-mine communities, and the other two towards the forest. Differences in floristic composition between grassland and shrubland communities were due to the increase in CEC and soil deepness and the decrease in the ratio easily oxidable carbon to total carbon towards the shrubland, and it responds to an altitude-topographic gradient in which grassland community occupies the top area of the slope topographic gradient. Therefore, a good project design for dump slope reclamation should adequately consider local topoedaphic conditions.



S02.02-P -8

INITIAL SOILS AND SOIL SOLUTION COMPOSITION IN AN ARTIFICIAL CATCHMENT

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The artificial catchment Chicken Creek was constructed 2005 in the mining area close to Cottbus/Germany to study processes of initial ecosystem development. The role of spatial and temporal structures and patterns is one of the main focus themes of the Transregional Collaborative Research Centre 38. As part of the project, initial soil characteristics and the composition of soil solution was studied over the first five years. Small differences in substrate characteristics of the initial catchment had marked effects on surface erosion, catchment hydrology and vegetation succession. Water erosion was very intensive in the first year when the unconsolidated sandy material was hardly vegetated. Soil texture influenced the form of developing erosion channels. Initial vegetation in the first year represented the soil seed bank of the substrate. In the next years, vegetation cover increased and patches started to establish first at more loamy parts within the catchments, spreading from there to the more sandy parts. Vegetation invading into the erosion channels largely reduced active erosion after three years. Soil solution composition varied considerably within the catchment at the beginning of the observation period. Compared to these spatial variations, differences in soil depth were less pronounced. Main components of all sampled soil solutions were Ca, Mg, HCO₃ and SO₄. Due to the carbonate content of the substrates, mean pH values varied between 7.0 and 8.4 in all samples. Concentrations of Ca, Mg and SO₄ decreased over the first year of measurements whereas bicarbonate concentrations increased indicating decalcification. The spatial variability decreased considerably.



S02.02-P -9

MOVING FORWARD WITH UNIVERSAL SOIL CLASSIFICATION

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In September 2009, in Hungary, several events were organized to celebrate the 100th anniversary of the 1st International Conference of Agrogeology. A symposium to overview the 100 years of advances in soil sciences and a seminar entitled "From the Dokuchaev School to Numerical Soil Classifications" were organized. As result of these discussions, a resolution (known as the "Godollo Resolution") was prepared and forwarded to the IUSS Council for discussion at the 2010 World Congress of Soil Sciences in Brisbane, Australia. The resolution stated that there is a need to develop common standards, methods and terminology in soil observations and investigations and a universal soil classification system and for a new Working Group to coordinate the efforts of this global undertaking. There was a general agreement that there is a need for evaluation of current spatial soil definition and classification systems and new innovative approaches should be investigated to develop a common universally accepted system. It was also agreed that a new working group should be set up to coordinate the work. During the 2010 World Congress of Soil Sciences in Brisbane, Australia, the IUSS Council unanimously accepted the "Godollo Resolution" and formally accepted the proposal for a new Working Group to carry out the proposed investigations and development of common standards, methods and terminology in soil observations and investigations and a universal soil classification system.



S02.02-P -10

PRIMARY COLONIZATION AND SOIL NEO-GENESIS IN DEGLACIATING ENVIRONMENTS AT HIGH ALTITUDE AND LOW LATITUDES: THE CASE OF THE LOBUCHE GLACIER (EVEREST MOUNTAIN - NEPAL).

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In arid environments, peculiar chemical-physical condition enhances the colonization of the mineral substrate by microorganism and plant to constitute a proto-soil (crust). The moraines are ideal sites to study primary colonization mechanism as glacier retreatment phenomena expose mineral substrate that can be colonized. Climatic and geographical conditions could differently affect the generation of proto-soil. In this work, we show the results about the characterization of proto-soil samples collected at the Nepal site (high altitude, low latitude). Seven stations were identified in the Lobuche glacier covered by black-grey biological soil crusts. The top soil fractions of each station were separated from the underlying mineral matter and both characterized. Environmental parameters (temperature, moisture, solar radiation) of the crust resulted diverse depending on the station position within the site. With regard to the deeper soil fraction, its origin seems consistent with the geological setting of the area (parent materials from granite and/or gneiss rock, slightly metamorphosed). The study of the microbiome showed different microbial communities in the crust (a-Proteobacteria class is the most abundant with the Sphingobacteriales and Rhizobiales orders) and in the deep layers. Moreover a trend of accumulation of elements in the crusts correlated with the position in the transect (highest values for lower stations) and with the depth of the crusts was found. Thus, plants and lichens within the site were classified. Multivariate analysis of both analytical data and environmental parameters will be applied to unravel the driving mechanisms involved in soil formation process.



S02.02-P -11

ROLE OF CARBOXYLATES RELEASED BY MICROORGANISMS AND ROOTS OF ALPINE PIONEER PLANTS IN MOBILISING P AND METAL CATIONS DURING EARLY SOIL FORMATION

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In the framework of an interdisciplinary study on initial soil formation along a deglaciation chronosequence, we examined the role of carboxylates in mobilising P and metal cations, in particular at the very early stages of soil development, where no or only little soil organic matter has built up. At selected sites with 6, 70 and 128 year old soils, soil solution was collected in-situ using micro suction cups, differentiating between the rhizosphere of specific plants and bulk soil. At the youngest site, carboxylates were enhanced in all rhizospheres exhibiting plant specific patterns, while phosphate and metal concentrations were increased in rhizospheres at all soil ages. Overall and independent of soil age, soil type and sampling date, net mobilisation of phosphate correlated strongly with the net production of tartrate, while the dissolution of metals correlated strongly with both tartrate and oxalate. A comparison with laboratory experiments on P mobilisation by plants and on granite dissolution by bacterial and fungal isolates, suggests that both bacteria and fungi are important for initial nutrient mobilisation. Bacteria, releasing mainly oxalate, are efficient in mobilising metals, while fungi, releasing mainly citrate and malate, are able to mobilise both phosphate and metals. Once first plants appear, they seem to strongly increase nutrient release from minerals in their rhizosphere with root exudation of carboxylates probably playing a two-fold role. On one hand it stimulates microbial activity, on the other hand contributes directly to weathering, in particular by means of efficient ligands such as tartrate.



S02.02-P -12

THE CONTRIBUTION OF BACTERIAL CELL WALL FRAGMENTS TO THE FORMATION OF SOIL ORGANIC MATTER - A CASE STUDY FROM A GLACIER FOREFIELD

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Recently, stocks of soil organic matter (SOM) have been shown to decrease in European soils and also worldwide, which compromises soil fertility and enhances emissions of carbon dioxide and other, even more potent green-house gases, to the atmosphere. However, the general structure of SOM, and thereby the mechanisms behind its genesis and loss, remain unclear. In this framework, microbial biomass is generally regarded to be of low importance for SOM formation. In particular on freshly exposed sites, however, bacteria colonize barren mineral surfaces faster than fungi or higher plants. Moreover, recent results indicate that bacterial cell wall fragments frequently occur on soil mineral surfaces and also accompany the microbial colonization of previously clean and sterile activated carbon surfaces after incubation in groundwater. Hence, we hypothesized that, at least in the initial stages of soil formation, bacteria and their fragments may play an important role in particulate SOM formation bearing in mind that most dead organic matter entering the soil is processed by bacteria. This hypothesis was proven by tracing the development of SOM in a chronosequence with samples from the forefield of a receding glacier (Damma-glacier, Canton Uri, Switzerland) by scanning electron microscopy and other methods. The initially barren mineral surfaces have been shown to be rapidly covered with microbial residues as soil age increases. Moreover, this data compares well to increasing C/N-ratios, water contact angles and fatty acid contents in earlier deglaciated samples.



S02.02-P -13

UNDERSTANDING THE FLUVIAL CRITICAL ZONE

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Geomorphological modelling has evolved significantly the representation of the link between river morphology, flow processes and sediment transport; notably recently, with an emphasis upon the interactions between vegetation dynamics and morphodynamics. Nevertheless, vegetation dynamics have tended to be treated as a simplistic “black box” in which time replaces the more complex underlying processes. Thus, riparian vegetation dynamics not only result from interactions between surface-flow, topography and vegetation resistance to disturbance, but also soil development within the fluvial zone, which affects nutrient and water supply. More generally labeled the critical zone, there is a lack of considering the “critical fluvial zone” in geomorphological models. Understanding the key drivers of this system, thus the processes interrelating vegetation, topography, soil (formation), subsurface- and surface-flow, are crucial to understand how riverine landscapes respond to increasing human pressure and to climate change. In this poster, we consider the likely nature of a braided river critical fluvial zone. Braided rivers in deglaciated forelands provide an opportunity to study the fluvial critical zone due to their dynamic properties, the restricted physical size, the simple ecosystems and the space-for-time relation caused by glacier retreatment after the “Little Ice Age”. The poster aims to commence a discussion on the fluvial critical zone, showing first results about: a) the system understanding of a braided river set in a recently deglaciated alpine foreland; b) methodological approaches to quantify the identified interrelating key processes; c) how quantitative understanding can be integrated into fluvial geomorphological modelling.



S02.03-P - PEDODIVERSITY IN SPACE AND TIME: CONCEPTS, MEASUREMENTS, APPLICATIONS

Thursday 05 July 2012 from 17:00 to 18:30. Room Poster Areas

S02.03-P -1

ASSESSMENT OF THE EFFECT OF SOIL PHYSIOGRAPHY UNITS AND GEOMORPHIC STATUS ON LAND PREPARATION IN PART OF SAFASHAHR SUBBASIN (KOR BASIN IN SOUTH OF IRAN)

Ahmad Landi, Ahvaz - Iran, Islamic Republic of

S02.03-P -2

DECISION TREE MODELS TO SOIL MAPPING AND LAND SUITABLE CLASSIFICATION

Ricardo Dalmolin, Santa Maria - Brazil

S02.03-P -3

DOES SOIL COMPOSITION CORRELATE WITH CORINE NOMENCLATURE IN WETLANDS? : HUMIC SUBSTANCES AS FUNCTIONAL INDICATORS

Charlotte Grasset, Villeurbanne - France

S02.03-P -4

GLOBAL AND LOCAL PEDODIVERSITY- RESULTS FROM ARID REGIONS OF SOUTHEAST IRAN

Hossein Khademi, Isfahan - Iran, Islamic Republic of

S02.03-P -5

PEDODIVERSITY INDICES IN THE ROMANIAN PLAIN

Alina Gherghina, Bucharest - Romania

S02.03-P -6

PEDODIVERSITY OF SOIL COVER OF RUSSIAN: CARTOGRAPHIC ASSESSMENT

Irina Alyabina, Moscow - Russian Federation

S02.03-P -7

PEDOSEDIMENTS AND CALCRETES OF KARSTIC SINKHOLES IN QUINTANA ROO, MEXICO: A RECORD OF SOIL DEVELOPMENT, GEOMORPHIC PROCESSES AND LANDSCAPE STABILITY

Hector Cabadas Baez, Wurzburg - Germany



S02.03-P -8

PROPERTIES AND SUSTAINABLE LEND USE OF ARENOSOLS

Piotr Sklodowski, Warsaw - Poland

S02.03-P -9

REFERENCE VALUES AND VARIABILITY OF SOIL PHYSICAL CHARACTERISTICS OF DELUVIAL-MEADOW SOIL

Emil Dimitrov, Sofia - Bulgaria

S02.03-P -10

RELIEF AS SOIL FORMING FACTOR IN KARST AREA

Janez Bergant, Ljubljana - Slovenia

S02.03-P -11

SOILS OF GEORGIA: CONDITION AND PROBLEMS

Teo Urushadze, Tbilisi - Georgia

S02.03-P -12

THE INFLUENCE OF AIR POLLUTION ON SOIL MINERAL WEATHERING-SOIL ACIDITY IN LIMESTONE ALPS, AUSTRIA

Undrakh-Od Baatar, Vienna - Austria

S02.03-P -13

VARIABILITY OF SOIL PROPERTIES WITHIN LARGE TERMITE MOUNDS – ORIGINS AND APPLICATIONS.

Hans Erens, Ghent - Belgium

S02.03-P -14

ECOLOGICAL FUNCTIONS OF SOILS AT UNDERGROUND GAS STORAGE TERRITORIES

Nadezhda Mozharova, Moscow - Russian Federation

S02.03-P -15

FRACTIONAL COMPOSITION OF HEAVY METAL COMPOUNDS IN THE SOILS

Tatiana Minkina, Rostov-on-Don - Russian Federation



S02.03-P -16

PEDOTECHNIQUES STRATEGIES TO IMPROVE SOIL RESILIENCE AGAINST THE IMPACT OF IRRIGATION BY MUNICIPAL WASTEWATER: USING ZEOLITIZED TUFFS AS SOIL AMENDMENTS

Andrea Buondonno, Caserta - Italy

S02.03-P -17

SUSTANIABLE REMEDIATION OF PB, ZN AND CD CONTAMINATED SOIL

Masa Jelusic, Ljubljana - Slovenia

S02.03-P -18

USE OF THE MICRORESP METHOD TO ASSESS POLLUTION-INDUCED COMMUNITY TOLERANCE TO METALS AND ECOPHYSIOLOGICAL TRAITS FOR SOIL MICROBIAL COMMUNITIES

Berard Annette , Avignon - France

S02.03-P -19

ZEOLITIZED TUFFS IN PEDOTECHNIQUE FOR QUARRY RESTORATION: EVALUATION OF PHYTONUTRITIONAL EFFICIENCY IN ^AUP MODEL HORIZONS

Andrea Buondonno, Caserta - Italy



S02.03-P -1

ASSESSMENT OF THE EFFECT OF SOIL PHYSIOGRAPHY UNITS AND GEOMORPHIC STATUS ON LAND PREPARATION IN PART OF SAFASHAHR SUBBASIN (KOR BASIN IN SOUTH OF IRAN)

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This study is part of Safashahr sub basin that located in north of Fars province of Iran. The objective was to investigate the effects of soil physiography units and geomorphic status on land preparation. Soils have extended on 4 type physiography units including Gravelly alluvial fan, Undulated Plateau & Upper Terrace, Slightly undulated Plateau & Upper Terrace and floodplain which classified in 3 orders, 3 suborders and 8 families. There are soil texture, relief and water limitations in alluvial fan. Since development of irrigated agriculture is affected by severe water restrictions thus these lands are suitable for dryland agriculture and gardening. Buried Argillic and Calcic horizons in Undulated Plateau and so sedimentary soils is verificate hydrological, climatic and pedogenic changes. Soils has created a suitable environment for agriculture due to the relatively large amount of clay particles and organic matter. We are faced with severe limitations of topography here, therefore changing in cropping pattern and a trend toward products with lower water requirements like Sunflower and Safflower can be effective. The role of faults in Slightly undulated Plateau as water resources is significant. Alluvial and calcareous layers create appropriate underground aquifers. However the land being in highlands has led frost garden products, therefore the gardening is not recommended. Due to diseases and low product diversity in crop rotation (Potato - Winter Wheat - Fallow), modifying cultivation pattern is advised. Because of marl deposits and coarse-textured soils in floodplain, holding potential of water is reduced, so agricultural development is not possible.



S02.03-P -2

DECISION TREE MODELS TO SOIL MAPPING AND LAND SUITABLE CLASSIFICATION

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Soil surveys for presenting basic information about soils and their distribution in the environment are needed to sustainable land management. Soils mapping in its traditional form is still predominant, but technological advances and new tools have emerged and contributed to the acquisition of important data to the knowledge of soils allowing the advancement of digital soil mapping (DSM). This technique allows to generating data at different spatial resolutions associated with quality indicators. The aim of this study was to propose a DSM for Erechim County (430 km² in Rio Grande do Sul State / Brazil), using specific areas for training and extrapolation of information to unmapped areas and to establish the assessment of land suitability classifications for growing erva mate (Ilex paraguariensis St. Hil). The study area was in a traditional farming of this crop. Covariates predictive factors related to relief and organisms were used in the WEKA data mining software models for the development of a Decision Tree (DT). DT was also used to establish the land suitability classifications having as covariates predictive parameters related to topography and soil parameters (DSM product). The proposed model showed an accuracy of the predicted soil map near 70% and accuracy of the suitability classification map close to 80%.



S02.03-P -3

**DOES SOIL COMPOSITION CORRELATE WITH CORINE NOMENCLATURE IN WETLANDS? :
HUMIC SUBSTANCES AS FUNCTIONAL INDICATORS**

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Wetlands are among the most threatened ecosystems in the world, making necessary to understand their functioning and what threatens their ecological well-being. However, the word wetland gathers a huge diversity of situations, which may deeply differ in terms of functioning and conservation requirements. This work aimed at determining how far the Corine nomenclature, based on phytosociological plant units and used for classifying European wetlands, was a good tool to discriminate wetland functioning. We focused on the organic carbon quality of wetland soils, as it reflects the patterns of organic matter degradation or accumulation. 101 wetlands, representing 14 CORINE units, were sampled during summer 2010 in southeast France. The amount of Total Organic Carbon (TOC), Humic Substances (Humic Acid (HA), Fulvic Acid (FA) and Humin) and Water Extractable Organic Carbon (WEOC) were measured in the upper 20 cm of soil. TOC discriminated aquatic habitats from the others; one of the reasons is the probably higher biodegradability of aquatic plants, which have less lignified tissues. The HA/FA ratio was high for habitats with species potentially rich in refractory compounds (e.g. oligotrophic habitats, helophytes or evergreen species) and for habitats with low pH, known to inhibit the microbial activity. The proportion of HAs was higher for water meadows than for peatlands suggesting that aerated conditions would favour their accumulation. The results outlined that simple chemical descriptors may discriminate wetlands and the necessity of understanding the reasons of the contrasting patterns observed in some CORINE units: functioning heterogeneity or signals of alteration?



S02.03-P -4

GLOBAL AND LOCAL PEDODIVERSITY- RESULTS FROM ARID REGIONS OF SOUTHEAST IRAN

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A geomorphic hierarchical downscaling method was used to decompose the forms and processes forming the landscapes and their subdivisions in an arid region of southeast Iran. This paper discusses the study of pedodiversity in two ways (1) based on the global scale using the digital soil map and (2) the local pedodiversity based on geomorphic hierarchical downscaling method. The calculation of diversity indices were carried out according to taxonomic categories of order, suborder, great group, and subgroup. Using the feed forward back-propagation algorithm, a neural network was trained for prediction of the digital soil map in each category level. The results showed that the diversity indices increase from soil order to soil subgroup at global and local scales. Therefore, the greater number of soil units or higher density of the soil map, the higher diversity at the subgroup category. An increase in K-entropy of soil and landscape confirms the hypothesis of soil divergence evolution, whereby differences in initial conditions or local perturbations, and dynamic in stability appear to have produced more variable soils and landscapes in the study area. The global diversity obtained based on soil map, so diversity measures depend on the density of the soil map. Therefore, higher soil diversity was achieved with greater density of different soil units. It was observed that areas with more detailed soil mapping units exhibit the largest pedodiversity and it was concluded that the measure of pedodiversity depends amongst others on the detail of the soil survey in an area.



S02.03-P -5

PEDODIVERSITY INDICES IN THE ROMANIAN PLAIN

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Pedodiversity express quantitatively differences between the soils patterns distribution, and refers to the soil type, the surface occupied in territory and the mode of distribution. The concept of pedodiversity refers both to the soils formation (genetic diversity) and to the different patterns in territory (spatial diversity) and reflects the qualitative differences between the components of the soil cover (Florea, 1997, 2009). Spatial pedodiversity indicates the complexity of the soil cover, soil differences (contrast) and the pedogeographical heterogeneity, which are important features of the soil cover assemblage (Florea, 1997). The purpose of this paper is to briefly describe the indices which characterize the spatial pedodiversity in the Romanian Plain. The soil cover of the eastern part of the Romanian Plain was analyzed from morphometric point of view. Were used the following pedodiversity indices: variability, weight, topo-pedo-geographical index, size, mean area, complexity index and Shannon's diversity index. The values of these indices were calculated on the basis of soil map scale 1:200.000 and reflect the influence of pedogenetic factors in soil formation. Also, there were compared differences in pedodiversity between the Romanian Plain geographical regions and it was highlighted the impact of the agricultural practices on pedodiversity indices.



S02.03-P -6

PEDODIVERSITY OF SOIL COVER OF RUSSIAN: CARTOGRAPHIC ASSESSMENT

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In previous studies, we estimated pedodiversity of the soil cover in the European part of Russia with Shannon's diversity index, and with introduced diversity index I_d . Now we attempt to assess both a lateral spatial differentiation and a vertical differentiation of the soil cover in Russia. Attributes of the soil cover were got from the digital Soil Map of the Russian Federation (1:2.5 M). Then data were computed in delineations of the digital Map of Soil-Ecological Zoning of Russia (1:2.5 M). A vertical differentiation of the soil covers was estimated as average number of soil horizons (index of vertical differentiation – I_{vd}). A lateral spatial differentiation of the soil covers (index of lateral differentiation – I_{ld}) was calculated according to equation: $I_{ld} = n/M$ (n – a number of soil taxonomy units; M – an area falling to the share of the predominant soil). Areas of the lowest units of the soil-ecological zoning vary considerably (from tens to tens of thousands of ha). Therefore I_{ld} was reduced to a common area 1 M sq km – $I_{ld}(red)$. The calculated I_{vd} varies from 0.2 to 6.2. The calculated $I_{ld}(red)$ varies from 0.2 to 2.8. The maximum common assessment of degree of the vertical and the lateral spatial differentiation of the soil cover was found for the plain zones of Soddy-podzolic soils of southern taiga, Gray forest soils of deciduous forests, and mountain soil provinces in the Caucasus. The generated digital map makes it possible to evaluate complexity of a soil mantle that is to estimate pedodiversity.



S02.03-P -7

PEDOSSEDIMENTS AND CALCRETES OF KARSTIC SINKHOLES IN QUINTANA ROO, MEXICO: A RECORD OF SOIL DEVELOPMENT, GEOMORPHIC PROCESSES AND LANDSCAPE STABILITY

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The pedogenetic and geomorphic processes controlling soil development in tropical karst landscapes, are still poorly understood. We have studied thick pedosediments and calcretes in karst dissolution "pockets", developed in Late Pleistocene calcareous eolianites, in the NE coast of the Yucatan peninsula. The morphological, geochemical and mineralogical characteristics of the pockets fills, were interpreted as a record of pedogenesis and geomorphic dynamics, that shaped the soil mantle during the Holocene. Sand fraction mineralogy, Zr/Ti ratio and Rare Earth Elements (REE) pattern, indicated a mixed origin of the soil parent material; volcanic and granitic/metamorphic components, redeposited in the lithoral and coastal environments were identified. Within the soil groundmass, primary minerals were transformed by weathering and caused desilicification, accumulation of clay (hydroxy-interlayered vermiculite and kaolinite) and dithionite-citrate-bicarbonate extractable iron oxides. Reworked pedofeatures indicative of clay illuviation and redoximorphic processes were observed. This set of processes points to a continuous phase of humid pedogenesis, several thousand years long in the Early-Middle Holocene. However, the development of thick recalcified pedosediments in the pockets, contrasting with the thin background Rendzinas requires active soil redeposition, during a late phase of geomorphic activity. The radiocarbon dates indicates that the switch of the erosion/sedimentation processes could be related to ancient Maya land-use impact.



S02.03-P -8

PROPERTIES AND SUSTAINABLE LEND USE OF ARENOSOLS

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According to WRB classification over 29 % of soils in Poland utilized as agricultural fields are mainly Brunic Arenosols. They are mostly the very light soils formed from weakly loamy sands and loose sands. The investigated Brunic Arenosols are characterized by low water capacity, low available water to plants and very high permeability. So these soils are permanently dry. The field water capacity of Brunic Arenosols had its highest values in humus horizons and it was decreasing with the depth. Investigated sandy soils characterized by the high exchangeable and hydrolytic acidity and the high content of exchangeable aluminum. These soils characterized low sorption and buffer capacity and the low content of: organic carbon and total N. Generally productive capabilities of Brunic Arenosols are very limited. Usually they are classified to V, VI soil valuation units or to the weakly rye (6) and weakest rye (7) complex of agricultural usefulness. Arenosols classified to the weakest rye (7) complex characterized by the lowest quality and agricultural usefulness. These soils are poorest soils and ineffective from the point of view of farming and they should be generally excluded from agricultural production. Most of Brunic Arenosols of poor rye soils – complex 6 will stay significant part of the sustainable rural development and be use for crop production, however it is very important that other conditions should be considered in making decisions about their future cultivations, such as: marketability, agroecological conditions, especially ratio arable land to grassland, possibilities of land improvement.



S02.03-P -9

REFERENCE VALUES AND VARIABILITY OF SOIL PHYSICAL CHARACTERISTICS OF DELUVIAL-MEADOW SOIL

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The study presents new data from two reference pits and net of boreholes (40 points) on soil physical properties of deluvial-meadow soil in the region of experimental station near Sofia. The reference pits characterized the area under grass and forest-park where cultivation has not been applied at least 40 years. The data were obtained for: soil profile morphology, soil texture, bulk density and particle density, specific soil surface, total porosity, water retention curve, content of air filled pores at different water potential, distribution of dry soil aggregates and water stable aggregates. The net sampling was realized in the surrounding areas of cultivated land covering deluvial soil and Cinnamonic forest soil (Haplic Luvisol Chromic) at the northern part. The samples from bore holes obtained at 10 cm interval (for 0-60 cm depth) and at 20 cm interval (for 60-100 cm depth) were analyzed for hygroscopic water content determined at controlled relative humidity (75%), particle size distribution, soil specific surface. In addition, the samples from 0-10 cm and 10-20 layers were analyzed for organic carbon and total nitrogen contents. These data are compared with historical data from large-scale (1:25000) survey of the area and from previous study conducted within the experimental field. The data allow to determine the reference values and natural variability of the soil physical properties and to estimate more precisely the current effects of different land use on soil physical status. Keywords: soil physical properties, soil structure, delluvial-meadow soil, Sofia region



S02.03-P -10

RELIEF AS SOIL FORMING FACTOR IN KARST AREA

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Relief and parent material are the most important soil forming factors in Slovenia. This is especially true for fluvial geomorphic systems, but less for karstic geomorphic system. Karst is characterized by specific surface morphology, hydrological processes and soil morphological, physical and chemical properties. Being highly vulnerable the karst areas require detailed soil information for adequate agricultural and environment protection activities. Coarse classic vector soil maps are currently being updated with digital soil mapping techniques. This study focuses on the relationship of relief and soil genesis on karst areas in order to better incorporate the use of detailed relief information in soil inference models. Detailed field mapping and sampling was carried out along the line transects on test case area, located on limestone area of Slovenia between upper Pivka valley and Javorniki plateau. At each sampling location the measurable relief elements were registered and soil horizon morphological features were described. Soil profiles were mainly distinguished by their depth and thickness of horizons, structure, texture etc. An extreme mosaic structure in soil types and depth was found within short distances. However, a detailed analysis of sampled transects proved some relationships between relief and soil horizon incidence, thickness and other soil morphological properties. We find a lack of mikrorelief and subsurface rock morphology data, which are of great importance in karst geomorphology and pedogenesis. High resolution digital relief data are only to a certain extent relevant for soil inference modeling in karst areas and should be improved with additional spatial information.



S02.03-P -11

SOILS OF GEORGIA: CONDITION AND PROBLEMS

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Georgia is characterized by very interesting types of soils. Here on a very small area one can find many of the soils which are distributed in the world. It may be explained by the fact that the combinations of soil formation change on a very short distance. Professor V.V. Dokuchaev called Georgia "Museum of soils in the open air". Some of the world soils were first described in Georgia, among them Cinnamonic (Cambisols Chromic), Meadow-Cinamonic (Cambisols Chromic), Yellow-Brown Forest (Acrisols Haplic). One of the fundamental laws of soil geography – the law on vertical distribution of soils was stated on the example of the Caucasus, particularly on the example of Georgian soils. Soils of Georgia are eroded – total water eroded area – 196.7 thousand ha. Soils of Georgia are polluted by radionuclide, heavy metals, pesticides. Radionuclide contamination in Georgia took place not only during nuclear weapon tests, but also during Chernobyl atomic electric power station wreck. At that time Georgia was the fourth among the most contaminated countries after Ukraine, Belarus and Russia. The risk of pollution may be external and internal – while consuming food of vegetative and animal origin. So it may be concluded that soil cover of Georgia are characterized with big diversity. Its ecological condition is very heavy.



S02.03-P -12

THE INFLUENCE OF AIR POLLUTION ON SOIL MINERAL WEATHERING-SOIL ACIDITY IN LIMESTONE ALPS, AUSTRIA

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CCE (Coordination Centre for Effects) stated that the knowledge about the interrelation between air pollution, climate change and biodiversity has already progressed. They emphasized that also atmospheric pollution in general, and nitrogen deposition in particular causes adverse effects to biodiversity. According to several studies the high input of sulphur and nitrogen leads to soil acidification in forests. The elevated input of nitrogen may have various other negative effects on natural ecosystems. In Austria the knowledge of nitrogen effects in forest is very scarce, but the studies carried out by Zechmeister et al., Environmental Agency of Austria, Huber et al., Dirnböck et al., Dirnböck & Mirtl, and Diwold et al. obtained some conclusions: Chronic nitrogen deposition has already affected soils, forest ground vegetation, epiphytic lichens and mosses. In this study several types of soils from different years (1994 and 2004) were investigated from International Cooperation Program forest level plots in Limestone Alps of Austria (National Park-Kalkalpen). Total soil mineral analyses, as well as clay mineral analysis were conducted to evaluate soil weathering processes related to air pollution effect.



S02.03-P -13

VARIABILITY OF SOIL PROPERTIES WITHIN LARGE TERMITE MOUNDS – ORIGINS AND APPLICATIONS.

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*The miombo woodlands of South Katanga (D.R.C.) are characterized by 3 to 5 conic termite mounds ha⁻¹ built by *Macrotermes falciger*. With an average height and diameter exceeding 5 and 18 m respectively, these are some of the largest biogenic structures in the world. Mound soil properties differ considerably from those of the surrounding Ferralsols. Most notably, mound soil exhibits a finer texture, higher CEC and exchangeable basic cation content, lower SOM content, and the build-up of carbonates. However, these soil properties were found to be far from uniform in the 250 m³ that constitute an average mound. Unlike many other mound-building termite species, the mounds of *Macrotermes falciger* are largely fossil, the result of continuous erosion and recolonization of existing mounds. The termites' nesting and foraging activity, combined with other pedological processes generates a wide range of physical, chemical, and biological conditions in different parts of the mound. Besides mapping the resulting variability of soil properties within large termite mounds, this study also contemplates its origin and possible applications.*



S02.03-P -14

ECOLOGICAL FUNCTIONS OF SOILS AT UNDERGROUND GAS STORAGE TERRITORIES

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Soils realizing their ecological function shield, deposit, oxidize, slow down passing methane fluxes, detain and concentrate methane on soil-geochemical barriers. The soil cover due to its heterogeneity differentiates migrating methane, demonstrating various responses at gas transport mechanisms. It is capable to create powerful biogeochemical barriers for weak diffusive methane flux, preventing or reducing emission to atmosphere. Convective methane fluxes are not assimilating by soils leading to great emission to atmosphere. As a result of natural and artificial (relocated) gas deposits operation their geochemical influence on porous structures amplifies, gas and bacterial anomalies in soils appear and extend; methane emission and consumption by soils is increasing comparison with background soils. Intensity and heterogeneity of methane fluxes from subsoil depends on natural and technogenic horizontal and vertical cracks of geological structures, closely connected with modern geodynamic processes. According to the experimental and settlement data about 5-10 % vol. of natural gas general losses of underground storage are concentrated in soils. Extension and intensity of gas anomalies strongly varies and depends on hydrothermal and technological conditions. Seasonal dynamics of functioning parameters, such as concentration of methane, its bacterial oxidation in soils, emission to the atmosphere and consumption by soils from the atmosphere and also processes of methane destruction and new solid mineral formations allowed to make representation about mass balances of pollutants in soil-atmosphere system, provide the first global calculation of methane emission, its bacterial oxidation and consumption at underground storage of natural gas.



S02.03-P -15

FRACTIONAL COMPOSITION OF HEAVY METAL COMPOUNDS IN THE SOILS

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A combined approach for fractioning metal compounds in soils on the basis of sequential and parallel extractions is proposed. On this base the effect of natural and technogenic factors on the state of Cu, Zn, Pb, Mn, Cr, Ni and Cd and the role of individual soil components in the retention of metals in soils of areas adjacent to the Novocherkassk power station has been revealed. Changes of the content of metals and the composition of their compounds in the soils of technogenic landscapes were estimated. The increasing of total content in soils of metals connected with technogenic emissions. It was marked the rise of metals mobility in the polluted soils and predominant participation of Cu, Pb, Mn, Cr and Ni organomineral complexes among their mobile species. The increasing of Zn and Cd mobility was provided predominantly by exchangeable forms and specifically sorbed by Fe–Mn (hydr)oxides. Organic substances and nonsilicate Fe minerals are the most involved in the strong fixation of heavy metals. The changing of metals compounds with different binding strengths to organic substances and Fe (hydr)oxides unare establish. The major hazard of contamination of the ecosystem is related to the increase in metal mobility. A higher metal mobility was found in soils with low buffering capacity.



S02.03-P -16

PEDOTECHNIQUES STRATEGIES TO IMPROVE SOIL RESILIENCE AGAINST THE IMPACT OF IRRIGATION BY MUNICIPAL WASTEWATER: USING ZEOLITIZED TUFFS AS SOIL AMENDMENTS

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A research was started aiming at evaluating the possible use of natural zeolites as exchange conditioners to improve and make durable the soil resilience against the adverse effects of the use of anomalous wastewater, for irrigation purposes. To satisfy such aims, two zeolitized tuffs (ZTs), viz. a Neapolitan yellow tuff (NYT) and a clinoptilolite bearing tuff (ZCL), were tested as pedotechnical materials to improve soil resilience against the impact of treatment by a 'dirty' municipal wastewater (DMW). Soils were a sandy, alkaline Entisol, and a sandy-loam, sub-acidic Alfisol. Results showed that the presence of ZTs resulted in several favourable effects. EC decreased and pH was buffered. COD, total N and total P greatly decreased in the supernatant as ZTs content into the soil/zeolite models increased. Nitrate was greatly removed from solution likely via bio-chemical reaction thus preventing ground water pollution. Ammonium was selectively taken up from the DSW, making the zeolitized tuffs almost saturated by NH_4^+ , by exchanging both beneficial cations, such as K^+ and Ca^{2+} , thus improving their potential availability to plants, and undesirable cations such as Na^+ , thereby hindering the exchangeable sodium percentage (ESP) increase and concurrent soil salinization-alkalinization. The mobility of Pb, Cu and Zn dropped off to a large extent. On the whole, the results obtained highlight the possible positive role played by zeolitized tuffs in pedotechnique strategies to improve soil functionality, and should lead us to broaden the study focusing on soils and zeolitized material with different natures and properties.



S02.03-P -17

SUSTAINABLE REMEDIATION OF PB, ZN AND CD CONTAMINATED SOIL

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Millions of hectares of agricultural land are contaminated world-wide. Remediation technologies have the potential to preserve now contaminated soil for safe production of food. Soil washing with chelants such as EDTA is an effective and potentially soil-friendly remediation option for toxic metal contaminated soil. However, soil washing cannot remove toxic metals from soil entirely, even at high chelant-to-metal ratios, and the long-term risks associated with residual metals are still largely unknown. Contaminated soil from Meža Valley (Pb 2140 mg kg⁻¹, Zn 700 mg kg⁻¹, Cd 16 mg kg⁻¹) was washed with increasing EDTA concentrations: 10, 30 and 60 mmol kg⁻¹ EDTA, removing 50, 70 and 80% of Pb, 11, 30 and 35% of Zn, 42, 48 and 62% of Cd respectively. The functioning of remediated soil as a plant substrate (*Brassica pekinensis*) was evaluated for a period of three months and compared against non-remediated soil. Fractionation with a 6-step sequential extraction, mobility, plant accessibility and oral bioavailability of Pb, Zn and Cd were determined. Soil chemical properties: toxic metal fractionation, pH, organic matter and carbon content, C:N ratio, micro nutrient concentration, cation-exchange capacity; soil physical properties: soil structure, water potential; soil biological properties: induced respiration, glukosidase, phosphatase (acid, alkaline), dehydrogenase; plant fitness, toxic metals uptake and photosynthetic activity was measured and will be presented.



S02.03-P -18

USE OF THE MICRORESP METHOD TO ASSESS POLLUTION-INDUCED COMMUNITY TOLERANCE TO METALS AND ECOPHYSIOLOGICAL TRAITS FOR SOIL MICROBIAL COMMUNITIES

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Understanding the ecological status of soil ecosystems and the impact of anthropogenic contamination requires being able to correlate exposure to toxicants with impacts on biological communities. Several tools are already available to assess the ecotoxicity of substances, but there is still a need for new tools that are ecologically relevant and easy to use. We have developed a protocol based on the substrate-induced respiration of a soil community, using the MicroResp™ technique, to study a pollution-induced community tolerance approach. We have tested the technique in a long-term field experiment aiming at studying the effects of a sewage treatment plant with high Cd and Ni contents on plants and soil. The study shows that MicroResp™ can be used in PICT-bioassays to assess the toxicity of metal (Cd) toward soil microbial communities. A community-level physiological profile based on the mineralization of different carbon substrates was established for each soil sample, basal respiration and microbial biomass were estimated and qCO₂ were calculated. All these ecotoxicological and ecophysiological biomarkers suggest the metal gradient impact of sludge on soil microbial communities in terms of biomass, allocation of carbon demand for energy requirements versus growth and metal-induced tolerance. This study is, as our knowledge, the first to investigate micro-SIR in a contaminated soil system as a tool for measuring induced tolerance in a microbial community and microbial physiological traits.



S02.03-P -19

ZEOLITIZED TUFFS IN PEDOTECHNIQUE FOR QUARRY RESTORATION: EVALUATION OF PHYTONUTRITIONAL EFFICIENCY IN ^AUP MODEL HORIZONS

Buondonno Andrea^{*[1]}, Grilli Eleonora^[1], Capra Gian Franco^[2], Glorioso Carmen^[1], Langella Alessio^[3], Leone Antonio Pasquale^[4], Leone Natalia^[3], Odierna Pierclaudio^[1], Vacca Sergio^[2], Vigliotti Renata Concetta^[1]

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A study was started aiming at assessing the suitability of zeolitized tuff as optimal mineral Human Transported Materials (HTMs) in pedotechnologies for quarry restoration. Different models of pedotechnosystems have been carried out by co-utilising (i) zeolitized tuff as natural K-rich zeolite-bearing rock with a huge cation exchange capacity and NH₄⁺ selectivity, (ii) commercial peat-amendment as source of exogenous organic matter, and (iii) a mixture of phosphorite and poultry as low-cost source of mineral P and organic nitrogen, respectively. The experimental pedotechnosystems were assembled as substrates for settlement and growth of pasture-grass. From the taxonomic point of view, they represent anthropogenic horizons designed “^Aup” according to the latest Keys to Soil Taxonomy, where the “caret” symbol (^) indicates just mineral or organic layers formed by Human Transported Materials (HTMs). In a previous research, data related to agronomic efficiency and organic matter evolution of such pedotechnosystems confirmed the relevant suitability and efficiency of zeolitized tuff as pedogenic substrates in quarry restoration. In the present paper our attention was focused on the estimation of present and potential phytonutritional efficiency through the assessment of both agronomic performance as well as residual fertility. In order to weight the key-components of the pedotechnosystems, and the possible interactions among them, conventional as well as special experimental indices were proposed. All investigated pedotechnosystems showed a huge crop production. The comparison among the experimental indices suggests that soil-plant relationships very well performed, especially for the less expensive pedotechnosystem, i.e. that fertilized with phosphorite and poultry manure without organic amendment.



S02.04-P - SOIL CLASSIFICATION: USING WRB FOR PROVIDING SOIL INFORMATION AND MAKING HARMONIZED MAPS ON A EUROPEAN LEVEL

Tuesday 03 July 2012 from 17:00 to 18:30. Room Poster Areas

S02.04-P -1

EXPERIENCE USE OF WORLD SOIL RESOURCES (WRB) IN GEORGIA (ON EXAMPLE OF THE HUMID SUBTROPIC SOILS)

Tamari Kvrivishvili, Tbilisi - Georgia

S02.04-P -2

ADAPTING HUMUS FORM CLASSIFICATION TO WRB PRINCIPLES

Graefe Ulfert, Hamburg - Germany

S02.04-P -3

APPLICATION OF PEDROMETRIC METHODS FOR CORRALTION OF NATIONAL SYSTEMS WITH WRB

Vince Lang, Godollo - Hungary

S02.04-P -4

APPLICATION OF THE WRB AND USDA SOIL TAXONOMY IN SOIL MAPPING ON THE EXAMPLE OF AN AREA TRANSFORMED BY MASS WASTING ACTIVITY IN GÓRY KAMIENNE (SUDETES, SW POLAND)

Lukasz Musielok, Kraków - Poland

S02.04-P -5

CONVERTING THE LEGEND OF THE SOIL MAP OF BELGIUM INTO THE WORLD REFERENCE BASE FOR SOIL RESOURCES: (I) LESSONS FROM CORRELATING NATIONAL SOIL SURVEY DATA TO AN INTERNATIONAL SOIL CLASSIFICATION SYSTEM

Antoine Bouhon, Liège - Belgium

S02.04-P -6

HARMONISATION OF DATASETS ON SOIL DISTRIBUTION USING WRB – EXPERIENCES FROM A FRENCH-GERMAN CROSS-BOUNDARY SOIL MAP IN THE FRAMEWORK OF INSPIRE

Einar Eberhardt, Hannover - Germany



S02.04-P -7

*HARMONIZATION OF SWISS LEGACY SOIL DATA: THE SOIL INFORMATION SYSTEM
NABODAT*

Urs Grob, Zürich - Switzerland

S02.04-P -8

*HOW TO COORDINATE SOIL INFORMATION ACROSS POLITICAL BOUNDARIES. A 1:200,000
APPROACH*

Wolf Eckelmann, Hannover - Germany

S02.04-P -9

*NATURAL VS ANTHROPOGENIC TRACE METALS IN SOILS: INADEQUACY OF
TAXONOMIES, USEFULNESS OF SOIL KNOWLEDGE*

Denis Baize, Orleans - France

S02.04-P -10

TOWARDS A UNIVERSAL SOIL CLASSIFICATION SYSTEM

Jaume Bech, Barcelona - Spain

S02.04-P -11

TRANSLATING SOIL PROFILE DATA BETWEEN NATIONAL SOIL CLASSIFICATION SYSTEMS

Markus Van Der Meer, Zurich - Switzerland



S02.04-P -1

EXPERIENCE USE OF WORLD SOIL RESOURCES (WRB) IN GEORGIA (ON EXAMPLE OF THE HUMID SUBTROPIC SOILS)

Kvrivishvili Tamari^[1], Urushadze Tengiz^[2], Matchavariani Lia^[3], Sanadze Ekaterine^[4], Ghambashidze Giorgi^[5]

^[1]Agrarian University of Georgia ~ Department of Agroecology, Division of Soil Science ~ Tbilisi ~ Georgia ^[2]Agrarian University of Georgia ~ Department of Agroecology, Division of Soil Science ~ Tbilisi ~ Georgia ^[3]Ivane Javakhishvili Tbilisi State University ~ Department of Geography ~ Tbilisi ~ Georgia ^[4]Agrarian University of Georgia ~ Department of Agroecology, Division of Soil Science ~ Tbilisi ~ Georgia ^[5]Agrarian University of Georgia ~ Department of Agroecology, Division of Ecological Agriculture and Nature Conservation ~ Tbilisi ~ Georgia

One of the most distribute classification-diagnostic system in the world are World Soil Resources (WRB) as example of soils correlation and international communication. Georgia characterized with very varied and interesting soil-cover. Introduce the data about Georgian soils in international soil information space are very important. In this direction were investigated soils of humid subtropics: Red, Yellow, Yellow-Podzolic and Yellow-Brown. Red soils are distribute in south-west part of humid subtropics and characterized by red color, deep profile and high content of clay with profile: A-AB-B1-B2-BC-C or A-AB-B-BC-C. The more or less high temperatures greatly enhance the effectiveness of leaching and the penetration of hydrogen ions in primary materials of the parent rocks. The argic, nitic, ferralic horizons are discharge clearly. Investigate red soil corresponding Nitisols of WRB. Yellow soils have wide area in West Georgia between 100-500 m above sea level and characterized by yellow color, deep profile and high content of clay with profile: A-AB-B-BC-C or A-B-BC-C. Yellow soils are characterized by the same intensive hydrolysis of weatherable minerals combined with a leaching of SiO₂ and bases and an accumulation of kaolinite and sesquioxides. Except argic, nitic, ferralic horizons in soil mark our cambic horizon. Yellow as well yellow-brown soils corresponding Acrisols of WRB. Yellow-podzolic soils are forming of the old marine terrace between 30-200 m above sea level and characterized with sharp differential profile: A-A1A2-A2-BC-C or A-A2-B-C. Soils marked by migration and accumulation processes. The main horizons are argic and albik. Yellow-podzolic soils corresponding Luvisols of WRB.



S02.04-P -2

ADAPTING HUMUS FORM CLASSIFICATION TO WRB PRINCIPLES

Ulfert Graefe^[1], Rainer Baritz^[2], Gabriele Broll^[3], Eckart Kolb^[4], Gerhard Milbert^[5], Christine Wachendorf^[6]

^[1]IFAB ~ Institute for Applied Soil Biology ~ Hamburg ~ Germany ^[2]Federal Institute for Geosciences and Natural Resources ~ - ~ Hannover ~ Germany ^[3]University of Osnabrueck ~ Institute of Geography ~ Osnabrück ~ Germany ^[4]Technical University of Munich ~ Fachgebiet für Waldernährung und Wasserhaushalt ~ Freising ~ Germany ^[5]Geological Service North Rhine-Westphalia ~ - ~ Krefeld ~ Germany ^[6]University of Kassel ~ Department of Soil Biology and Plant Nutrition ~ Witzenhausen ~ Germany

The recently published European Reference Base for humus forms (ERB) aims to harmonize the classification of humus forms specifically required for transnational inventories and monitoring of soil conditions at the European scale. Although some of the proposed units still need to be confirmed in the field, the ERB marks a significant progress and lays the foundation for the further development of the classification. We suggest to adopt basic principles and rules of the WRB soil classification system for the classification of humus forms and topsoil conditions. This includes the restriction to two categorial levels consisting of main humus types (Mull, Moder, Amphi, Anmoor and others) at the first level, and a set of prefix and suffix qualifiers that are added to the name of the main humus type at the second level. The main humus types are differentiated according to the primary humus forming processes that have produced the characteristic humus profile (e.g. litter fragmentation, mixing with mineral soil). At the second level with qualifiers, the units are differentiated according to factors that have influenced the primary humus forming processes. Qualifiers may be related to the parent material of the humus form (e.g. Arenic, Siltic, Clayic, Histic), or to plant materials (Rhizic, Lignic), physical (Epilithic, Peyric), chemical (Eutric, Dystric), biological (Vermic, Mycotic) and hydrological (Hydric, Ombric, Rheic) characteristics. Furthermore, qualifiers related to diagnostic features of the A horizon facilitate to broaden the classification system to humus forms and topsoil conditions across the whole variety of soils and land uses.



S02.04-P -3

**APPLICATION OF PEDROMETIC METHODS FOR CORRALTION OF NATIONAL SYSTEMS
WITH WRB**

Micheli Erika^[1], Lang Vince^{*[1]}, Fuchs Marta^[1], Waltner Istvan^[1], Dobos Endre^[2]

^[1]Szent Istvan University ~ Soil Science and Agricultural Chemisitry ~ Godollo ~ Hungary ^[2]University of Miskolc ~ Applied Geography ~ Miskolc ~ Hungary

Harmonization of soil data and correlation of national soil classes became an important and challenging issue in several international projects, European and global initiatives. The World Reference Base for Soil Resources (WRB) is the endorsed international correlation scheme for soil classification since 1998. The application of the WRB for correlation of profiles is a relatively easy task. Applications for correlation soil classes and especially map units however are very difficult, as there is very seldom a one to one match of classes. One often have to deal with partial memberships of classes or changing spatial distribution of the correlated soil types. The paper is discussing the traditional and new approaches of soil correlation. The application of the diagnostics, that are the basic elements of classification and at the same time represent continuous layers or properties in landscapes are promising in the spatial solutions, while calculations of taxonomic distances are promising in sematic solutions in the harmonization processes.



S02.04-P -4

APPLICATION OF THE WRB AND USDA SOIL TAXONOMY IN SOIL MAPPING ON THE EXAMPLE OF AN AREA TRANSFORMED BY MASS WASTING ACTIVITY IN GÓRY KAMIENNE (SUDETES, SW POLAND)

Musielok Lukasz*^[1], Kacprzak Andrzej^[1]

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The specificity of soil cover in the mountainous area of Góry Kamienne manifests itself in a mosaic-like structure which is a result of a diversity of soil forming process typical of mountain areas as well as a significant influence of Holocene mass wasting processes. Soil profiles of the study area were described and classified according to the criteria of the World Reference Base for Soil Resources (2006) and USDA Soil Taxonomy (1998). Consequently, it was possible to draw soil maps based on these classification systems and appropriate mapping guidelines. The investigated area was ca. 17,5 hectares and the maps were drawn at a scale of 1: 3 500. The obtained results of soil mapping were compared with a landform map of the investigated area and a detailed typological map of surface materials displaying soil morphology and properties without adhering to any classification system. The comparison reveals differences between the distinguished contours and soil associations depending on both the general structure as well as specific detailed criteria of classification systems used in the study. The analysis points out significant problems with proper depiction of the variability of soils in areas with varied topography, especially where intensive mass movements occur. The study also indicates a need to enrich the lists of qualifiers applicable for the RSGs of Umbrisols and Leptosols in the WRB, based on the properties of soils occurring in the investigated area. The study was financially supported by a MNiI grant no. N N306 312636.



S02.04-P -5

CONVERTING THE LEGEND OF THE SOIL MAP OF BELGIUM INTO THE WORLD

REFERENCE BASE FOR SOIL RESOURCES: (I) LESSONS FROM CORRELATING NATIONAL SOIL SURVEY DATA TO AN INTERNATIONAL SOIL CLASSIFICATION SYSTEM

Bouhon Antoine^{*[1]}, Stefaan Dondeyne^[2], Xavier Legrain^[3], Karen Vancampenhout^[4], Carole Ampe^[5], Nathalie Cools^[6], Geert Baert^[7], Patrick Engels^[8], Roger Langohr^[9], Eric Van Ranst^[10], Jozef Deckers^[2], Jean Chapelle^[1]

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Soils in Belgium were mapped between 1947 and 1991 and published at a 1:20000 scale. These maps are used in land consolidation projects and for assessing soils' vulnerability to erosion and pollution. Integration of land-use and environmental policies within the European Union however requires a harmonization of different national soil classification systems. With the World Reference Base for Soil Resources (WRB) as common classification system within the Union, the authorities of Flanders and Wallonia commissioned a study to elaborate a methodology for converting the Belgian soil legend into WRB. The Belgian legend is based on field properties such as texture, drainage status and profile development. The WRB classification is based on diagnostic features defined by morphological, physical and chemical properties. A key and software programme have been developed to convert the Belgian units into WRB units. However, as many Belgian units could not unequivocally be translated into WRB units, additional guidelines had to be derived based on soil survey data classified according to WRB. The data show that principles of the legend shifted over time or were interpreted differently to take regional specificities into account. To overcome resulting ambiguities it is proposed to establish a database of reference soil profiles. Whereas, overall WRB is satisfactory for classifying soils at national level, the experience also shows that some WRB concepts may benefit from revisions to facilitate its correlation with national soil survey data.



S02.04-P -6

HARMONISATION OF DATASETS ON SOIL DISTRIBUTION USING WRB – EXPERIENCES FROM A FRENCH-GERMAN CROSS-BOUNDARY SOIL MAP IN THE FRAMEWORK OF INSPIRE

Eberhardt Einar^[1], Sauter Joelle^[4], Pätzold Annett^[1], Boulonne Line^[3], Willer Jan^[1], Baritz Rainer^[1]

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Cross-boundary harmonised information on soil distribution is still a deliverable in the European Union. This has recently been addressed by the INSPIRE directive by giving rules how existing digital data on spatial distribution of soil should be formatted in order to be interoperable, i.e. exchangeable between electronic systems and connectable to spatially adjoining datasets without much effort. Harmonisation of such connecting datasets has been defined as a deliverable that has to be addressed if feasible only. One of the components of harmonisation is the use of the international soil classification World Reference Base for Soil Resources (WRB), for which a simplified structure is implemented in the INSPIRE Data Specifications Soil. Within the framework of the eContentPlus project GS Soil, we produced a French-German 1 : 250.000 draft soil map covering an area between south-western Germany (Baden-Württemberg) and the Région Alsace. The data originate from DONESOL soil database of INRA on the French side, and from the German soil database 1 : 200.000 (BÜK 200) from BGR. With this example, we evaluate the overall suitability of WRB, and the need of a minimum set of core parameters of soil profiles to correlate between the French and German map legends, and how the INSPIRE structure fits the ideas of the “Guidelines for constructing small-scale map legends using the World Reference Base for Soil Resources”. The example gives insights into capabilities and challenges of harmonisation between mapping projects with different philosophies and approaches.



S02.04-P -7

**HARMONIZATION OF SWISS LEGACY SOIL DATA: THE SOIL INFORMATION SYSTEM
NABODAT**

Grob Urs^{*[1]}, Rehbein Kirsten^[1], Van Der Meer Markus^[1], Keller Armin^[1]

^[1]Research Station Agroscope Reckenholz-Tänikon ART ~ Swiss Soil Monitoring Network ~ Zürich ~ Switzerland

On the European scale efforts are being undertaken to translate national soil maps for a comprehensive common soil map for Europe. In the case of Switzerland, there is currently no common national soil dataset available, simply because the responsibility for soil mapping is at the cantonal level. While some cantons carried out soil mapping activities, other cantons did not map their soils for several reasons. During the last decades this led to a situation in Switzerland, where the data sources for soil information are very scattered and the soil data itself are not always interoperable. Therefore, we developed the Swiss National Soil Information System NABODAT to process and harmonize legacy soil data from various sources and from the cantons into one common system. Recently, the first projects to translate and process soil databases from different cantons started. This poster highlights the benefits of NABODAT in the context of harmonizing Swiss soil legacy data and summarizes our experiences in data processing.



S02.04-P -8

HOW TO COORDINATE SOIL INFORMATION ACROSS POLITICAL BOUNDARIES. A 1:200,000 APPROACH

Eckelmann Wolf^{*[1]}, Krug Dietmar^[1], Stegger Ulrich^[1]

^[1]Bundesanstalt für Geowissenschaften und Rohstoffe (BGR), Hannover, Germany

To coordinate soil information in Germany, a network of soil specialists of the respective authorities of the 16 federal state agencies and the Federal Institute for Geosciences and Natural Resources (BGR) has been formed. This network, the "Ad-hoc-AG Boden" synchronizes data sets, soil maps and methods across the 16 federal state areas. In 1990, this network started to develop a mutual basis for a common German soil map at scale 1:200,000. This map became the first German soil map under a standard, decided to be the only common cross border dataset for soil information of Germany. One of the most important steps in preparing a mapping manual for the 1:200,000 scales was the definition of a soil regions concept, which was later enlarged to the area of the European Union in close cooperation with the members of the European Soil Bureau Network (ESBN) (HARTWICH et al. 2006). This regional concept has turned out to be one of the most crucial prerequisites for the compilation of harmonized soil maps for the different regions. Now, where about 80 % of the German area is covered by printed maps, it is seems to be necessary to review the soil regions concept again, to recheck the consistency of the developed data bases, and to think about the development of an updated soil map of Germany at scale 1:1,000,000.



S02.04-P -9

NATURAL VS ANTHROPOGENIC TRACE METALS IN SOILS: INADEQUACY OF TAXONOMIES, USEFULNESS OF SOIL KNOWLEDGE

Baize Denis*^[1]

^[1]INRA ~ Science du Sol ~ Orleans ~ France

There is no question of denying the importance of soil classifications as languages of communication between scientists, as well as tools for soil cartographers wishing to class and compare soils. However, the highest categories of national or international systems are often used in an inappropriate way, for example as stratification units in the study of trace element contents in soils. Categories at the highest taxonomic level, such as the RSG of the WRB, are not relevant to this study because the linkage of a particular solum to a high level taxon is made according to different morphological or analytical criteria but never taking into account the geochemical inheritance from the parent material. For proper environmental soil management it's of vital importance to be able to distinguish between natural pedogeochemical concentrations and anthropogenically elevated levels of trace elements. Thanks to this distinction, it's possible to obtain an initial assessment of possible dangers to human health, especially through phytoavailability to cultivated plants. Trace metals of anthropogenic origin are much more reactive species than those of natural origin, even when the latter are abnormally abundant. Our presentation will stress on the major role played by the initial geochemical composition of the parent material and by the subsequent soil forming processes able to accumulate trace elements in certain soil horizons or to wash them down. It's the reason why pedology, its concepts and knowledge acquired over decades, is so useful in interpreting trace element concentrations and assessing risk. Various concrete examples will be presented.



S02.04-P -10

TOWARDS A UNIVERSAL SOIL CLASSIFICATION SYSTEM

Pazos Mabel Susana^[1], Roca Núria^[2], Bech Jaume*^[2]

^[1]Universidad Nacional del Centro de la Provincia de Buenos Aires ~ Edafología Agrícola ~ Azul ~ Argentina

^[2]Universitat de Barcelona ~ Biologia Vegetal ~ Barcelona ~ Spain

Presently, two soil classification systems compete for global acceptance, Soil Taxonomy (ST) and WRB. Notwithstanding many harmonization intents, both systems are so different, particularly in their structure, that next step in order to have a unique universally accepted soil classification system is to develop a new one that fulfils this necessary condition. Among the many differences, the antinomy between open and closed system is of utmost importance. ST gives names to all soils at the subgroup level, while WRB provides lists of qualifiers to be used under certain priority for the different soil reference groups. The latter avoids many problems that arise from the tight ST scheme. The closed structure of ST conceptually means that any soil can be classified with its keys, but implicitly results in that some soils get a name that does not show their actual properties, and the eventual official actualization of the system, if achieved, takes too much time. Conversely, WRB allows the mentioning of all properties arising from a soil description, thus fully describing its properties. Whichever be the resulting Universal Soil Classification, an open low hierarchical level, equivalent to the present subgroup of ST, with precise and concise definition as present WRB qualifiers and clear rules of utilization, would be the best result.



S02.04-P -11

TRANSLATING SOIL PROFILE DATA BETWEEN NATIONAL SOIL CLASSIFICATION SYSTEMS

Van Der Meer Markus^[1], Grob Urs^[1], Rehbein Kirsten^[1], Keller Armin^[1]

^[1]Research Station Agroscope Reckenholz-Tänikon ART ~ Swiss Soil Monitoring Network ~ Zurich ~ Switzerland

In the framework of the Swiss National Soil Information System NABODAT and data harmonization of soil legacy data we faced the problem of translating soil data from the French and German soil classification system into the Swiss one. Depending on the definition and keys of the soil attributes some soil features could be translated while for others additional algorithms and rules had to be applied. The technical processing and mapping of the comprehensive datasets were realized using the Feature Manipulation Engine (FME, Safe Software) that is originally designed for GIS data transformation and integration into various technical systems and propriety formats. FME transformation files were created to transform and convert the soil profile data sets between the different soil classification systems. This poster highlights the complexity of data processing in translating soil data between soil classification systems and demonstrates the benefits using the FME technique.



S02.05-P - BIOLOGICAL WEATHERING AND CYCLING OF IRON, SILICON AND OTHER MAJOR AND TRACE ELEMENTS IN SOIL

Wednesday 04 July 2012 from 17:00 to 18:30. Room Poster Areas

S02.05-P -1

BIOLOGICAL SOIL CRUSTS IMPROVE PHYSICOCHEMICAL PROPERTIES OF SOIL SURFACE HORIZON

Yolanda Canton, Almeria - Spain

S02.05-P -2

CHEMICAL AND MINERALOGICAL FORMS OF IRON AND MANGANESE AND FACTORS AFFECTING THEIR VERTICAL DISTRIBUTION IN SOME FOREST SOILS

Ahmad Heidari, Karaj - Iran, Islamic Republic of

S02.05-P -3

CRITICAL EXAMINATION OF THE PROCEDURES USED TO QUANTIFY THE PHYTOLITH POOL IN SOILS

Jean-Dominique Meunier, Aix-en-Provence - France

S02.05-P -4

EFFECT OF GUARD OF IMPLANTED FORESTS ON AMORPHOUS SILICA BIOMINERALIZATIONS IN ENVIRONMENTS OF PRAIRIE, ARGENTINA

Margarita Osterrieth, Mar del Plata - Argentina

S02.05-P -5

EFFECT OF VARIOUS SOURCES OF SILICON ON CADMIUM AND COPPER TOXICITIES IN DURUM WHEAT

Catherine Keller, Aix-en-Provence - France

S02.05-P -6

EFFECTS OF SOIL AQUIC CONDITION ON POTASSIUM AVAILABILITY IN SOME PADDY SOILS

Ahmad Heidari, Karaj - Iran, Islamic Republic of



S02.05-P -7

EFFECTS OF TOTAL AND ACTIVE CALCIUM CARBONATE EQUIVALENT ON THE AVAILABILITY OF SOME MICRONUTRIENTS IN SOIL

Ahmad Heidari, Karaj - Iran, Islamic Republic of

S02.05-P -8

EFFECTS OF TOTAL AND ACTIVE CALCIUM CARBONATE EQUIVALENT ON THE AVAILABILITY OF SOME MICRONUTRIENTS IN SOIL

Ahmad Heidari, Karaj - Iran, Islamic Republic of

S02.05-P -9

EFFECTS ON SOIL CLAY ASSEMBLAGE OF CORN PLANTS INOCULATED WITH ARBUSCULAR MYCORRHIZA FUNGI

Paola Adamo, Portici (NA) - Italy

S02.05-P -10

EVALUATION RELATIONSHIP OF SOME SOIL CHARACTERISTICS WITH POTASSIUM Q/I CURVE PARAMETERS IN SOME SOIL OF GUILAN, PROVINCE (IRAN)

Akbar Forghani, Rasht - Iran, Islamic Republic of

S02.05-P -11

INVOLVEMENT OF COMPLEMENTARY AND INTERACTIVE BACTERIAL COMMUNITIES IN THE WEATHERING PROCESSES AND CYCLING OF ELEMENTS IN HYDROMORPHIC PADDY SOILS .

Jacques Berthelin, Vandoeuvre-lès-Nancy - France

S02.05-P -12

IRON OXIDES ARE STABILISED AS DISPERSED, NANO-SIZED AGGREGATES IN SOIL EFFLUENTS

Andreas Fritzsche, Jena - Germany

S02.05-P -13

MAGNETIC PROPERTIES OF ALLUVIAL SOILS POLLUTED WITH HEAVY METALS

Sarka Dlouha, Prague - Czech Republic

S02.05-P -14

MAGNETIC PROPERTIES OF IRON (OXY)HYDROXIDES IN A SUB-ALPINE HUMIC CAMBISOL

Diana Jordanova, Sofia - Bulgaria



S02.05-P -15

MAGNETIC PROPERTIES OF SOILS DEVELOPED UNDER DIFFERENT ENVIRONMENTAL SETTINGS

Neli Jordanova, Sofia - Bulgaria

S02.05-P -16

MAGNETIC VISCOSITY OF TROPICAL SOILS

Jan Igel, Hannover - Germany

S02.05-P -17

MICROBIAL EFFECTS ON THE REACTIVITY AND MOBILITY OF COLLOIDAL (NANO PARTICULATE) IRON-OXIDE GEOSORBENTS.

Sneha Narvekar, Jena - Germany

S02.05-P -18

MODELING FOREST SOIL AND SEDIMENT BIOGENIC SILICA CONCENTRATIONS IN A SMALL CATCHMENT AREA IN SOUTHERN FINLAND – A BAYESIAN APPROACH

Virpi Siipola, Helsinki - Finland

S02.05-P -19

MYCORRHIZAL FUNGI TURN RULES OF WEATHERING UPSIDE DOWN

Jens Boy, Hannover - Germany

S02.05-P -20

PHOSPHORUS CYCLES UNDER ECTOMYCORRHIZAL AND ARBUSCULAR MYCORRHIZAL ECOSYSTEMS: SIMILAR OR DIFFERENT?

Nina Koele, Lincoln - New Zealand

S02.05-P -21

SI CYCLING IN A QUARTZ-RICH, FORESTED BIOGEOSYSTEM

Axel Höhn, Müncheberg - Germany

S02.05-P -22

THE IMPORTANCE OF FUNGI IN CYCLING OF POTENTIALLY BIOAVAILABLE SILICON

Maria Lehtimäki, Helsinki - Finland



S02.05-P -23

THE INFLUENCE OF PLANT SILICA BIOMINERALIZATIONS (SILICOPHYTOLITHS), IN THE SOIL MATRIX CONSTRUCTION, IN PAMPEAN PLAIN SOILS AFFECTED BY AGRICULTURAL PRACTICES.

Margarita Osterrieth, Mar del Plata - Argentina

S02.05-P -24

THE MAGNETIC PARAMETERS OF SOILS AS INDICATORS OF THEIR DIFFERENTIATION WITH DEPTH

Maria Jelenska, Warsaw - Poland

S02.05-P -25

ZINC MINERAL WEATHERING AS AFFECTED BY PLANT ROOTS

David Houben, Louvain-la-Neuve - Belgium



S02.05-P -1

BIOLOGICAL SOIL CRUSTS IMPROVE PHYSICOCHEMICAL PROPERTIES OF SOIL SURFACE HORIZON

Chamizo Sonia^[1], Miralles-Mellado Isabel^[2], Rodriguez-Caballero Emilio^[1], Sole-Benet Alberto^[2], Domingo Francisco^[2], Canton Yolanda^{*[1]}

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Water and nutrients are scarce resources in arid and semiarid ecosystems. In these systems, biological soil crusts (BSCs) occupy a wide extension in the interplant spaces.. BSCs perform an essential function in hydrological processes and nutrient cycling in drylands. BSCs modify soil roughness, porosity and cracking, thus affecting infiltration-runoff, evaporation, soil moisture and water availability. They fix carbon and nitrogen and increase organic matter of soils and reduce erosion by water and wind, preventing from the loss of fertility. However, the way in which BSCs affect soil properties varies depending on species abundance and crust composition. Cyanobacterial crusts represent the earliest successional stages of BSCs, whereas lichens and mosses appear during the later stages. We hypothesized that physicochemical properties of BSCs and of their underlying soils would improve with BSC development. Physicochemical properties of various types of soil crusts in different developmental stages and of the underlying soil from two semiarid areas in SE Spain were analysed. Our results showed that water content (at -33 kPa and -1500 kPa) increased in the crust and the underlying soil, with crust development, and that this effect was more significant on coarse than on fine-textured soils. Organic carbon and total nitrogen content also increased in the crust and its underlying soil with crust development. This enhancement in organic carbon and total nitrogen was especially important in the upper soil layer underneath the crust. Our results highlight the relevant role of BSCs in water availability and soil fertility in semiarid areas.



S02.05-P -2

CHEMICAL AND MINERALOGICAL FORMS OF IRON AND MANGANESE AND FACTORS AFFECTING THEIR VERTICAL DISTRIBUTION IN SOME FOREST SOILS

Heidari Ahmad^{*[1]}, Mohebbi Sadegh Mohammad Javad^[1]

^[1]University of Tehran ~ Soil Science ~ Karaj ~ Iran, Islamic Republic of

Chemical forms and mineralogical composition of soil Fe and Mn compounds, their amounts and distribution in soil pedons are the results of several involved soil genesis processes. Fe-Mn concentrations occur in some contrasting microenvironmental conditions from soil matrix with different characteristics which are important in both soil genesis and classification and environmental aspects. In order to investigate abundance and distribution of Fe and Mn chemical forms, factors affecting them and comparison of Fe and Mn concentrations' characteristics with their adjacent soil matrix, five horizons containing Fe-Mn concentrations selected from four natural forest soils affected by aquic condition and located in north of Iran were studied. Total (Fet), free (Fed), amorphous (Feo) and DTPA extractable iron and two forms of Mn including total (Mnt) and DTPA extractable Mn were measured. Mineralogical characterization of the concentrations were performed using XRD, (SEM) and EDS methods. Results showed that organic matter by bonding Fe and Mn ions and causing to make their non-crystalline forms. Formation of argillic horizon also by reducing soil permeability and creation of waterlogged conditions influence different forms of Fe and Mn in the studied soils. Lepidocrocite, goetite, ferrihydrate were main iron minerals and birrensite was main manganese mineral in Fe-Mn concentrations. Distinct contradictory conditions of microzones of the Fe and Mn concentrations with their adjacent environment have caused to higher concentrations of Fed, Fet, Feo, Mnt and Feo/Fed ratio in Fe-Mn concentrations compared to the adjacent soil matrix and they affect on distribution of iron forms.



S02.05-P -3

CRITICAL EXAMINATION OF THE PROCEDURES USED TO QUANTIFY THE PHYTOLITH POOL IN SOILS

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The soil phytolith pool plays a key role in the biogeochemical cycle of Si because it provides a source of silica that is easily soluble and bioavailable for plants. The concentration of soil phytoliths has recently been shown to be depleted in cultivated land. In the literature, two basic approaches are used to quantify the phytoliths: either a time-consuming physical extraction or a chemical extraction by alkaline solutions but its robustness has not been assessed yet. Improving the procedures for the quantification of soil phytolith is required for better evaluating the impact of human activity in the environment, from the soil development to global change. We present the preliminary results of a study comparing the physical extraction and extractions with Na₂CO₃ or Tiron. We show that the grain size as well as the plant type and the maturity of the phytoliths in the soil can affect the yield of the Na₂CO₃ extraction. Physical extraction and Na₂CO₃ give results within the same range (that is with differences < 100%) for sample concentrations of 0 to 2 wt % Si. Contrary to previous findings, we suggest that the physical extraction does not necessarily give an underestimation of phytoliths. The Tiron extraction, well suited for the quantification of phytoliths in plants gives higher Si concentrations than the two other techniques. However, we show that Tiron dissolves other silicates as well.



S02.05-P -4

**EFFECT OF GUARD OF IMPLANTED FORESTS ON AMORPHOUS SILICA
BIOMINERALIZATIONS IN ENVIRONMENTS OF PRAIRIE, ARGENTINA**

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Typical Argiudolls are the representative soils of the southeastern Pampas region, Argentina. The pristine vegetation predominant in the study area across the Quaternary were grasslands. The contribution of silicophytoliths along the Quaternary, in these soils reaches about 40% of the total mineralogical components. 50 years ago, a process of artificial forestation with the aim of creating recreation areas, generated the replacement of the natural grass vegetation by forest species (Eucalyptus sp., Pinus sp., Cupressus sp., Acacia sp.) in numerous wide zones. The aim of this work is to analyze the role of implanted forests in the guard of the biogenic amorphous silica pool in Argiudolls in the southeastern of the Pampean Plain, Argentina. In the grasses plot, phytoliths represent about 40% (A), 10% (B), 5% (C) of the total mineralogical components of the soil. In the arboreal plots, phytolith content is very representative too. In these plots, phytoliths represent about 40-60% (A), 20% (B) of the total mineralogical components of the soil. Although the arboreal species analyzed are no phytolith producers, the high phytolith content in these plots reflect the previous vegetal cover of grasses, not only by the representative quantities, but the morphologies observed. In arboreal plots relates to the greater development of the organic horizons and their protective effect in these plots with respect the grasses ones. All these factors allow the presence and preservation of an important pool of available biogenic silica in these soils, which is essential for their development and associated plant communities.



S02.05-P -5

EFFECT OF VARIOUS SOURCES OF SILICON ON CADMIUM AND COPPER TOXICITIES IN DURUM WHEAT

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*Silicon has not been considered as an essential element for higher plants, but has been proved to be beneficial for the growth and development of many plants, particularly graminaceous plants such as rice. Silicon accumulates in plants up to more than 10%, especially in monocots, and has been shown to alleviate various abiotic stresses including metal stress. We hypothesized that the form and the amount of Si amendment impact plant response to Cd stress in wheat. We designed an experiment with durum wheat (*Triticum turgidum* L.) that we grew on Cd or Cu-contaminated synthetic substrates or Cd-contaminated soil with various sources and amounts of Si. Amorphous Si supplied as diatomite increased biomass and Si content in the shoots and decreased significantly Cd and Cu content in shoots and roots when plants were exposed to either Cu or Cd, while vermiculite had less effect and quartz had no effect. We concluded that 1) Si present as amorphous Si (diatomite) was available for plant uptake and, to a less extent vermiculite could also provide Si to plant and, 2) amorphous Si could alleviate Cd and Cu stress induced by toxic amount of Cd or Cu in soils and thus increased wheat tolerance to Cd or Cu in soil.*



S02.05-P -6

EFFECTS OF SOIL AQUIC CONDITION ON POTASSIUM AVAILABILITY IN SOME PADDY SOILS

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Aquic condition in paddy soils causes arising many problems in nutrients availability. Clay mineralogical composition in combination with soil water status plays an effective role in potassium forms as a major nutrient. Therefore, studies on different forms of potassium in soils have been a key focus in soil fertility management. Three forms of unavailable, slowly available and readily available K exist in normal soil equilibrium systems. Six (three paddy soils, two kiwi fruit and one citrus cultivated) pedons from northern Iran were studied for possible relationships between forms of soil potassium with the clay mineralogical suite and physico-chemical properties. Mineralogical analyses showed that smectite, illite and vermiculite were the most abundant clay minerals in the studied soils. Mean soluble and exchangeable potassium in paddy soils were rather low compared to soils which have recently undergone kiwifruit cultivation and their potassium fertilization. This study showed that while smectitic soils are rich in $\text{NH}_4\text{OAc-K}$, they have modest amounts of $\text{HNO}_3\text{-K}$, with moderate K release rates. On the other hand, illitic soils have only modest amounts of $\text{NH}_4\text{OAc-K}$ with high amounts of $\text{HNO}_3\text{-K}$, and high rates of K release. Non-exchangeable K plays a significant role in supplying available K, particularly in soils containing K-bearing minerals. Therefore determination of both exchangeable and HNO_3 -extractable K could give a better indication of the K potential and management for rice production in paddy soils. To improve rice production and potassium reserves in these paddy soils requires precise potassium management.



S02.05-P -7

EFFECTS OF TOTAL AND ACTIVE CALCIUM CARBONATE EQUIVALENT ON THE AVAILABILITY OF SOME MICRONUTRIENTS IN SOIL

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Carbonates are among the most common soil constituents in arid and semiarid. Considering the soil productivity, in spite of their high carbonates most of calcareous soils do not show severe limitations compared to the other arid zone soils. This may cause some difficulties in interpretation of actual roles of soil carbonates. Carbonates, especially active carbonates may cause different problems including micronutrients deficiency in soils. This study investigates the effects of carbonates on the availability of some micronutrients amounts in four soil orders including: Inceptisols, Aridisols, Alfisols and Mollisols. Active calcium carbonate equivalent was measured according to ammonium oxalate method, and the available concentrations of the studied micronutrients were measured using DTPA extraction method. The results did not show any regression between the available concentrations of micronutrients with CCE content. However, strong regression coefficients were observed between them and ACCE at ACCE contents less than 2.5 %. After a sharp decrease at the range of 2.5 % ACCE, except for available Cu similar trends with limited tolerances were obtained for the relationships between ACCE and available Fe, Mn and Zn contents.



S02.05-P -8

EFFECTS OF TOTAL AND ACTIVE CALCIUM CARBONATE EQUIVALENT ON THE AVAILABILITY OF SOME MICRONUTRIENTS IN SOIL

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S02.05-P -9

EFFECTS ON SOIL CLAY ASSEMBLAGE OF CORN PLANTS INOCULATED WITH ARBUSCULAR MYCORRHIZA FUNGI

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Plants can extract K from exchangeable and non-exchangeable sites in the soil clay mineral structures. The latter, known as fixed K, is usually seen as an illite layer, i.e. an anhydrous K layer that forms a 1.0 nm structural layer unit as seen by X-ray diffraction. Nutrient availability can be enhanced in the root zone by arbuscular mycorrhiza fungi. In this study, the effects of non-inoculated and *Glomus intraradices* inoculated corn plant growth under different experimental conditions on soil K-bearing clay minerals were identified. The soil, a Vertic Xerofluvent, was planted in corn in a 2008-2010 randomized field experiment. Bulk and rhizosphere soil sampling was carried out from May to September 2010 from fertilized plots (N200P90K160 and N200P0K160) with and without plants. According to XRD analysis, three major K-bearing minerals were present in soil: smectite-rich mixed layer mineral, illite-rich mixed layer mineral and illite. Results at 40DAS indicate extraction of K from clay minerals by plant uptake, whereas at 130DAS much of the nutrient seems to be returned to the soil. There is an apparent difference between bulk and rhizosphere clays. The XRD patterns are not unequivocally affected by *Glomus* inoculation. There are observable changes in clay mineralogy in fallow unfertilized compared with fertilized soil. In the studied soil, the illite rich mixed-layer minerals seem to be the source of K absorbed by plants, while illite acts as sink of K released from the plant-microorganisms system at the end of the growing season and as source for the following crop.



S02.05-P -10

EVALUATION RELATIONSHIP OF SOME SOIL CHARACTERISTICS WITH POTASSIUM Q/I CURVE PARAMETERS IN SOME SOIL OF GUILAN, PROVINCE (IRAN)

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So far, numerous criteria have been proposed for the evaluation of potassium absorption in soils and Q/I procedure is one of the best methods. In this method, Quantity and intensity relationship was evaluated. In this method, potassium availability and PBCK are determined. This method is very complex and need to better understanding of soil characteristics and very expensive. Soils samples were taken of central region Guilan province from depth of 0-25 cm. For a typical Q/I curve, soil samples were taken equilibrium with CaCl_2 constant concentration and different concentration of KCl. Results showed that a positive significantly correlation were between KL and clay content ($r=0.824^{**}$) and between KL and CEC ($r=0.734^*$). Another's positive and significant correlations were observed between PBCK and clay content ($r=0.746^{**}$) and also between PBCK and CEC ($r=0.635^*$). Using stepwise method showed PBCK is related to clay content ($\text{PBCK}=27.58+0.961\text{clay}$, $R^2=0.55$) and in the other hand amount of KL was significantly related to clay content and pH.



S02.05-P -11

INVOLVEMENT OF COMPLEMENTARY AND INTERACTIVE BACTERIAL COMMUNITIES IN THE WEATHERING PROCESSES AND CYCLING OF ELEMENTS IN HYDROMORPHIC PADDY SOILS .

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To progress in the knowledge of the weathering processes in the lowland paddy soils and the cycling of elements, characterization of soils and soil solutions and laboratory experiments have been done and were mainly focussed on the functions of bacterial communities. Results show redistribution of iron, aluminium, sulfur in the soils with seasonal releases of iron, sulfate, organic acids in the soil solutions. This suggest bacterial activities verified in experiments. Soils provide bioavailable reducible iron, biodegradable organic matter supporting iron reducing bacterial activities, reduced forms of sulfur used by sulfur oxidizing bacteria . Various bacterial communities have been determined using classical and molecular biology methods (PCR-TGGE). They have complementary metabolic pathways in the cycling of carbon, iron, sulphur, nitrogen, in different environmental conditions: fermentative facultative iron reducers (Bacillus, Clostridium...), iron respiring (Geobacillus, Alkaliphilus...), sulphur oxidizers (Thiobacilli...), sulfate reducers (Desulfovibrio...). They have also heterotrophic, autotrophic, aero anaerobic, anaerobic metabolic properties, indicating a large diversity and adaptability in their activities and play a major role in the cycling of elements and in the coupling of biogeochemical cycles.



S02.05-P -12

IRON OXIDES ARE STABILISED AS DISPERSED, NANO-SIZED AGGREGATES IN SOIL EFFLUENTS

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Freshly precipitated iron oxides generally form settling macroaggregates. On the other hand, dispersed iron oxide nanoaggregates are mobile in the liquid phase and highly reactive. The occurrence of such colloidal iron oxides in soil solutions would have major impacts on the activity and reactivity of soils and the elemental cycling within soils. In this study, soil columns were filled with material from the topsoil horizons (Ah, Ap) of a gleyic Fluvisol and stagnic Luvisol, respectively. The columns were operated in duplicate under water-saturated conditions with a low ionic influent. The respiration of soil microorganisms induced anoxic conditions and consequently the accumulation of Fe(II) in the soil solution owing to the reductive dissolution of pedogenic iron oxides. The column effluent was re-aerated after its discharge resulting in the oxidation of Fe(II) and the precipitation of Fe oxides. Mössbauer spectroscopy and XRD revealed the formation of poorly ordered ferrihydrite. Its crystallisation was disturbed by (in)organic species that have associated with ferrihydrite. FTIR spectroscopy pointed to mainly polysaccharides, carboxyls, proteins and aromatics as available organic compounds. The aggregation decreased with decreasing effluent ionic strengths and higher organic carbon/Fe ratios. Dynamic light scattering revealed aggregate sizes as low as 50 nm, which was confirmed by AFM and SEM. The size of these ferrihydrite nanoaggregates remained constant for at least several weeks. Independent of actual dimensions, similar physical properties of the aggregate surfaces were detected. Concluding, this study demonstrates the reproducible, long-term stabilisation of ferrihydrite colloids in complex solutions like effluents from soil.



S02.05-P -13

MAGNETIC PROPERTIES OF ALLUVIAL SOILS POLLUTED WITH HEAVY METALS

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Magnetic properties of soils, reflecting concentration and grain-size distribution of Fe-oxides, proved to be useful tool in assessing the soil properties in terms of various environmental conditions. In many cases, significant correlation with harmful substances, such as heavy metals, was reported. Our study is focused on the magnetic properties of alluvial soils from the Litavka floodplain (Czech Republic). The investigated area is heavily polluted with risk elements; the main source of pollution is a nearby Pb smelter. Vertical magnetic-susceptibility profiles were recorded in-situ using the SM400 device. The mass-specific magnetic susceptibility χ , frequency-dependent magnetic susceptibility χ_{FD} , isothermal remanence IRM, anhysteretic remanence ARM and hysteresis parameters were measured on selected samples from the layers with contrasting magnetic susceptibility. Some of the geochemical parameters were determined; pH value, organic carbon, content of risk elements, and the content of iron-hydr(oxides). Two types of magnetic variation in soil profiles were observed corresponding to identified soil types (Fluvisols, and Gleyic Fluvisols). The measurements exhibited the magnetically enhanced layers in topsoil and significant peak in the layer of fluctuating ground water. The content of Pb, Zn and Cu correlates significantly to the susceptibility. The results of the size-dependent parameters (ARM, IRM) and the ARM/ χ ratio showed the significant difference in the size of ferrimagnetic particles of individual soil layers. The magnetically enhanced topsoil layer is characterized by relatively low χ_{FD} and ARM/ χ values, reflecting the significant presence of coarse magnetite, which can be attributed to the input of anthropogenic ferrimagnetic particles from the nearby metallurgical plant.



S02.05-P -14

MAGNETIC PROPERTIES OF IRON (OXY)HYDROXIDES IN A SUB-ALPINE HUMIC CAMBISOL

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Humic Cambisols are widespread in the high-altitude mountainous areas in Bulgaria. The major process, determining soil properties is the accumulation of relatively big amounts of organic matter in the uppermost levels. Humic Cambisol profile from Rila mountain (2080 m a.s.l) was sampled at 2cm depth increment and detailed magnetic, physical and geochemical analyses are carried out. Magnetic characteristics discriminate clearly the uppermost organic-rich horizon by low values of anhysteretic remanence and high-field magnetic susceptibility, and lower S-ratio. Underlying humic horizon is characterized by higher magnetic susceptibility, higher remanent magnetizations (both ARM and IRM) and S-ratio close to 1. Humic horizon is distinguished by higher clay content and total iron content, as compared to the organic horizon. Magnetic mineralogy shows distinctly different results for samples from the organic and humic horizons. DCB extraction data suggest that humic horizon contains the highest amount of well-crystalline iron oxide forms. Oxalate extraction takes negligible part of Fe, thus indicating low amounts of poorly crystalline iron oxides in the whole profile. The role of organic matter for the observed variations will be discussed. Thus, magnetic properties of the studied Humic Cambisol reflect in a very sensitive manner iron speciation and distribution along the depth.



S02.05-P -15

MAGNETIC PROPERTIES OF SOILS DEVELOPED UNDER DIFFERENT ENVIRONMENTAL SETTINGS

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Forms of iron oxy(hydr)oxides in soils are sensitive indicators about the environmental conditions (past and present). Rock magnetic techniques give insightful information about the concentration, grain size and kind of iron-containing minerals in soils. Thus, comprehensive analysis of the influence of these different environmental factors on magnetic signature of various soil types would give additional information about their environmental state. Detailed analyses of different type soils from diverse environments include extensive magnetic measurements (magnetic susceptibility, anhysteretic (ARM) and isothermal (IRM) remanences, hysteresis parameters); determination of physical characteristics (grain size fractions, pH) and geochemical analyses (total Fe content, oxalate- and dithionite-soluble Fe). The main results can be summarized as follows. Magnetic susceptibility and IRM, which are concentration dependent characteristics, can be used as indication of soil pH in case of aerobic soils. Pedogenic magnetic enhancement in aerobic soils is due to ferrimagnetic minerals generally linked to the clay fraction. Soils formed under waterlogged conditions show systematic decrease of magnetic grain sizes (judged from ARM/X ratio) with increasing soil pH. There is a linear relationship between total Fe content and high-field magnetic susceptibility, suggesting that most of the Fe is incorporated in the paramagnetic fraction. Ratio SIRM/X can be used to deduce the relative amount of dithionite-extractable iron (Fed). Clear depth variations of different magnetic and geochemical characteristics allow precise characterization of differentiation of the soil horizons and their description.



S02.05-P -16

MAGNETIC VISCOSITY OF TROPICAL SOILS

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A total of 473 rock and soil samples from across the tropics are investigated in this study. The data show that frequency dependent susceptibility depends on the parent material as well as on the degree of weathering. Ultrabasic and basic rocks and their derivatives have higher susceptibility and absolute frequency dependence than material originating from intermediate, acid and sedimentary rocks. Within each parent material group, absolute frequency dependence increases steadily with increasing alteration from unweathered rock to topsoil. This is an effect of either residual enrichment of weathering resistant ferrimagnetic minerals including superparamagnetic (SP) grains, comminution of larger ferrimagnetic minerals or neoformation of SP minerals during soil formation. Relative frequency dependence is generally lower than 15% for the investigated samples with some few exceptions. It increases with alteration for all igneous rocks but remains at the initially high level for sediments. This means that the relative concentration of SP minerals with respect to the total magnetic fraction changes for igneous rocks while it remains constant for sediments. Soils deriving from ultrabasic, basic and intermediate rocks show low relative frequency dependence and their magnetic susceptibility is mainly caused by MD lithogenic minerals whereas soils deriving from acid rocks and sediments show the highest values and their susceptibility is mainly caused by SP minerals that are either formed during pedogenesis or residually enriched.



S02.05-P -17

MICROBIAL EFFECTS ON THE REACTIVITY AND MOBILITY OF COLLOIDAL (NANO PARTICULATE) IRON-OXIDE GEOSORBENTS.

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Solubility and transport of nutrients and pollutants is affected by the presence of colloidal and (nano-) particulate organomineral compounds which act as mobile geosorbents. In soils and aquifers, pure and organic modified Fe and Mn oxy-hydroxides are of particular importance as they are progressively used for environmental cleanup. Colloidal or nanoparticulate sized mobile geosorbents are extremely reactive and exhibit unique properties with decrease in size. The mobility of the iron oxy-hydroxides is governed by various processes, e.g. flocculation/dispersion, filtration and straining, accumulation at the air-water interface, and sorptive interactions with the immobile solid surfaces. Yet, a vastly underestimated factor is the effect of microorganisms on mobility and transport by, e.g., direct attack (corrosive and/or reductive dissolution, oxidative formation or bio mineralization), or indirectly by the interactions with microbially released organic substances, components of EPS or interactions with biofilms. Direct microbial effects will effect in change of size and geometry and a new arrangement of surface sites. The objective of our study is to fundamentally understand how microbe-mediated processes and interactions effect composition, structure and properties of mobile natural geosorbents and their reactivity and mobility.



S02.05-P -18

MODELING FOREST SOIL AND SEDIMENT BIOGENIC SILICA CONCENTRATIONS IN A SMALL CATCHMENT AREA IN SOUTHERN FINLAND – A BAYESIAN APPROACH

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This study approaches the modeling of concentrations and uncertainty related to the distribution of soil and sediment biogenic silica (BSi) concentrations by means of Bayesian statistics. BSi in forest soils consists mainly of phytolith silica from plants whereas sediment-BSi consists mainly of phytoplankton (diatom) silica. There are both types of BSi in both environments but the extent of mixing is usually not known. Bayesian modeling has been used for ecological modeling with success but so far not extensively in the field of environmental chemistry. When trying to model a quantity such as concentration of an element in soil, spatial variation can be large due to changes in soil characteristics. Equations can be used to model the concentrations and uncertainty is usually associated with some variable(s) of the equation. Many times these equations are further modified to fit the data better. As the overall distribution of an element concentration can possibly be highly peaked (kurtosis) or skewed, fitting equations to data can be difficult and some information may be lost in the process. Bayesian statistics, however, allows you to incorporate all relevant information into your model. The resulting distributions give you useful information beyond mere averages of the sampled data and allow you to make predictions concerning the problem. The hypotheses are (1) the resulting silicon distributions will show similarities in skewness and kurtosis and (2) sediment concentrations are higher and more widely distributed than forest soil concentrations because of larger mixing of BSi types in sediments.



S02.05-P -19

MYCORRHIZAL FUNGI TURN RULES OF WEATHERING UPSIDE DOWN

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*Weathering is fundamental to life on earth, transforming bedrock to soil and providing most of the nutrients required for the efficient functioning of the global carbon and oxygen cycles. In a field experiment under *Alnus*, determining mycorrhizal weathering rates of five selected rock-forming minerals contrasting in stability, we found that ectomycorrhizal fungi, already known to establish close contacts between plants and mineral surfaces, selectively weather those minerals containing elements for which the host plant is in short supply. This gives rise to a chemical weathering sequence which greatly contrasts the 'classical' weathering sequence predicted from mineral structure alone: the most stable micas and microcline showed the fastest mycorrhiza-driven weathering rates ($1.8\text{--}3.3 \times 10^{-12} \text{ mol m}^{-2} \text{ s}^{-1}$), exceeding by far those predicted on the basis of proton activity alone. Despite being chemically the most labile, augite and apatite were the least dissolved minerals during the study period (9.1×10^{-13} and $8.6 \times 10^{-14} \text{ mol m}^{-2} \text{ s}^{-1}$). This overruling of the classical weathering sequence highlights the role of plant energy supply and plant symbioses in promoting the weathering rates of specific minerals, with broad implications for biogeochemical processes associated with the formation and function of the Earth surface and atmosphere.*



S02.05-P -20

PHOSPHORUS CYCLES UNDER ECTOMYCORRHIZAL AND ARBUSCULAR MYCORRHIZAL ECOSYSTEMS: SIMILAR OR DIFFERENT?

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The ecological significance of both ectomycorrhizal fungi (EM) and arbuscular mycorrhizal fungi (AM) for forest nutrient cycles remains largely unknown, especially their respective roles in mineral weathering and decomposition of recalcitrant organic matter. We used a globally unique forest pattern of sites that have been exclusively EM or AM for the past 18,000 years to investigate phosphorus (P) budgets. Foliage, wood, organic forest floor and mineral soil at different depths were sampled in 12 pairs of EM and AM forests on schists, granites and tills on the South Island of New Zealand. Total, plant available and organic P were analysed in all samples. Preliminary results indicate that virtually all mineral P originates from apatite in the parent material, and this is the largest source of P to the soils. Furthermore mineral soil layers deeper than 10 cm under EM forest sites tend to be higher in both total P and total Fe than the AM paired sites, possibly caused by binding of P to Fe (hydr)oxides in Bs horizons. Organic matter accumulation is significantly higher in AM sites. The results obtained so far do not show a significant difference in P pools between EM and AM forest ecosystems. However soil processes such as podzolization, the formation of organo-mineral constituents and the accumulation and decomposition of organic matter are likely to be differently affected by EM or AM dominance.



S02.05-P -21

SI CYCLING IN A QUARTZ-RICH, FORESTED BIOGEOSYSTEM

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After oxygen, Silicon (Si) is the most abundant element in the earth's crust. Si plays a very important role in the global carbon cycle through (i) weathering processes on geological time scales, and, (ii) Si-fluxes in to the oceans which supply diatom growth. Leaching of silica over time leads to Si losses from soils – a pedogenic process called desilication. Only few studies are focused on the Si-cycling of terrestrial biogeosystems, especially the leaching rates of Si from soils. Leaching rates are influenced by chemical processes like silicate weathering, but also as a part of the biological cycle, via the Si uptake through plants. The input of biogenic Si into the soil is controlled by litterfall and subsequent decay of the organic material. The plant derived Si will be partially dissolved, taken up by plants again or transported with the soil solution into the vadose zone. Here we present the results of a Si budget analysis on a site in northeast Germany with sandy brown earth soils under a beech forest. During a three year observation period we investigated the Si pools in different compartments of the ecosystem, the temporal dynamics of in- and outputs and the Si-fluxes between different pools using the Biome-BGC model.



S02.05-P -22

THE IMPORTANCE OF FUNGI IN CYCLING OF POTENTIALLY BIOAVAILABLE SILICON

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*The biological uptake and transformations of silicon (Si) affect the occurrence of different Si forms and the bioavailability of Si in soil ecosystems. These processes are also important for the transport of potentially bioavailable Si from catchment areas to the water ecosystems where Si plays an important role. The cycling of silicon by terrestrial plants has been recognized lately, but the significance of fungi is not yet investigated. In this study, the importance of fungal decomposition of plant material in the dissolution of biogenic silica (BSi) was determined by laboratory experiments. Axenic study conditions were prepared using sterile 5 l plastic containers in which 80 g of stalks of wheat (*Triticum aestivum*) were placed with 300 ml of sterile Si-free water. Containers were inoculated either with basidiomycetous *Pleurotus pulmonarius* or with ascomycetous *Trichoderma harzianum*. Fungus was not added to containers which were used as controls. The containers were irrigated by sterile Si-free water and water samples from the outlets of the containers were taken at three days intervals during the experiment. Preliminary results indicate that fungal decomposition increases the dissolution of plant BSi and that fungi accumulate small concentrations of Si. Fungi are among the most important decomposers in soil and thus the results indicate that fungi might be essential components in the biogeochemical cycling of silicon in soil.*



S02.05-P -23

THE INFLUENCE OF PLANT SILICA BIOMINERALIZATIONS (SILICOPHYTOLITHS), IN THE SOIL MATRIX CONSTRUCTION, IN PAMPEAN PLAIN SOILS AFFECTED BY AGRICULTURAL PRACTICES.

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In Argentina, the soils of the pampean plain are one of the most fertile of the world and they have been used for agricultural activities for more than 150 years. These human activities have modified the physical, chemical and biological properties of the soils. The aim of the study is to define and quantify the presence of silicophytoliths in soils, and in the matrix of the aggregates, in the typical Argiudolls affected by agricultural practices. The presence of silicophytoliths in the soils ranges between 3% (parental material) and more than 50% (superficial horizons). In the epipedons (A) the stock of phytolith is about 59-72x10³ Kg/ha, and the stock of Si from phytolith is 25-30x10³ Kg/ha; the contribution of amorphous silica is relevant. These values are higher in the cultivated plots due to burning activities and the presence of crop residues. The matrix of the aggregates of strong pedal, is made up in turn by microaggregates with a recurring elemental composition, mainly consisting of carbon and silicon. A higher land use leads to lower carbon content and to an increment of amorphous silica, along with calcium, iron, aluminum subordinates. The weathering of silicophytoliths is an ongoing process in these soils and contribute to the formation of amorphous silica-rich matrix of the aggregates and thus to maintain stability. Despite the intensity of tillage in cultivated soils, the negative effect would be mitigated by the high contribution of the same silicophytoliths.



S02.05-P -24

THE MAGNETIC PARAMETERS OF SOILS AS INDICATORS OF THEIR DIFFERENTIATION WITH DEPTH

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The studied soils comprise profiles from brown soil and from chernozem originated from various parent rocks: loess, granite and carbonate sediments. The aim of the study is to find the set of magnetic parameters characterizing vertical structure of soil. Magnetic susceptibility, anhysteretic remanent magnetization, dependence of magnetic susceptibility on frequency of magnetic field and hysteresis parameters has been used. Magnetite/ maghemite is present in the upper part of the profile whereas hematite contribution is significant at the bottom. Soil forming conditions influence the enhancement of X in greater extend than parent material. Formation of brown soil have resulted in greater X and XARM enhancement than formation of chernozem. Brown soil is formed in humid conditions in deciduous forest whereas chernozem is characteristic for steppe areas. Vertical differentiation of soils indicated by magnetic parameters present the opportunity for magnetic characterization of pedogenic horizons. X, XARM, Ms, Mrs, Hc, Hcr alone are not sufficient for distinguishing between sharp boundaries and transition zones of individual soil horizons. X versus XARM relationship was the best indicator of horizontal differentiation of soil. On the basis of X and XARM variability we can suggest differentiation with depth of chernozem profile not described pedologically.



S02.05-P -25

ZINC MINERAL WEATHERING AS AFFECTED BY PLANT ROOTS

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*A continuous flow experiment was carried out to quantitatively assess the effect of Italian ryegrass (*Lolium multiflorum* Lam.) root activity on the weathering of smithsonite (ZnCO_3), a common zinc mineral. Results showed that the rate of Zn release from smithsonite to leachates was doubled in the presence of plants. The strong correlation ($r = 0.95$; $p < 0.001$) between concentrations of Zn and dissolved organic carbon (DOC) exuded by the roots in leachates suggests that organic root exudates were closely involved in the smithsonite weathering. After 14 days, the total Zn amount released by smithsonite (i.e. the sum of Zn amounts lost by leaching and taken up by plant) was multiplied by a factor 2 in the presence of plants. Although this was a laboratory study and further in situ long-term investigations are required, our results clearly highlighted that plants can enhance metal release into the environment by accelerating mineral weathering. Thus, the potential role of plants on metal phases weathering should be further considered when revegetation strategies are proposed for the reclamation of heavy metal polluted soils.*



S03.01-P - SOIL DEGRADATION

Monday 02 July 2012 from 17:00 to 18:30. Room Poster Areas

S03.01-P -1

ADSORPTIVE COMPLEX OF SALINE SOILS IN VOJVODINA, SERBIA

Jovica Vasin, Novi Sad - Serbia

S03.01-P -2

BANK STABILITY ON THE RIVER ELBE TOWARDS SHIP GENERATED WAVES

Thomas Neugebauer, Kiel - Germany

S03.01-P -3

CARBONIFEROUS CLAYSTONES TRANSFORMATIONS DURING WEATHERING AND THEIR INFLUENCE ON APPLICATION OF THE ROCKS AS A LANDFILL COVER.

Anna Pytlak, Lublin - Poland

S03.01-P -4

COMPARING SOIL WETTING AND RUNOFF GENERATION PATTERNS AT SMALL SCALE IN CONTROL AND HYDRO-MULCHED AREAS IN A BURNT MARITIME PINE STAND IN CENTRAL PORTUGAL

Diana Catarina Simões Vieira, Aveiro - Portugal

S03.01-P -5

EFFECT OF SOLUBLE HUMIC ACIDS ON THE UPTAKE OF HEAVY METALS BY VETIVERIA ZIZANIOIDES IN CONTAMINATED MINE SOILS

Ana Moliner, Madrid - Spain

S03.01-P -6

EFFECTIVENESS OF ENCLOSURES IN RESTORATION OF DEGRADED SEMI-ARID RANGELAND IN LAKE BARINGO BASIN, KENYA

Eric Van Ranst, Gent - Belgium

S03.01-P -7

EFFECTS OF DIRECT DRILL AND CA-AMENDMENT OVER SOME BIOLOGICAL PARAMETERS OF A DEGRADED SOIL IN WESTERN SPAIN

Paloma Leon, Madrid - Spain



S03.01-P -8

**EFFECTS OF SOIL CLEAN - UP USING LEMON GRASS ON THE INTERACTION OF
SELECTED SOIL MINERALS WITH ORGANIC POLLUTANTS: MANAGEMENT IMPLICATIONS**

Eucharia Nwaichi, Port Harcourt - Nigeria

S03.01-P -9

**EFFECTS OF SOIL TEXTURE AND LAND USE INTERACTIONS ON ORGANIC CARBON
AMOUNTS IN SOILS IN NORTH OF IRAN**

Farshad Kiani, Gorgan - Iran, Islamic Republic of

S03.01-P -10

**EFFECTS OF TOPSOIL REMOVAL AS A NATURE MANAGEMENT TECHNIQUE ON SOIL
FUNCTIONS**

Violette Geissen, Wageningen - Netherlands

S03.01-P -11

**EVALUATION OF AGGREGATES DISTRIBUTION AND OF THE MEAN WEIGHT DIAMETER OF
A CONSTRUCTED SOIL, IN A COAL MINING AREA, SOUTHERN BRAZIL, CULTIVED WITH
DIFFERENT SPECIES**

Eloy Antonio Pauletto, Pelotas-RS - Brazil

S03.01-P -12

**EVALUATION OF SOIL WORKABILITY USING MICROLEIS DSS IN PISTACHIO ORCHARDS
OF RAFSANJAN, IRAN**

Ardavan Kamali, Rafsanjan - Iran, Islamic Republic of

S03.01-P -13

**IMPACT OF GRAZING ON SOIL CHARACTERISTICS IN THE SAVANNA OF NORTHERN
SENEGAL**

Cecile Guillet, Gießen - Germany

S03.01-P -14

**INFLUENCE OF MOULDBOARD PLOUGHING AND SHALLOW TILLAGE ON SOIL PHYSICAL
PROPERTIES AND CROP PERFORMANCE**

Nargish Parvin, Uppsala - Sweden



S03.01-P -15

INFLUENCE OF SELECTED LAND USE TYPES AND SOIL TEXTURE INTERACTIONS ON SOME SOIL PHYSICAL CHARACTERISTICS IN AN ALLUVIAL LAND

Orhan Dengiz, Samsun - Turkey

S03.01-P -16

LAND TAKE IMPACT ON SOIL RESOURCES IN TURKEY

Yusuf Yigini, Ispra (VA) - Italy

S03.01-P -17

LAND TAKE IMPACT ON SOIL RESOURCES: A METHODOLOGICAL APPROACH

Ciro Gardi, Ispra VA - Italy

S03.01-P -18

LOAD INDUCED SOIL DEFORMATION UNDER CONSERVATION AND CONVENTIONAL TILLAGE IN SOUTH NORWEGIAN SOILS

Alexander Zink, Kiel - Germany

S03.01-P -19

MACRONUTRIENT INPUT THROUGH LITTER IN A RIPARIAN FOREST ON DIFFERENT BRAZILIAN SOILS

Marcio Roberto Soares, Araras - Brazil

S03.01-P -20

MAPPING DEGRADATION AND CONSERVATION IN 16 STUDY SITES OF THE DESIRE PROJECT

Godert Van Lynden, Wageningen - Netherlands

S03.01-P -21

PEDO-ECOLOGICAL PATCHINESS AS AFFECTED BY ROCK FRAGMENTS IN SEMIARID RANGELANDS

Sarah Pariente, Ramat Gan - Israel

S03.01-P -22

PENETROMETER RESISTANCE AS AFFECTED BY CROP SEQUENCE AND MECHANICAL DECOMPACTION IN A DEGRADED SOIL IN THE ARGENTINE PAMPAS.

Guillermo Raúl Gerster, Oliveros - Argentina



S03.01-P -23

PHYSICAL PROPERTIES OF VOLCANIC ASH SOILS IN SOUTHERN CHILE

Patrick Neumann, Kiel - Germany

S03.01-P -24

RECOVER OR ORGANIC CARBON AND NITROGEN BY REVEGETATION OF A DEEPLY EXCAVATED OXISOL DURING 19 YEARS

Carolina Dos Santos Batista Bonini , Ilha Solteira - Brazil

S03.01-P -25

RELATION BETWEEN GLOMALIN AND WATER STABLE AGGREGATES IN THE SOIL OF TWO DIFFERENTLY MANAGED OLIVE ORCHARDS IN SOUTH OF ITALY

Luca Lombardo, Potenza - Italy

S03.01-P -26

RUNOFF AND SOIL EROSION CONTROL WITH PAM AND FOREST RESIDUE MULCHING AFTER FOREST FIRES IN PORTUGAL.

Sílvia Regina Faria, Aveiro - Portugal

S03.01-P -27

SALINIZATION LEVELS OF SOIL AND WATER IN A MEDITERRANEAN COASTAL WETLAND: THE PEGO-OLIVA MARSH (SPAIN)

Eugenia Gimeno-García, Moncada - Spain

S03.01-P -28

SOIL COMPACTION SUSCEPTIBILITY: TUNING OF A NEW ESTIMATION INDEX

Sergio Pellegrini, Firenze - Italy

S03.01-P -29

SOIL DEGRADATION AND DESERTIFICATION IN THE MEDITERRANEAN: PROBLEMS AND POSSIBLE SOLUTIONS

Jose Luis Rubio, Moncada, Valencia - Spa

S03.01-P -30

SOIL DEGRADATION INDUCED BY THE CHANGE IN MANAGEMENT OF THE “ARENADOS” SYSTEM (LANZAROTE, CANARY ISLANDS)

Francisco Díaz, La Laguna - Spain



S03.01-P -31

SOIL PHYSICAL PROPERTIES UNDER DIFFERENT CROPPING SYSTEMS IN ESTONIA

Diego Sánchez De Cima, Tartu - Estonia

S03.01-P -32

SOIL QUALITY AND PRODUCTIVITY LOSSES DUE TO COMPACTION IN ESTONIAN GRASSLANDS

Endla Reintam, Tartu - Estonia

S03.01-P -33

SOIL QUALITY EVALUATION UNDER AGRO-SILVO-PASTORAL MEDITERRANEAN MANAGEMENT SYSTEMS

Rosa Francaviglia, Rome - Italy

S03.01-P -34

SOIL QUALITY INDEX TO COASTAL PLAIN ECOSYSTEM FOREST

José Carlos Casagrande, Araras - Brazil

S03.01-P -35

SOIL QUALITY RECOVERY FOLLOWING NATURAL VEGETATION SUCCESSION AFTER LAND ABANDONMENT

Erik Cammeraat, Amsterdam - Netherlands

S03.01-P -36

SOIL RESISTANCE TO PENETRATION OF AN OXISOL IN RECOVERY BY 19 YEARS

Carolina Dos Santos Batista Bonini , Ilha Solteira - Brazil

S03.01-P -38

SOIL SALINITY ASSESSMENT IN THE NERETVA RIVER FLOODPLAINS

Monika Zovko, Zagreb - Croatia

S03.01-P -39

SOIL SECURITY - PRIORITIZING GLOBAL UNDERSTANDING OF SOIL DEGRADATION AND ITS AMELIORATION

Andrea Koch, Sydney - Australia



S03.01-P -40

SOIL STRUCTURE IN THE MAIN ECOSYSTEMS OF THE MEDITERRANEAN ISLE OF PIANOSA, ITALY

Roberto Pini, Pisa - Italy

S03.01-P -41

SURVEY OF THE EFFECT OF PLANTS ON SOIL PROPERTIES AND STABILIZATION (CASE STUDY: SEMNAN-IRAN)

Gholamreza Zehtabian, Tehran - Iran, Islamic Republic of

S03.01-P -42

SUSTAINABLE MANAGEMENT SYSTEMS AFFECT TOPSOIL PHYSICAL PROPERTIES AND ORGANIC C CONTENT IN A HIGH DENSITY OLIVE ORCHARD

Nadia Vignozzi, Firenze - Italy

S03.01-P -43

THE CONTRIBUTION OF KEY MICROORGANISMS FOR RESTORING SOILS FROM FORMER COAL MINING SITES

Jessica Gutknecht, Halle - Germany

S03.01-P -44

THE ECOLOGICAL RECOVERY OF THE STERILE DUMPS FROM HUSNICIOARA QUARRY, DISTRICT MEHEDINTI

Ana Maria Dodocioiu, Craiova - Romania

S03.01-P -45

THE EFFICIENCY OF DIFFERENT APPROACHES TO ANTI-EROSION PROTECTION IN SELECTED AREAS

Borivoj Sarapatka, Olomouc - Czech Republic

S03.01-P -46

THE EVALUATION OF EROSION HAZARD IN DASTKAN REGION - IRAN BY SLEMSA METHOD

Mojgan Entazari Najafabadi, Isfahan - Iran, Islamic Republic of

S03.01-P -47

THE IMPACT OF ANTHROPOGENIC SOIL SEALING ON THE SOILS OF PROTECTED COASTAL LAGOONS (ALBUFERA DE VALENCIA, SPAIN)

Juan Antonio Pascual Aguilar, Valencia - Spain



S03.01-P -48

THE QUALITATIVE EVALUATION OF SOIL EROSION HAZARD

Mojgan Entezari Najafabadi, Isfahan - Iran, Islamic Republic of

S03.01-P -49

THE SOIL AND NUTRIENT LOSSES BY LIQUID RUNOFF ON SLOPE SOILS

Ana Maria Dodocioiu, Craiova - Romania

S03.01-P -50

TREE COVER INFLUENCE ON WATER BALANCE OF SOILS IN SEMI-ARID REGIONS

Maarten De Boever, Ghent - Belgium



S03.01-P -1

ADSORPTIVE COMPLEX OF SALINE SOILS IN VOJVODINA, SERBIA

Vasin Jovica^{*[1]}, Belic Milivoj^[1], Nešić Ljiljana^[1], Sekulic Petar^[1], Milic Stanko^[1], Ninkov Jordana^[1], Zeremski Tijana^[1]

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Sampling of soil from the pedological profiles was carried out in 25 locations whose soils had been classified as solonchaks in the soil map of Vojvodina - north part of Serbia (1971). Based on field and laboratory research the soils in these locations were reclassified in accordance with the current domestic soil classification. This paper presents the analyses of soil classified to belong to the order of halomorphic soils (soil types solonchak and solonetz). The predominant water-soluble cation is Na⁺. With the depth of the soil cation content decreased in solonchaks (which follows the fall in value and salt content with depth), and the participation of cations Ca, Mg and K are increased. Indicator of alkalization - sodium adsorption ratio (SAR) has a very high value, especially in the surface solonchaks horizons. SAR is also decreased with depth. Dominant salt in the surface solonchaks horizons is Na₂CO₃. Cation Exchange Capacity (CEC) values vary between soil types, as well as between individual horizons within the pedological profile. In all tested soils the predominant adsorbed cation is calcium. Exchangeable Sodium Percentage -ESP values of solonchak with profile structure A/E-Bt-BC and iluvic (Bt) and transition (BC) horizon of solonetz are significantly higher than the value of ESP threshold (15 %). Based on the results of analysis in this study can be concluded that the pedogenesis in solonchaks has moved on from the initial process of salinization in the process of alkalization. result is a gradual transition of solonchaks in solonetz.



S03.01-P -2

BANK STABILITY ON THE RIVER ELBE TOWARDS SHIP GENERATED WAVES

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The Tideelbe is an important shipping channel between Northern Sea and Hamburg. Over the past years this shipping channel was widened and deepened to suit the draft of modern container ships. Traveling on the Elbe, these ships generate waves that may cause erosion on the banks. To investigate the stability of the bank soil samples were taken from grassland and reed bed on six parts of the Tideelbe. After predrying to -6 kPa stress strain curves and stress and time dependent changes in the pore water pressure were analyzed and the precompression stress as a function of salt concentration, soil development, and soil depth determined. The wave energy that ship generate was derived as approx. 20 hPa and was applied to the predrained (-6 kPa) soil cores (236 cm³) with cyclic loading tests (50 loading cycles). During the cyclic loading test, the matrix potential and compression of the soil cores were logged. From these data the compressibility factor (C_n) of the soil cores was calculated. The soil cores from the reed bed have a greater compressibility factor than the grassland samples. The collected data show that the younger Fluvisols near to the stream channel have a lower stability, because of a lower developmental stage.



S03.01-P -3

CARBONIFEROUS CLAYSTONES TRANSFORMATIONS DURING WEATHERING AND THEIR INFLUENCE ON APPLICATION OF THE ROCKS AS A LANDFILL COVER.

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Exploitation of coal in Lublin Coal Basin (LCB) in 2010 reached 5,8 mln tones and resulted in production of c.a. 2,2 mln tones of a spoil consisting of carboniferous claystones. Mineral composition of the claystones is predominantly kaolinite and illite with small amounts of quartz, sulphide minerals and plant detritus. The spoil rocks may be applied as a landfill covering. However, during weathering sulfides have the potential to form acidic leachate. Additionally in coal and sulphide-rich wastes endogenic fires may occur which have to be considered prior to application of the waste rock as a landfill capping. In the study concentrations of heavy metals (Fe, Cu, Mn, As, Pb), S and C speciation of the rocks from LCB were investigated as a function of the weathering time. Aerobic and anaerobic free-draining column tests were used to assess pH and leaching behavior of basic cations and anions from rocks stored for 0 to 10 years on a pile. Rocks weathered for up to 3 years remained neutral with low sulphate ($\approx 0,01\%$) levels and pyrite concentration not exceeding 0,8 %. Materials after 5 and 10 years of storage were sulphate-rich (up to 0,32%) and acidic (pH 4,3 and 2,7). Free-draining tests revealed that Fe, Mn, Cu, As and Pb mobility in claystones from LCB increases after 5 years of storage and is more enhanced in aerobic conditions. It was concluded that rocks from LCB may be applied as landfill sealing providing that within 10 years they will be prevented from further weathering.



S03.01-P -4

COMPARING SOIL WETTING AND RUNOFF GENERATION PATTERNS AT SMALL SCALE IN CONTROL AND HYDRO-MULCHED AREAS IN A BURNT MARITIME PINE STAND IN CENTRAL PORTUGAL

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It is well-established that runoff production after forest fires will increase and induce soil erosion. The best solution reported until now is to protect the uncovered soil with some mulch, i.e.: straw, chopped bark, or hydromulch. However, the underlying processes were not well studied yet. The objective of this research is to analyze the changes that hydromulch can induce in runoff, soil moisture, soil water repellence and eventually soil erosion. On the framework of the FCT-founded project EROSFIRE-II, a study area in a burnt pine slope was installed in April 2009. Half of eight runoff microplots (0.28 to 0.5 m²) and half of an adjacent strip were hydromulched randomly. The monitoring methodology involved: (i) weekly runoff volume readings; (ii) monthly rainfall, runoff and soil moisture data downloads from an automatic rainfall gauge, four tipping-buckets and eight soil moisture probes inserted on the adjacent strip; (iii) monthly independent measurements of soil moisture and soil water repellence (MED-test) on control and treated strips. Fifteen months results showed a strong overall reduction of runoff and erosion (70% and 80% respectively). Besides the water storage effect of hydromulching, runoff reduction was attributed to a decrease of soil water repellency, and soil erosion followed the runoff pattern. Strong soil water repellency (MED class >5 at 2,5 cm) was observed during 4 months on the control strip, whereas only 1 month on the treated area. Lower soil water repellency levels on hydro-mulching area should be attributed to an increase of 47% of soil moisture.



S03.01-P -5

EFFECT OF SOLUBLE HUMIC ACIDS ON THE UPTAKE OF HEAVY METALS BY VETIVERIA ZIZANIOIDES IN CONTAMINATED MINE SOILS

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Remediation of abandoned mine sites is a real challenge. Phytoremediation, the use of plants to extract contaminants, is an attractive solution since it does not imply costly technology and only requires common agricultural practices. The only handicap is the slow growth rate and low biomass production. Metals in abandoned mine soils become more stabilized with time, being strongly bonded to soil solids. In order to increase bioavailability of metals in soils, we used humic acids extracted from leonardite. Hyperaccumulator plants usually accumulate only one or two specific elements and are thus not applicable to extract multiple elements. Researchers have suggested that a plant used for phytoremediation should be fast growing, deep-rooted, easily propagated and have a high biomass production. Vetiveria zizanioides has proven to be tolerant to high concentration of metals and has very deep roots. The objective of this research was to investigate the use of humic acids from leonardite as chelators in assisted phytoextraction, using vetiveria zizanioides as the extractante plant. Results showed that each dosis of humic acids was suited for releasing different metals from the soil matrix and making them available for plant uptake. Key words: heavy metals, humic acids, leonardite, phytoextraction.



S03.01-P -6

EFFECTIVENESS OF ENCLOSURES IN RESTORATION OF DEGRADED SEMI-ARID RANGELAND IN LAKE BARINGO BASIN, KENYA

Van Ranst Eric*^[1]

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Land degradation, mainly been attributed to overgrazing and climatic variability and change is a major problem in the semi-arid rangelands of Sub-Saharan Africa. For over 25 years, some pastoralists in northern Kenya have been restoring degraded rangeland using enclosures in response to pasture scarcity and droughts. This study aimed to establish the effectiveness of enclosures in restoring degraded semi-arid rangeland. Botanical diversity, herbage production, infiltration rate and soil loss were used as indicators of ecological restoration. Soil hydrological properties were tested using a Kamphorst simulator inside and outside the enclosures. Plant diversity and herbage yield were determined using the line transect and quadrat method respectively. Results showed higher species diversity inside than outside the enclosures, and high community similarity between the enclosures and open grazing areas. The herbaceous standing crop was significantly higher in the enclosures than in the adjacent open grazing areas. The mean sediment yield inside the enclosures was significantly lower than in the open grazing areas. A higher water infiltration rate was recorded inside the enclosures than in the open grazing areas. The higher species diversity, herbaceous production, infiltration rate, and lower soil-loss inside the enclosures than in the open grazing areas show that the process of land degradation in the study area is reversible. This study demonstrated the enclosure system as an effective way of combating soil and vegetation degradation in the semi-arid rangeland. Enclosures could thus be used to restore degraded patches in semi-arid areas under pastoral land use.



S03.01-P -7

EFFECTS OF DIRECT DRILL AND CA-AMENDMENT OVER SOME BIOLOGICAL PARAMETERS OF A DEGRADED SOIL IN WESTERN SPAIN

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Acidic soils of Cañamero's raña formation in western Spain were cleared and then cropped in the 40's of 20th century. As a consequence, extraction of Ca through the harvest resulted in a lower Ca:Al ratio which increased the Al toxicity; also, soil tillage reduced the organic matter content. These effects led to a drastic yield reduction and the retirement of many farmers. This study has evaluated different management strategies (direct drill (DD) vs traditional tillage (TT)) and a Ca-amendment application (sugar beet foam + red gypsum (SBF+RG)) to recover soil quality in this area. The evaluation has involved the study of different enzyme activities (β -glucosidase, dehydrogenase and β -glucosaminidase) as biochemical indicators and other parameters such as pH, total organic carbon or microbial biomass carbon (MBC). After 4 years of SBF+RG application and 3 years of DD, the amendment has increased the pH and the DD management has increased soil organic matter content. β -glucosidase activity has been positively affected by DD, whereas dehydrogenase activity has increased with the amendment and β -glucosaminidase activity has concentrated around crop residues. The analysis of MBC has shown a negative effect of the amendment but a positive effect of DD (without significant differences in this case). Finally, stratification ratios indicate as well a certain recovery of the natural conditions through the mentioned practices that have been also effective to prevent soil quality losses in other Mediterranean areas.



S03.01-P -8

**EFFECTS OF SOIL CLEAN - UP USING LEMON GRASS ON THE INTERACTION OF
SELECTED SOIL MINERALS WITH ORGANIC POLLUTANTS: MANAGEMENT IMPLICATIONS**

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Successful soil phytoremediation presumes that the target pollutants can be made bioavailable and that a competent flora, community of potential microbial degraders either already exists and can be stimulated or that can be introduced and established. The formation of organic – mineral interfaces in a crude oil inundated “illegal oil pipe tapping soil” was studied by monitoring the variables – texture, pH, Organic carbon, total Nitrogen, available P, Dry mass loss, PAHs concentration, and Base (Ca, Mg and K) as well as the 90d resulting clean soil. The clean – up technique employed Lemon grass and introduction of Compost and Humin amendments were undertaken for comparison. After 90d, CO₂ mineralization was significant and N cycling was strongly coupled to the C cycling. Addition of compost indicated co-metabolic degradation. Also, the concomitant activity of phytoremediation and the agronomic management practice were more effective. PAHs levels above intervention values was sequestered up to > 50%. The dissipation of the 16 USEPA-listed PAHs was largely enhanced from no significant change to 50.8±12.4% (for humin amended); 62.9±7.1% (for compost amended). The study demonstrated the critical role of Organic matter in determining the fate, mobility, and bioavailability of these priority contaminants. The results also suggest that improving the composting process with optimal organic compositions may be a feasible remediation strategy in PAH contaminated soils. Keywords: Soil interactions; Contaminated Soil; Remediation; Bioavailability; PAHs; Humin



S03.01-P -9

EFFECTS OF SOIL TEXTURE AND LAND USE INTERACTIONS ON ORGANIC CARBON AMOUNTS IN SOILS IN NORTH OF IRAN

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Limited information exists on the linkages between soil texture and land use on C storage efficiency. Soil texture was the key to attaining elevated SOC concentrations in different land use types under different management intensities. The purpose of this study was to clarify the effects of land use change on vegetation carbon storage in Ziarat forests (a tourism village located in Golestan province in the north of Iran). For this reason, four land uses including forest, pasture, cultivated and urban were selected. Soil samples of 0 to 30 cm depth were taken and analyzed by completely randomized split-plot with two geographical aspects from north and west, and designed with five replications. The effect of soil texture on POC was examined, by analyzing the relationships of clay/OC, silt/OC and clay+silt/OC ratios with soil POC in the different land uses. Analysis of samples indicated that there were a negative correlations significant statistical (<0.0001) between labile carbon with clay/OC, silt/OC and clay+silt/OC ratios. Ziarat watershed, is a main drinking water resource of Gorgan(the capital of Golestan province), so, this study demonstrated that trend of soil degradation and mismanagement caused increasing hazard of urban floods, sediment problem and human health problems due to water pollution in main city of province.



S03.01-P -10

EFFECTS OF TOPSOIL REMOVAL AS A NATURE MANAGEMENT TECHNIQUE ON SOIL FUNCTIONS

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We studied the effect of topsoil removal, a nature management technique used in the Netherlands and other countries in North Europe to restore heath land vegetation. Sandy soils under original heath land vegetation were compared with sites that were transformed to farmland in 1950 and sites where after the transformation topsoil removal took place 17 and 10 years ago. All soils were sandy and acidic. Topsoil removal led to a 88-94% reduction in the C storage. Therefore, the C storage and the buffer function of the soils were drastically decreased. The N and P storage in the soils where topsoil was removed was also greatly reduced. However, the N and P storage increased in the years after the removal again probably due to areal deposition (N) and input from litter (N and P). Furthermore, even 10 and 17 years after topsoil removal no re-colonization of earthworms had occurred and microbial activity was significantly reduced. This led to increased soil density in the sites without topsoil and a typical abiotic soil structure. These changes in soil properties negatively influenced several soil functions which are relevant in nature and environmental protection, e.g. Cstorage, filtering and buffering. We therefore conclude that removal of topsoil cannot be recommended as a nature management technique due to its negative effects on soil quality.



S03.01-P -11

EVALUATION OF AGGREGATES DISTRIBUTION AND OF THE MEAN WEIGHT DIAMETER OF A CONSTRUCTED SOIL, IN A COAL MINING AREA, SOUTHERN BRAZIL, CULTIVED WITH DIFFERENT SPECIES

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*The largest Brazilian coal mine is located in Candiota municipality, southern Brazil. The open-pit mining method, adopted in this site, promotes deep changes in the topography, vegetation hydrology of area. The extraction process involves the removal of the original soil horizons, followed by the removal of the rock strata that overlies the coal seams, which are subsequently returned to the previous pit and leveled by a bulldozer. The topsoil which was removed from the mining front is then placed on top of the overburden layers, completing the construction of the soil. The use of plants that act as soil decompactors is an important strategy for the recovery of its quality. This study aimed to analyze the influence of different cover grass in a constructed soil aggregation, in the Companhia Riograndense de Mineração coal mining site, located in the municipality of Candiota, RS. The treatments studied were: T1-Vaquero Grass (*Cynodon dactylon*), T2-Braquiaria brizanta Grass (*Brachiaria brizantha*), T3 - Tanzania Grass (*Panicum maximum*), T4-Braquiaria humidicola Grass (*Brachiaria humidicola*), T5-Hemarthria Grass (*Hemarthria altissima*), T6-Tifton Grass (*Cynodon dactylon*). A constructed soil without cover crops was used as a control. For this study undeformed soil samples were collected in July, 2008 and October, 2009, in 0.00-0.05 and 0.10-0.15m layers, in which micro-aggregates and macro-aggregates percentage and mean weight diameter were obtained. It was observed that all treatments had better results when compared with the control for both layers, especially the Brachiarias that showed the highest values of mean weight diameter and percentage of macroaggregates.*



S03.01-P -12

EVALUATION OF SOIL WORKABILITY USING MICROLEIS DSS IN PISTACHIO ORCHARDS OF RAFSANJAN, IRAN

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Optimum soil moisture content is an important factor to protect the physical soil quality during tillage practices. It also specifies the time periods suitable for tillage without soil structure destruction after rainfall or irrigation in agricultural lands. Regarding to the economic importance of pistachio, assessment of soil workability should be taken into account to reach the sustainable management of the crop. This study was conducted to estimate the proper soil moisture percentage by Aljarafe statistical model of MicroLEIS DSS program for some pistachio orchards of Rafsanjan region. To compile required soil data, 17 soil pedons were excavated, described and ninety soil samples were taken from all genetic horizons of each pedon. Physical and chemical analyses were performed on each sample based on standard soil laboratory methods. Then, the obtained laboratorial data were entered to the model to determine the workability classes for each pedon. According to the observed results, the suitable moisture content is moderate to high in studied soils. Although sufficient time is available for tillage between the two irrigation periods, tillage practices in the studied area must be done based on soil moisture contents determined in this research.



S03.01-P -13

IMPACT OF GRAZING ON SOIL CHARACTERISTICS IN THE SAVANNA OF NORTHERN SENEGAL

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Land degradation in arid lands can be distinguished into climate- and human-induced processes. The assessment of these processes is widely recognized as a challenge. The effect of grazing on soil properties in the Sahel was investigated in a strongly flattened quaternary aeolian dune area in the sandy Ferlo region in northern Senegal. After a long term grazing experiment, carried out over 27 years by the German GTZ, topsoils (0 – 10 cm) of grazed and ungrazed plots at the same relief position and of three different savanna types under varying local conditions (vegetation and relief) were investigated in order to characterize particle size, pH, electrical conductivity (EC) and nutrient contents (Na, K, Mg, Ca, K, P). Results of the three savanna types reveal significant differences for grazed plots in nutrient contents and particle size distribution, especially in the fraction of coarse silt. For ungrazed plots there are weaker significant differences (e.g. in particle size distribution) between savanna types while nutrient contents show no significant differences. Comparative analysis of nutrient contents of the two extreme alternatives show higher contents of total C, N, P and cation exchange capacity in topsoils of the regeneration plots. It can be concluded that the absence of grazing results in an increase in soil nutrients in the absence of grazing or that a ongoing grazing induced a slow degradation of the communal pasture.



S03.01-P -14

INFLUENCE OF MOULDBOARD PLOUGHING AND SHALLOW TILLAGE ON SOIL PHYSICAL PROPERTIES AND CROP PERFORMANCE

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With the aim of assessing the effect of shallow tillage and mouldboard ploughing on some soil physical properties (e.g., saturated hydraulic conductivity, K_s ; bulk density, B_d ; penetrometer resistance, PR ; and water retention capacity) and the performance of spring barley, this study was conducted in spring 2011 in a long-term field experiment established for different tillage experiments in 1974. Undisturbed soil samples were taken before sowing the seeds at the depth of 15-20, 25-30 and 35-40 cm for the determination of K_s , B_d and water retention in laboratory condition. Penetrometer resistance were measured in the field after one month of sowing. Plant density was also counted after one month of sowing. Field water content in 15-20 and 25-30 cm was significantly higher for mouldboard ploughing. Water retention at 1 meter suction was also significantly higher in the treatment with mouldboard ploughing. Significantly higher K_s value was found for shallow tillage at the depth of 15-20 and 25-30 cm. Soil B_d was significantly lower for mouldboard ploughing for the first two investigating depth. Significant higher PR value was found for shallow tillage especially at the depth of 5-35 cm compare to the mouldboard ploughing but the PR was within the limit for proper root growth. Plant density and crop yield were significantly higher (154 %) in shallow tilled treatment. Relative yield was also recorded higher (104 %) in shallow tillage for last 15 years. We conclude that the yield of spring barley favoured by shallow tillage.



S03.01-P -15

INFLUENCE OF SELECTED LAND USE TYPES AND SOIL TEXTURE INTERACTIONS ON SOME SOIL PHYSICAL CHARACTERISTICS IN AN ALLUVIAL LAND

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Alluvial soils, formed by rivers as accumulated sediment deposited at different times, show large variations in their physical properties over short distances. Soil physical properties that have been taken into consideration in this study showed variability as a result of dynamic interactions among natural environmental factors such as parent material, land use managements and topography. The main objective of this research was to determine impact of selected land use types and different soil textures (clay, clay loam and loam) interactions on some soil physical characteristics such as soil organic matter (SOM), bulk density (BD), water stable aggregates (WSA), and hydraulic conductivity (HC) in surface layers (0-20 cm) of an alluvial land. This study was carried out in Çetinkaya district located on Bafra Deltaic Plain. The study area covers about 1365.4 ha. The main water resource to this area is Kizilirmak River. Most of the study area is flat and slightly sloped (0.0-2.0%) and the majority of research area's soils are Entisol, Inceptisol and Vertisol. The study area has been commonly used for irrigated agriculture activities particularly, for field crops (wheat, maize and barley) and for vegetables (bean, pepper, watermelon, cucumber, tomato, cabbage and spinach). According to the results of MANOVA statistical analysis, affecting different land uses was significantly found that was occurred as $p < 0.01$ for SOM, WSA, and HC, $p < 0.05$ for BD as well. In addition, while affecting of texture was significantly detected as $p < 0.01$ for SOM and WSA, it was determined statistically as $p < 0.05$ for HC.



S03.01-P -16

LAND TAKE IMPACT ON SOIL RESOURCES IN TURKEY

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Land take, related to urbanisation process, is one of the most significant drivers of global environmental change today. In Europe, between 2000 and 2006 more than 670,000 ha (yearly mean 113000 ha) of lands have been changed into artificial areas. In many cases the land take occurs on most fertile and valuable soils for agricultural production. That being the case, the land take process also significantly affects soil resources in Turkey. Referring the years 2000-2006, about 43000 ha of lands have been taken as a consequence of urbanisation in Turkey. This study aims to determine to what extent land take is impacting on soil resources in Turkey. For this purpose, CORINE Land Cover changes between 2000 and 2006 and land use capability data, from National Soil Information System of Turkey, were used as input data. As a result, the impacts of land take on soil resources were analysed and land take extent on each land use capability class have been calculated at country scale.



S03.01-P -17

LAND TAKE IMPACT ON SOIL RESOURCES: A METHODOLOGICAL APPROACH

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European Union has one of the highest population densities in the world, and a very dynamic and diverse economy. Approximately 75 % of the European population live in urban areas, and by 2020 this percentage will reach 80 %; Artificial areas, sensu Corine Land Cover, covers in Europe the equivalent of one of its medium-size state: in 10 years (1990 – 2000), Germany, Spain and France lost between 200,000 and 150,000 ha each, while in relative terms, the Netherlands are most affected as they lost 2.5 % of their agricultural land resources. In this dynamic and competitive context it is clear that the competition for the use of land, among different economic sectors, is extremely high. In this competition the agricultural sectors is often the looser. In many cases the land taken is characterized by the most fertile and valuable soils for agricultural production. This process, generally known as “land take”, can have a strong influence on food security at European level. The objective of this research is to realize a detailed assessment on the impact of Land Take on soil resources in the different member states, using the concept of Soil Quality as measure of the impact.



S03.01-P -18

LOAD INDUCED SOIL DEFORMATION UNDER CONSERVATION AND CONVENTIONAL
TILLAGE IN SOUTH NORWEGIAN SOILS

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Economisation and productivity enforcement in modern agriculture is still leading to higher levels of mechanisation. Combined field operations and bigger working width the requirement of higher pulling forces leads to heavier machinery during tillage. Beside tillage, machinery weight is also increasing by fertilization operations, which also cause high wheel loads on the fields. With increasing size and weight of agricultural machinery we find arable soils more and more “under pressure”. Soil compaction as a result of mechanical stress below the wheels constitutes a severe problem for sustainable agriculture. Within a cooperative project of the institute of plant nutrition and soil science of the University of Kiel and Bioforsk Institute for Agricultural and Environmental Research, Øst Apelsvoll, Norway, there were done outdoor wheeling experiments with tractors and slurry trailers up to total load of 20 Mg. Stress impact and its distribution below the wheel as well as the deformation were determined by using a combined stress state transducer (SST) and displacement transducer system (DTS). Experimental plots have been sampled in the range of the load tracks to characterize changes in soil stability parameters (precompression stress), hydraulic and aeration properties under laboratory conditions. The measurements took place on two different field sites of a Bioforsk experimental farm under consideration of two tillage treatments (conservation and conventional). Aim of the investigation was to quantify the influence of tillage and with this different topsoil conditions on stress impact and soil properties.



S03.01-P -19

MACRONUTRIENT INPUT THROUGH LITTER IN A RIPARIAN FOREST ON DIFFERENT BRAZILIAN SOILS

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The litter is particularly important for acting on the soil surface as a system of nutrient cycling, accumulating vegetal material that decompose and supply the soil and roots with nutrients and organic matter, which is essential in restoring soil fertility in degraded areas. This study was conducted in two tracts of riparian ecosystems of 2 ha each, composed of two populations of semideciduous mesophytic forest, and an agroecosystem cultivated with sugar cane. The forested areas differ in age [9 (recent forest - RF) and 18 years (old forest - OF)] and in soil type [Typic Hapludox (TH) and Arenic Hapludult (AH)]. Total litter produced in old and recent riparian forests on TH was, respectively, 10.5 ton ha⁻¹yr⁻¹ and 13.6 ton ha⁻¹yr⁻¹, while on AH was 10.1 ton ha⁻¹yr⁻¹ in old forest and 11.1 ton ha⁻¹yr⁻¹. The average time of renewal of forest litter in recent and in old forest was estimated at 0.77 yr and 0.57 yr. In our experiment, we obtained the following range of N, P, K, Ca and Mg, consecutively: 159-278; 11,4-15,5; 27,8-43,9; 164,6-265,2 and 20,7-30,5 kg ha⁻¹ year. The amount of nutrients contributed by litter varied according to the total mass of litter produced, in higher quantity in the recent forests in comparison with the old forest, regardless soil type. In the recent forests, the cycling of nutrients occurred more quickly. Since in the old forests, this time was larger, providing nutrients more slowly, indicating a better equilibrium and sustainability of the forest.



S03.01-P -20

MAPPING DEGRADATION AND CONSERVATION IN 16 STUDY SITES OF THE DESIRE PROJECT

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The World Overview of Conservation Approaches and Technologies initiative (WOCAT) started in 1992, in reaction to the Global Assessment of Soil Degradation (GLASOD) by ISRIC. The original idea of WOCAT was to develop a world map similar the GLASOD one, however showing the positive side, i.e. describing what achievements had been made to combat soil degradation. Since 1992 WOCAT has developed and tested a method for standardized documentation and evaluation of Sustainable Land Management (SLM). It comprises three questionnaires, for documenting “Technologies” (what is actually implemented in the field), “Approaches” (what is needed in terms of “enabling environment” for a successful implementation of a technology) and a mapping questionnaire. The resulting database currently counts more than 350 technologies and over 250 approaches from around 50 countries. In the DESIRE project the WOCAT mapping tool was used to map area coverage, degree, impact, effectiveness, and other parameters of land degradation and conservation for 16 study sites. The mapping method in the study sites complements the information provided by the individual case studies on technologies and Approaches. It evaluates what type of land degradation is actually happening where and what is done about it in terms of Sustainable Land Management (SLM). The on-line map database is hosted by WOCAT, and the mapped outputs that can be generated from this database provide a powerful tool to obtain an overview of land degradation and conservation in a country, a region, or worldwide.



S03.01-P -21

PEDO-ECOLOGICAL PATCHINESS AS AFFECTED BY ROCK FRAGMENTS IN SEMIARID RANGELANDS

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The research aims were: (a) to investigate the effects of RF, of divers sizes and in various positions, on soil temperature, and moisture, organic matter, and calcium carbonate contents; (b) to study the effects of hillslope aspect on the above properties of soil underneath RF; and (c) to assess the ecological benefits of RF. On north- and south-facing hillslopes in the northern Negev region of Israel, soil was sampled from beneath RF of divers sizes – small, medium, and large, i.e., 4-6, 8-10, and 13-16 cm, respectively – that were positioned on the soil surface or partially embedded in the soil. Control samples were taken from bare soil. For each soil sample, the various soil properties were determined. The rock fragment characteristics affected the various soil properties with differing intensities. Under the large and medium RF soil moisture contents were significantly higher than those under the small ones; and embedded RF promoted higher moisture contents than those on top of the soil. RF position had the most significant effect on soil organic matter content, which was higher under "on top" fragments. Rock fragment size and position had significantly greater effects on the south-facing than on the north-facing hillslopes, with regard to increasing the spatial variability of soil temperature, and moisture and organic matter contents. Variations in soil properties were associated with the RF, which can be seen as fertile micro-islands, i.e., concentrating natural resources and releasing them to the environment, and forming potential habitats for varied fauna and flora.



S03.01-P -22

PENETROMETER RESISTANCE AS AFFECTED BY CROP SEQUENCE AND MECHANICAL DECOMPACTION IN A DEGRADED SOIL IN THE ARGENTINE PAMPAS.

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In the Argentine Humid Pampas region, soybean is mostly planted as monoculture under no tillage in silty-loam soils. Under these conditions, subsurface soil compaction mainly due to agricultural traffic is commonly observed. In order to break compacted layers, the inclusion of cereals in the rotation as well as deep tillage (i.e. up to 30 cm depth) has been suggested, but results have been inconsistent, especially with the latter option. The aim of this study was to analyze the effects of deep tillage and crop sequence on penetrometer resistance. The experiment began in 2006 on a silty-loam soil (typic Argiudoll). Treatments consisted of two crop sequences (Soybean-Soybean and Maize-Soybean-Wheat/soybean) combined with (up to 27 cm) and without deep tillage. In 2009, 2010 and 2011, mechanical penetration resistance (MPR), up to 40 cm depth, was measured at 2.5 cm intervals. Mechanical decompaction and cereal inclusion in the crop rotation reduced MPR and no interaction between deep tillage and crop sequence was observed in any depth. In 2009 and 2010, deep tillage showed lower MPR between 7.5 cm and 25 cm depth. The inclusion of cereals in the rotation showed significant differences below 25 cm in 2009 and below 10 cm in 2010. In 2011, MPR reductions were observed in the whole analyzed profile in response to cereal inclusion and also to deep tillage. These results suggest that a long term response of deep tillage may be associated with root proliferation below 25 cm.



S03.01-P -23

PHYSICAL PROPERTIES OF VOLCANIC ASH SOILS IN SOUTHERN CHILE

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Depending on climate conditions and stage of soil development, soils affected by volcanic ashes belong to the most productive soils in the world. In southern Chile (40° S), they are widespread and, thus, form the basis of intensive agricultural use. As a function of the distance between the volcanoes emitting fly ashes and the affected areas, soils vary due to texture and age of the primary material and show development gradients. Therefore, younger soils close to the volcanoes can be classified as Regosols, while with increasing distance, Andosols can be found more often. To find out about the changes in soil mechanical stability and soil functionality due to weathering stage, soil samples were taken from different profiles along a catena representing different stages of soil genesis. Beside soil genesis also different intensities of land use (secondary forest, meadow, and cropland) can influence soil hydraulic and mechanical properties such as saturated hydraulic conductivity (k_s), air conductivity (k_a), dry bulk density (ρ_t), porosity (e), and precompression stress value (P_v). In addition to these properties organic matter content (OM) was analyzed. We found that an increase in land use intensity may lead to a decrease in k_s and k_a as well as to an increase in ρ_t and P_v . While e declines, the fraction of middle pores increases due to the loss of macro pores. This leads to a decrease in air capacity, while field capacity increases. Furthermore, as a consequence, OM content decreases.



S03.01-P -24

RECOVER OR ORGANIC CARBON AND NITROGEN BY REVEGETATION OF A DEEPLY EXCAVATED OXISOL DURING 19 YEARS

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The objective this study was to quantify the organic carbon and nitrogen 9 and 19 years after revegetation of an abandoned area, resulting from deep excavation of an Oxisol, by the construction of hydroelectric power plant, recovering nineteen years ago with lime, gypsum and green manure. The studied area is located in Mato Grosso do Sul, Brazil. The experimental design was a completely randomized with seven treatments and four repetitions. The treatments were: control (tilled soil without culture); *Stizolobium aterrium*; *Cajanus cajan*; lime+*S. aterrium*; lime+*C. cajan*; lime+gypsum+*S. aterrium*; lime+gypsum+*C. cajan*. In 1994, all treatments with *C. cajan* were replaced by *Canavalia ensiformis* and in 1999, *Brachiaria decumbens* was implanted in all treatments. Data from vegetated treatments were compared with the control bare soil. Soil organic carbon and nitrogen were determined by elemental analyzer. Samples were collected at 0.00-0.10, 0.10-0.20 and 0.20-0.40m depth, in 2001 and 2011. The results were analyzed by analysis of variance, following Scott-Knott test (5%) of probability to compare averages. Mean values for C and N at the 0-0.10 cm depth were 0.24% and 0.015% in 2001 and 0.53% to 0.060% in 2011, respectively. Therefore C and N topsoil contents increased 2 and 4 times respectively during the last 10 years. Moreover, in 2001, C and N of the vegetated plots didn't differ statistically from the control, whereas in 2011 significant differences were found. It was concluded that green manure was efficient for increasing organic carbon and nitrogen in the topsoil, initiating recover of soil profile differentiation.



S03.01-P -25

RELATION BETWEEN GLOMALIN AND WATER STABLE AGGREGATES IN THE SOIL OF TWO DIFFERENTLY MANAGED OLIVE ORCHARDS IN SOUTH OF ITALY

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Glomalin is a high molecular weight insoluble glycoprotein stored in great quantity in the cell wall of the hyphae of arbuscular mycorrhizal fungi (AMF); once released outside it is able to improve soil fertility by slowing the degradation of organic matter and the associated nutrient loss, through the stabilization, via hydrophobic interactions, of aggregates that physically protect the particulate matter from the activity of enzymes. The aim of this work was to investigate the possible correlation between glomalin (or glomalin related soil proteins, GRSP) and the concentration of water stable aggregates (WSA), in two adjacent olive groves located in Basilicata (Italy) and managed for 11 years according to different horticultural model (conventional and sustainable). The sustainable farming model provided a drip irrigation system with treated urban wastewater, spontaneous cover cropping and light annual pruning, with resulting material left in the field. The conventional system provided plants growing under rain-fed conditions, shallow tillage, mineral fertilization carried out once a year and biennial heavy pruning. Soil sampling was performed at four depths between the trees in the line and between the lines for three replies per thesis. WSA resulted to be a highly sensitive indicator of the effect of soil management on soil structuration (especially in the "macro" fraction) showing the highest statistically significant values in the sustainable system. The highest concentration of glomalin was found in the first 20 cm layer of the conventional model probably due to the disruption of the mycelium provoked by the mechanical tillage.



S03.01-P -26

RUNOFF AND SOIL EROSION CONTROL WITH PAM AND FOREST RESIDUE MULCHING AFTER FOREST FIRES IN PORTUGAL.

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The surface affected by wildfires in Portugal had grown in the last decades and could increase following the foreseen future climate change scenarios. Wildfires lead to an increase in overland flow and soil erosion in burned areas. Post-fire stabilization treatments, such as mulching and the new and easy-to-use polyacrilamide (PAM), have been pointed out by many authors as some of the best techniques to relieve these impacts. This study evaluates the effectiveness of chopped bark mulch, applied at a rate of 13,6 Mg ha⁻¹ (80% of cover), and PAM, at a rate of 0,05 Mg ha⁻¹, for reducing surface runoff and erosion in an eucalyptus plantation at two scales: microplot (0,24m²) and slope (100m²) in northern Portugal. After the first year (mean precipitation 1442 mm), the control plots showed 45% of runoff coefficient at microplot scale, and 2,5% at slope scale. Soil erosion was 7,8 Mg ha⁻¹ and 0,81 Mg ha⁻¹ for small and slope scale respectively. The treatment with chopped bark mulch reduced runoff by 55% and sediment loss by 90% on both scales. The PAM treatment reduced runoff by 20% but wasn't effective for sediment loss reduction. Besides the mulch treatment, plot size and position on the slope proved to be important factors in the hydrological and erosive response as a consequence of hydrologic connectivity, fire intensity and ground cover.



S03.01-P -27

**SALINIZATION LEVELS OF SOIL AND WATER IN A MEDITERRANEAN COASTAL WETLAND:
THE PEGO-OLIVA MARSH (SPAIN)**

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In the last decades, the increases of the anthropogenic pressure and the related socio-economic development have provoked important changes in Mediterranean coastal wetlands, through drainage for cultivation, construction and development of infrastructures, irrigation systems, etc. These transformations lead to the degradation of this high status ecological habitats (destruction of flooding prairies, riparian habitats and breeding areas), with also important repercussions on soil and water quality. This study is focused on the evaluation of soil and water quality parameters related to salinization in the Pego-Oliva coastal wetland (1250 hectares), a Natural Park in the Valencia Community (Spain), also included in the RAMSAR Agreement. In this area, 46 soil samples from three land uses (rice farming and marsh area, citrus crops and shrubland soils), and 67 water samples from different sources (ditches and irrigation channels, lake, rivers, groundwater) were analysed. The soil and water quality parameters studied were electrical conductivity (EC), sodium and chloride ion concentrations, and sodium from the soil exchangeable complex (ESP). Main results show that 24% of soil samples have $EC > 4 \text{ dS m}^{-1}$, all of them coming from the rice farming and marsh areas. These soils showed mean ESP of 26.5%, with values up to 78%. However, the other land uses did not exceed the ESP of 5%. Regarding waters, 82% of samples presented $EC > 2 \text{ dS m}^{-1}$, and sodium and chloride concentrations higher than 200 mg L^{-1} were found in the 85% of samples. Attending their sources, the highest values were obtained from the lake and ditches waters.



S03.01-P -28

SOIL COMPACTION SUSCEPTIBILITY: TUNING OF A NEW ESTIMATION INDEX

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Soil compaction due to the ever-growing size and power of agricultural machinery is commonly considered one of the main causes of decreasing soil productivity and environmental degradation. Compaction susceptibility was assessed by the model of Smith et al. (1997), having as input data the silt plus clay percentage. The model validation was performed through the determination of soil compressibility index (C); uniaxial compaction tests were carried out on air-dried and sieved (2 mm) samples of 16 soils from different geographic areas of Italy under different soil use (arable, orchard, pasture and natural vegetation). C represents the slope of the linear portion of the relationship between bulk density (ρ_b) and the decimal logarithm of applied pressure. Soil samples were moistened and equilibrated at 3 different water contents: field capacity (-33 kPa), 110% and 90% (w/w) of plastic limit (1.1PL and 0.9PL, respectively). Four different pressures (50, 100, 200 and 400 kPa) were then applied by means of a hydraulic press. Results show that C , since it represents the average slope of the compression lines for a range of water contents, does not attribute adequate significance to the bulk density values resulting from the compaction tests. This may lead to an inconsistent assessment of real soil compaction susceptibility. In order to improve the representativeness of C , a modification was made by the addition of the bulk density values resulting from an applied pressure of 100 kPa ($\rho_{b100kPa}$). Such corrected C values (C_{cm}) better describe the compaction behaviour of soils.



S03.01-P -29

SOIL DEGRADATION AND DESERTIFICATION IN THE MEDITERRANEAN: PROBLEMS AND POSSIBLE SOLUTIONS

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Soil Degradation-Desertification is an important menace to the capacity of Mediterranean terrestrial ecosystems to provide services, biomass production and ecological functions. In the last decades dramatic land use changes occurred in many parts of the Mediterranean countries driven by crisis of traditional agriculture and associated land set aside. Both the abandon of cultivation and the abandon of maintenance of soil conservation structures originated the loss of soil capacity to buffer extreme climate events like torrential rains or drought periods. The socioeconomic changes influenced the increase of forest fires together with the concentration of human activities in coastal areas (littoralization). The consequences of such enormous pressures and the sealing effect of urbanization are the irreversible loss of very productive soils and the disruption of the infiltration and run-off pattern. Climate change and aridification trend will also exacerbate the unsustainable exploitation of water resources leading to serious environmental damage to land, including chemical and organic contamination, salinization and marine intrusion on coastal aquifers. The current schemes of soil conservation should be expanded to include new perspectives and implications in the context of the sustainable use of terrestrial ecosystems. The demands for the maintenance of biodiversity, carbon cycle regulation, food production, regulation of water resources, landscape maintenance and preventing land degradation require new paradigms in the protection of the soil to be developed under the prospects of multiuse and multifunctionality. Soil is a key and complex natural resource demanding urgent and comprehensive policy protection addressed by the European Commission and the Member States.



S03.01-P -30

SOIL DEGRADATION INDUCED BY THE CHANGE IN MANAGEMENT OF THE “ARENADOS” SYSTEM (LANZAROTE, CANARY ISLANDS)

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Lanzarote is one of the most arid zones of the EU. Dryland agriculture could be developed thanks to a traditional agrosystem called “arenados”, which rely on the use of basaltic tephra mulch. Recently, the availability of new water resources: desalinized seawater and reclaimed municipal water, has generated new expectations for higher agricultural productivity. As a consequence, irrigation has been introduced to the traditional agrosystems. The aim of this study was to evaluate the quality of the irrigation waters and its impact on soil properties. Eighty irrigated field plots were selected, along with their non-irrigated counterparts. Fifty plots were irrigated with desalinized water and thirty with reclaimed municipal wastewater. Irrigation water was sampled periodically. The irrigated soils showed an increase of salinity, especially in the case of wastewater irrigation. The main problem observed was the accumulation of boron in soils, in some cases, at potentially toxic levels. The results showed that water management practices are applied without proper knowledge of the soil–water dynamics of the mulched soils. This, together with a better control of water quality are essential requirements to prevent mid-term soil degradation leading to situations hardly recoverable. It is important to attain the sustainability which characterizes the dryland agrosystem.



S03.01-P -31

SOIL PHYSICAL PROPERTIES UNDER DIFFERENT CROPPING SYSTEMS IN ESTONIA

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A five years crop rotation system (pea, potato, barley, red clover and winter wheat) based on 80 plots was conducted at the experimental station of Estonian University of Life Sciences in Eerika, Tartu (Estonia) since 2008. From those plots, 40 were cultivated under conventional farming system with different concentrations of mineral fertilizers, and 40 under organic farming conditions and winter oil-rape, winter rye, winter wheat, ryegrass and under seeding as rotating crops. From these, 20 of them were under cover crops (organic I), and for the other 20 (organic II), manure were added. A total of 320 samples taken (4 replications per plot), taken in October 2010 and October 2011, respectively. From these samples, penetrability, field water retention capacity, porosity, air filled pores, and water permeability were studied respectively. Results doesn't show any no significant difference between organic and conventional management for penetration resistance and water permeability, but results of 2011 show an increase in the penetration resistance especially in the conventional plots in comparison with the organic ones and comparing the different crops under the four systems from 2011, barley us. and w. wheat presented a higher penetration resistance in comparison with the other cultures. Analysis from 2010 show differences in porosity and air filled pores within the organic plots, where w. wheat + ryegrass and pea + oil rape had higher values. In the case of water permeability the plots under conventional treatment shown higher values in comparison with the organic ones.



S03.01-P -32

SOIL QUALITY AND PRODUCTIVITY LOSSES DUE TO COMPACTION IN ESTONIAN GRASSLANDS

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Identifying the vulnerability of soils to compaction damage is becoming an increasingly important issue when planning and performing farming operations. Although grassland species are more resistance to soil compaction, the yield losses occur also there due to repeated overriding. In conventional agriculture the whole field is passed usually more than once and field edges even 8 to 10 times. However, the losses of plant biomass may not be remarkable high, but soil compaction affects also the quality of the production and soil. The field experiments with different grassland species at different compaction and fertilization levels and farm field survey were conducted in Estonia in time period 2008–2011. Soil physical and chemical properties, such bulk density, porosity, penetration resistance, water content and permeability, pH, available P, K, Ca, Mg, total N and organic C content were measured. From plant analyses the plant shoots and roots biomass, yield and their nutrient content was measured. The results revealed the reduction of grassland plants productivity up to 80% due to continuous compaction in the experiment on sandy loam soil. On the farm grasslands the average reduction of the aboveground biomass during one season was 20% in the tyre traces and field edges. However, even the compaction did not affect the biomass of the plants; it decreased the nutrient content of plants. Mainly the losses of plant productivity were connected with lower soil aeration in wet years and higher penetration resistance and amount of plant unavailable water in dry years.



S03.01-P -33

**SOIL QUALITY EVALUATION UNDER AGRO-SILVO-PASTORAL MEDITERRANEAN
MANAGEMENT SYSTEMS**

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According to Franzluebber (2002) the degree of stratification of soil organic C and N, as well as other parameters, with soil depth, expressed as a ratio, can indicate soil quality or soil ecosystem functioning and sustainability under different agricultural management. Stratification ratios > 2 indicate a higher soil quality and contribution to agriculture sustainability. A case study from north-eastern Sardinia (Italy) is presented. Agriculture is mainly extensive and markedly agro-silvo-pastoral, and is typical of similar areas of the Mediterranean basin. The following land uses were considered: tilled vineyards established in 1994 (TV), no-tilled grassed vineyards established in 1991 (GV), hay crop (oats, Italian ryegrass and annual clovers or vetch) with sparse cork oaks (HC), pasture, covered with spontaneous herbaceous vegetation with sparse cork oaks (PA), semi-natural systems (scrublands, Mediterranean maquis and Helichrysum meadows), former vineyards set-aside about 30 years ago (SN), forest (Quercus suber L.) established in the past century (CO). The tilled vineyards and no-tilled grassed vineyards are agricultural higher intensive land uses, whereas hay crop, pasture, semi-natural and forest are agro-silvo-pastoral lower intensive land uses. Data are discussed in terms of soil organic C and total N levels in g kg⁻¹, and stratification ratios calculated from contents in the 0-20 cm soil layer divided by that in the 20-50 cm.



S03.01-P -34

SOIL QUALITY INDEX TO COASTAL PLAIN ECOSYSTEM FOREST

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In recent decades, with growing concern about natural resources and environmental quality, intensified research, resulting in the definition of soil quality (SQ), strongly rooted in the concept of sustainability. To this aim, several models have been proposed in attempt to assess the Soil Quality Index (SQI). The coastal plain ecosystem (Restinga forest) is associated with rain forest (Mata Atlântica), and is the most fragile and susceptible to human disturbance. The aim of this study is to determine the Soil Quality Index for Restinga forest, to high and middle stages of vegetation regeneration and soil without vegetation, based on their chemical, physical and microbiological attributes. It was developed in four locations of São Paulo state: (1) Anchieta Island, Ubatuba, (2) Juréia-Itatins Ecological Station, Iguape, (3) Vila das Pedrinhas, Comprida Island; and (4) Cardoso Island, Cananéia. The soil samples were collected at a depth of 0 to 10 cm for chemical, physical and microbiological analysis, and also evaluated the distribution of the root system into the soil profile. It was used the Comparative Additive Model to SQI determinations. The SQI values obtained for all studied areas demonstrated low production potential biomass of these soils, as well as its low resilience; SQI similar values (0,1 a 0,3) to the forests with and without vegetation showed that Restinga forest is edaphic; the use of routine chemical analysis is sufficient to determine the SQI to this ecosystem.



S03.01-P -35

SOIL QUALITY RECOVERY FOLLOWING NATURAL VEGETATION SUCCESSION AFTER LAND ABANDONMENT

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Abandonment of agricultural fields is a wide-spread phenomenon on the southern slopes on the island of Tenerife (Spain). Land abandonment has negative environmental impacts because of its close relation with soil degradation especially in the early stages of abandonment when vegetation recovery is only at its initial state. Focus of this research is to study the rate of soil recovery after the abandonment of agricultural practices, and trying to shed some light on the still poorly understood relationship and interactions between vegetation and soil development. The research was carried out near the village of Villaflor, an area where agricultural field abandonment is abundant on sloping areas. Soil degradation/regeneration in abandoned agricultural fields has been evaluated for fields belonging to different age groups of abandonment with comparable soil types. Soil quality was evaluated using simple parameters (slope angle, exposition, soil organic matter content, aggregation, texture, vegetation cover and species). We found significant correlations between aggregate stability, clay content, organic matter, slope angle and number of plant species. Aggregate stability and organic carbon content showed a non-asymptotic development over time. Surprisingly, we observed a drop in aggregate stability between 10-20 years after abandonment, after which the stability increased again and additional research is required to explain these results. However the results obtained provide valuable information about the sensitivity of aggregate stability as an indicator for soil quality restoration and degradation vulnerability in relation to revegetation.



S03.01-P -36

SOIL RESISTANCE TO PENETRATION OF AN OXISOL IN RECOVERY BY 19 YEARS

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The objective this paper was to evaluate the soil resistance to penetration of a degraded Oxisol after 19 years in recovery. The area studied is located in the state of Mato Grosso do Sul, Brazil, and the soil studied is an Oxisol degraded by the construction of hydroelectric power plant is recovering 19 years ago with lime, gypsum and green manure. The experimental design was a completely randomized with seven treatments and four - replication. The treatments were: mobilized soil (tilled soil without culture); Stizolobium aterrium; Cajanus cajan -until 1994 and then substituted by Canavalia ensiformis; lime+S. aterrium; lime+C. cajan until 1994 and then substituted by C. ensiformis; lime+gypsum+S. aterrium; lime+gypsum+C. cajan until 1994 and then substituted by C. ensiformis. In 1999, all treatments were implanted Brachiaria decumbens. The data were compared with two control: exposed soil and native vegetation of the Savannah . Were determined the soil resistance to penetration and soil moisture in the depths of 0.00-0.10, 0.10-0.20 and 0.20-0.40m, in year 2011. The results were analyzed effectuating the analysis of variance, Scott-Knott test to 5% of probability to compare averages. The highest and lowest values of soil resistance to penetration were found to control, degraded soil and native vegetation of Savannah , respectively. The values of soil resistance to penetration decreased recovery treatment in relation to soil degradation and show that the soil is in the process of recovery. The treatments are effective in recovering soil for this indicator of soil quality.



S03.01-P -38

SOIL SALINITY ASSESSMENT IN THE NERETVA RIVER FLOODPLAINS

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Environmental degradation in the coastal areas is a current problem in some regions of the Adriatic coast and it is mainly related to the soil and water salinization, very serious threats to the ecosystems and causes of desertification. The Lower Neretva region (Croatia) is intensively used for agriculture, and it is at the same time environmentally highly sensitive. A major threat to disturbing the balance of the agricultural ecosystem is the salinization of water and soil. Rational management of soil salinization requires an understanding of how soil salt concentrations vary across the land. The general goal of this research was to identify and map the salinity of soils in a geographically defined area of 5,815 ha of the Lower Neretva region. In order to identify the spatial variability of soil salinity in the surface layer (0-25 cm), topsoil samples (0-25 cm) were collected from 246 locations using a systematic sampling on a 500-m grid. Subsoil samples (25-50, 50-75, 75-100 cm) were collected from 63 locations using a systematic sampling on a 1000-m grid. Electrical conductivity as well as sodium and chloride concentrations measured in the saturated soil extract show high variability of soil salinity level. High variability of the soil salinity level in both horizontal and vertical spatial dimensions was identified through statistical and geostatistical analyses and mapping. An intermediate scale map may be useful in delineating specific areas where soil salinity may be problematic for agriculture, wetland habitats and other natural habitats in the Neretva valley.



S03.01-P -39

SOIL SECURITY - PRIORITIZING GLOBAL UNDERSTANDING OF SOIL DEGRADATION AND ITS AMELIORATION

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Soil degradation is a largely silent phenomenon. Left unaddressed it will lead to catastrophic consequences. Yet bringing the attention of society to this major threat is very difficult. Soil is silent in most cultures, even though soil provides the ecosystem services upon which life on earth depend. What is required is a conceptual term that encapsulates the threat but at the same time communicates the required response and the benefits of the response. It must be something that grabs the attention of scientists, policy makers and land managers. It must be simple enough to communicate and be recognized by the general public at local and global scales. It must be easily translated into policy and into practice. "Soil security" is a new term that achieves this requirement. Soil security is the maintenance or improvement of the world's soil resource so it can provide sufficient food and fibre, fresh water, contribute to energy sustainability and climate stability, maintain biodiversity and overall environmental protection and ecosystem services. For soil to be secure it must maintain its function. Soil carbon is a key indicator of soil function. Therefore a principal mechanism for achieving soil security is the management and sequestration of soil carbon through active land management systems and technologies. Soil security can be achieved by increasing and managing soil carbon in the world's soils. The science, technology and management practices already exist to achieve this. By taking a new lens through soil security, the threat of soil degradation can be reversed.



S03.01-P -40

SOIL STRUCTURE IN THE MAIN ECOSYSTEMS OF THE MEDITERRANEAN ISLE OF PIANOSA, ITALY

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The Isle of Pianosa is a typical Mediterranean ecosystem. Past agricultural activities had a strong impact on the original vegetation, which is believed to have been a Mediterranean macchia. After being abandoned, the agricultural land is undergoing re-naturalization. We studied the effects of both the different land use and the cessation of agricultural activities on soil structure in natural Mediterranean macchia (M), arable fields (A), and permanent pasture land (P). The organic carbon content was highest in M and lowest in A. [[Porosity data indicated that]] the soil was moderately porous, irrespective of the land use. Modifications in land use from natural macchia to human activities compacted the soil, with pasture and tillage reducing the overall volume of pores that retain water available for plant and microorganisms. The three vegetation systems showed similar values of the total amount of pores greater than 50 mm, but the amount of the largest pore classes increased in the order: M, P, and A, in all cases mainly due to the increasing presence of elongated pores. Total cracking increased significantly from M to P to A. However, the total length of cracks moved in the opposite direction (M>P>A). More numerous and thinner cracks were formed in M, and fewer larger cracks in A. There was an intermediate condition in P. These data indicate that soil finds it more difficult to regenerate a good structure when the land use leads to a decrease in organic carbon content.



S03.01-P -41

SURVEY OF THE EFFECT OF PLANTS ON SOIL PROPERTIES AND STABILIZATION (CASE STUDY: SEMNAN-IRAN)

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*Survey of the effect of plants on soil properties and stabilization (case study: Semnan-Iran) Gh. Zehtabian¹, KH. Nazeri², *R. Masoudi³, H. Khosravi³ Iran is located on desert belt of the world and it has arid and semi- arid climates. So most of the areas expose to desertification and degradation of desert ecosystem. Wind is one of the most important reasons of erosion in arid region and using vegetation cover is one of the best ways of soli stabilization in these areas. The main aim of this study is survey of the effects of plant such as calligonum sp, on soil physic- chemical properties in sand dune of Semnan, so that positive effects are introduced and is prevented from expansion of Desert. at the first place, two main areas were selected and soil samples were, then, taken from beneath bushes and between bushes. After sampling, some factors such as organic matter, n, ph, clay and silt percentage were calculated and then the obtained results were analyzed by MSTAT statistical software. Considering the analysis of data, significant differences were observed between treatments. The result showed organic matters, N and PH increase in soil of beneath bushes comparison with soil of between bushes; also some physical factors like clay and silt percentage are so. As a result, creation of vegetation cover can have many positive effects on soli and ecological properties moreover they can reform unstable soil as sand dunes. Keywords: soil properties, vegetation, organic matter, wind, Iran*



S03.01-P -42

SUSTAINABLE MANAGEMENT SYSTEMS AFFECT TOPSOIL PHYSICAL PROPERTIES AND ORGANIC C CONTENT IN A HIGH DENSITY OLIVE ORCHARD

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In recent years there is evidence of an increasing occurrence of heavy rainfall events associated with climate changes, that further expose the soil to erosion and flooding. One of the main aspect of soil degradation is crusting, due to the impact of raindrops when the soil is bare and dry. In spite of all these problems, periodic tillage is still the most commonly adopted method to control weeds in olive orchards. The aim of this study was to evaluate the effect of two conservative soil management practices, namely minimum tillage (MT) and natural grass cover (NC), on soil characteristics and tree performance in a high density, deficit-irrigated olive orchard on a Typic Haploxeralf sandy loam soil. We compared soil macroporosity, water infiltration rate, different fractions of organic carbon five years after the beginning of the trial, and yield components over five years. Soil macroporosity in the upper layer of NC management was significantly higher than MT, which had very low values (2%). Water infiltration rate in MT plots was much lower than in NC ones, because of soil surface crusting. NC also had higher values of total organic carbon (TOC) and total exchangeable carbon (TEC) than MT, whereas the humic carbon (HC) fraction was unaffected by soil management. Yield components were differently affected by soil management: the number of fruits of the NC plots was significantly lower than that of MT, whereas the oil content in the mesocarp was similar for both treatments.



S03.01-P -43

THE CONTRIBUTION OF KEY MICROORGANISMS FOR RESTORING SOILS FROM FORMER COAL MINING SITES

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Remnant soils from coal strip-mining, such as in central Germany, are very nutrient poor and are thus a challenge to re-vegetate or restore. In this study we examine how key microbes (mycorrhizal fungi and N-fixing bacteria) and plant species composition can best be combined to restore soils from former brown coal mines in a low-input, sustainable manner for biomass production. First, we conducted a survey of three former mining sites that vary in recovery time since mining (8, 12, and 18 years). From each site we performed a full soil analysis and analyzed plant biomass and species composition, mycorrhizal colonization, and microbial community structure, biomass, and activity. We found that soil abiotic parameters (pH, cation concentrations, extractable nutrients) did not change significantly between sites but that the youngest site had less microbial activity (extra-cellular enzyme activity) and less plant biomass, mostly due to lower herb, versus grass or legume, biomass. In addition we conducted greenhouse and field experiments to specifically test how different plant species grow with or without microbial inoculation (commercial AMF and N-fixing bacterial inocula, or 'native' inocula of undisturbed topsoil) on mineral sub-soil or mixed A and B horizon soil from an active mine. Initial results of these experiments suggest that both 'native' and commercial microbial inoculations can improve plant growth, but that this is highly plant-species dependent. In summary, specific microorganisms do play a role in the restoration of disturbed soils but this role may vary substantially based on specific plant species and localized site conditions.



S03.01-P -44

**THE ECOLOGICAL RECOVERY OF THE STERILE DUMPS FROM HUSNICIOARA QUARRY,
DISTRICT MEHEDINTI**

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In Romania the lignite coal is extracted by open cut mining. The open cut lignite mining determines the most harmful degradation of soil, the upper fertile layer of soil being replaced. In Oltenia, alone, by this kind of mining there are affected 17,400 ha. The ecological recovery of these lands is very important for locals and it assumes two main actions: - the reclamation, technical mining activity; - the biological recovery or ecological reclamation. In this respect, there were carried out researches on the gangues resulted after open cut mining in Husnicioara quarry – Mehedinti District that has affected 614 ha of which 329 ha of quarry and 285 ha as gangues. There were tried several crops on different doses of fertilizers and manure. The wheat crop does not succeed on gangues even with fertilization, the yields being of 448 – 1,208 kg/ha. The corn crop gives good yields on gangues only with manure and fertilizers; by chemical fertilization it can produce 2,200 kg/ha and by manure application, 3,500 kg/ha; The sunflower crop does succeed on gangues even without fertilization yet it can produce much better with mineral and organic fertilization. Pulses give good yields on gangues, the alpha-alpha crop has produced 4,417 kg of hay per hectare with organic and mineral fertilization. The same results are given by chickpea and peanuts. In order to fasten the versants of the gangue deposits, the best results were given by cross cropping of acacia



S03.01-P -45

**THE EFFICIENCY OF DIFFERENT APPROACHES TO ANTI-EROSION PROTECTION IN
SELECTED AREAS**

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Erosion is the most serious world-wide degradation factor and threatens the quality of soil and production of crops cultivated on it. Oldeman (1994) indicated that soil erosion accounted for 82 per cent of human-induced soil degradation, affecting 1,643 million hectares. Water erosion is also a serious problem in the Czech Republic (half of arable acreage). Recently, increasing numbers of farmers in Europe have been using agri-environment measures on the basis of Council Regulation 1257/1999. In 2002 roughly 25% of agricultural land in Europe was covered by agri-environment measures. Applicants for subsidies from these measures must also maintain Good Agricultural and Environmental Conditions (GAEC), which are based on Council Regulation (EC) 73/2009 and also cover erosion. A comparison of anti-erosion methods was carried out in chosen regions of Moravia in the Czech Republic. After evaluation of current potential erosion our research focused on comparison of GAEC anti-erosion efficiency and classically proposed anti-erosion protection (AEP) utilizing organizational, agro-technical and technical measures. The results indicate insufficient soil protection within GAEC management, especially in the area of Moravia. The efficiency of these measures in the analysed areas is between 13.6 % and 42.9 %. In comparison the efficiency of AEP, which unlike GAEC includes linear measures and soil-protective grassing in its conception, is within a range of 40.9 % to 73.4 %. With its rational utilization of landscape the AEP proposal fundamentally reduces soil loss due to water erosion and, in contrast to GAEC, uses an individual approach to the localities of interest.



S03.01-P -46

THE EVALUATION OF EROSION HAZARD IN DASTKAN REGION - IRAN BY SLEMSA METHOD

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In geographical studies, soil is not only considered as a natural resource, but also it is exposed to a corrupted danger called erosion, so it needs study, guarding and control. These quantities would be very useful for planning's. In this research, dominant erosion type, regions of more risks towards erosion rate and the most important influential in Dastkan auriferous basin which is located in north of Isfahan , between geographical length of 51°29'42" - 51°19' , 11" and geographical width of 33 °28'04" – 33 °38' , 02" were studied. To do this, data were gathered through library search, Aerial photograph of the region, , topographical and geology maps, GIS and RS techniques, Surfer 8 and ILWIS softwares. Also, basic maps for factors in SLEMSA model, such as isotherm, isorain, plant covering, geology and finally erosion rate maps were prepared. In the region, 5 erosion focuses in the north part were observed. Considering influential factors on these regions showed that the main erosion factor at the risk focuses was at first rain energy and the other factors were the ground gradient and plant covering .In addition, soil fatigue capability, which was the main erosion factor in the region, did not play so much role at the risk focuses .The research finding showed that water erosion is the dominant type of erosion in the region and erosion rate of average 1.412 ton per hectare is lower, compared to erosion rate of the country .
Keywords: Erosion, Dastkan, SLEMSA,



S03.01-P -47

THE IMPACT OF ANTHROPOGENIC SOIL SEALING ON THE SOILS OF PROTECTED COASTAL LAGOONS (ALBUFERA DE VALENCIA, SPAIN)

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Anthropogenic soil sealing is one of the most worrying soil degradation factors to European level. Its development is a persistent threat in Mediterranean environments where socio-economic changes have produced the concentration of most productive activities in the alluvial coastal plains. Such trends may also affect soils in protected coastal lagoons. In this work a methodology based on the spatial and temporal analysis of artificial layers (concrete, asphalt, etc.) is developed. Data used have consisted in the extraction of soil sealing covers in polygon layers for the years 1991 and 2007, a layer with municipal limits and a layer with the limits of the protected area of the Albufera Natural Park, the study area located to the south of the city of Valencia, Spain. The analysis has consisted in the development of a set of statistics describing the situation of soil sealing and land fragmentation, understanding the first as the direct measure of soil losses and the later as a measure of loss of soils functionality. Results show that in 1991 almost 15% of the total administrative area studied was sealed and that it has increased to almost 19%, with variable trends according to individual municipalities. Such behaviour is identified in the soil of the protected area with smaller values, ranging from 3.75% in 1991 to 5.20% in 2007. The extension of the sealed surfaces has been also reflected in the fragmentation of soils with a considerable increase of soil patches and the subsequent reduction of their average size.



S03.01-P -48

THE QUALITATIVE EVALUATION OF SOIL EROSION HAZARD

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Soil erosion not only weakened soil, makes discouraging farms and a lot of hurt, but also causes destruction by sedimentation solid of materials in streams. Sources, dams, ports and decreases the amount of their capacity. One of the most central purposes in local studying and land use evaluation the hazard of erosion variation areas and determine its quantity. For evaluating erosion, there are many methods. In this methods, there are different factors such as rain erosion, value of erosion soil and plant coverage. In this study, we are studying soil erosion in Varmishgan basin between geographical length of 47° - 47°,38' and geographical width of 33 °,13' – 33 °,36' in Kohdasht in the northwest Lorestan province with SLEMSA method and using Arc GIS 9.3. SLEMSA is a model for estimation of soil erosion in southern Africa and developed and validated by Ewell(1978) and Stoking(1981,1988). For evaluating soil with this model, we obtained information maps contain topography, rainfall, slope and plant coverage. then with composing this layers, basin is separated to 100 units and the value of erosion soil is measured and giving value is as unit of erosive hazard in basin. . The results showed that the main erosion factor at the risk focuses was at first slope and the second factor was soil fatigue capability. The research finding showed erosion rate of average 667 ton per hectare

Key words: evaluation, soil erosion, Varmishgan



S03.01-P -49

THE SOIL AND NUTRIENT LOSSES BY LIQUID RUNOFF ON SLOPE SOILS

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The paper presents the evolution of the response of soils and the main nutrients from hilly zones of Oltenia and Moldavia, respectively, Preajba and Perieni as well as their loss from the soil as a result of fertilization by several doses, ensuing the following: - the soils become more acid, especially due to unilateral fertilization with nitrogen; - the available phosphorus content decreases from the top of the slope toward the base where it increases as a result of fertile soil deposition; - the potassium is, also, taken by runoff and its content increases at the base of the slope; - the most eroded nutrient, both with slope soils surface and depth is nitrogen from applied fertilizers. Putting together the total nutrient losses there can be noticed that the nitrogen losses range between 0.66 and 81.93 kg/ha. The eroded potassium on slope plots is 0.15-12.82 kg/ha. The humus quantity taken away along with the eroded soil is between 10.38 and 1,439.40 kg/ha. The phosphorus records maximal values of 5.23 kg/ha, iron, 25-4,668 g/ha, manganese, 12-3,744 g/ha, copper, 0.63-112.81 g/ha and zinc, 1.5-957.1 g/ha. The maximal values of nutrient runoff on slope soils by liquid and solid losses are recorded with permanent furrow plots taken as control that are not protected against erosion at all. With the case of cropped plots, the highest losses were recorded with the not fertilized corn variant, the fertilization determining a higher resistance to erosion and nutrient losses. The lowest losses were recorded with the sown and fertilized pastures.



S03.01-P -50

TREE COVER INFLUENCE ON WATER BALANCE OF SOILS IN SEMI-ARID REGIONS

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*Several studies in arid and semi-arid regions have shown that isolated trees play an important role in reducing the negative effects of climate and soil aridity. They strongly influence the environments under their canopies by changing soil moisture, soil nutrients, microbial activity, light availability and temperature in these sites. The objective of this study was to investigate the impact of *Acacia raddiana* trees on soil hydraulic properties and the near-surface water content (0-10 cm). The study was conducted in an *Acacia raddiana* pseudo-savanna ecosystem in the Bou-Hedma National Park in central Tunisia. *Acacia* trees are considered as keystone species persisting spontaneous on the edge of the desert. Two sub-habitats were distinguished: tree-covered areas and open areas respectively located underneath and outside the canopy of *Acacia* trees. Samples were taken in each major wind direction at 0.5 m and 10 m from stem, respectively underneath and outside the canopy. Preliminary results show that the water-holding capacity of the near-surface soil underneath the canopy was significantly higher ($p < 0.05$) than outside the canopy (26.9 ± 4.0 vs. 21.6 ± 2.5 %). How this affects the soil water balance will be further investigated by measuring the evolution of near-surface soil water content in time for both sub-habitats after rainfall events during the wet season.*



S03.02-P - SOIL EROSION AND DEGRADATION ON AGRICULTURE LAND

Tuesday 03 July 2012 from 17:00 to 18:30. Room Poster Areas

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A MATHEMATICAL MODELLING FOR LAND DEGRADATION IN A MINIATURE ARTIFICIAL RAIN MODEL

S.ali Almodaresi, Yazd - Iran, Islamic Republic of

S03.02-P -2

ABANDONMENT OF VINEYARDS AND ITS CONSEQUENCES IN ORGANIC CARBON, SOIL STRUCTURE AND WATER HOLDING CAPACITY

Maria Jose Marques, Madrid - Spain

S03.02-P -3

AGRICULTURAL SOIL ALTERATION DUE TO LAND IMPROVEMENTS IN THE ALPS (AOSTA VALLEY, NW-ITALY)

Fabienne Curtaz, Turin - Italy

S03.02-P -4

ASSESSING THE SOIL EROSION RATE OF SLOPING VINEYARDS BY MEANS OF MODIFIED MMF-SAGA MODEL

Marcella Biddoccu, Turin - Italy

S03.02-P -5

ASSESSMENT OF PHOSPHORUS TRANSFER FROM AGRICULTURAL LANDS TO THE SURFACE WATER IN FRANCE

Magalie Delmas, Orléans - France

S03.02-P -6

ASSESSMENT OF THE EROSION RISK IN THE FEDERAL STATE OF BRANDENBURG IN THE CONTEXT OF CROSS COMPLIANCE

Detlef Deumlich, Müncheberg - Germany

S03.02-P -7

BREAKDOWN OF SOIL AGGREGATES DEVELOPED ON DIFFERENT PARENT MATERIAL USING LOW INTENSITY ULTRASONIC VIBRATIONS

Taru Lehtinen, Vienna - Austria



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CARBON LOSSES AND AGROECOLOGICAL ASSESSMENT OF ERODED SOILS UNDER DIFFERENT BIOCLIMATIC ZONES OF RUSSIAN PLANE

Artemyeva Zinaida, Moscow - Russian Federation

S03.02-P -9

CHANGES IN SOIL CARBON AMOUNTS UNDER THE IMPACT OF RAPID GROWTH URBANIZATION IN NORTHERN IRAN

Farshad Kiani, Gorgan - Iran, Islamic Republic of

S03.02-P -10

CHANGES OF BULK DENSITY AND AIR-WATER PROPERTIES OF SOILS IN BASINS WITHOUT OUTLETS AS AN EFFECT OF EROSION AND ANTHROPOGENIC DENUDATION, STUDIES FROM NORTH-WESTERN POLAND

Bogusława Przewozna, Warsaw - Poland

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CONDITIONS FOR THE OCCURRENCE OF SLAKING AND OTHER DISAGGREGATION PROCESSES UNDER RAINFALL

Frédéric Darboux, Orléans - France

S03.02-P -12

DECENTRALISED POLICY FOR SUSTAINABLE WETLAND RESOURCES IN THE IGULUIBI AND UPPER RIVER RUIZI WATER CATCHMENTS LAKE VICTORIA BASIN UGANDA.

Alice Nakiyemba Were, Tororo - Uganda

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EFFECT OF PERSISTENT SUBSOIL COMPACTION ON N₂O EMISSIONS FROM ARABLE SOILS

Asko Simojoki, Helsinki - Finland

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EFFECTS OF EROSION ON GREENHOUSE GAS FLUXES IN A YOUNG MORaine LANDSCAPE OF NE GERMANY

Madlen Pohl, Müncheberg - Germany

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EVALUATING THE IMPACT OF HYDROFOBICITY IN OLIVE GROVES OF SOUTHERN SPAIN

Maria Burguet, Cordoba - Spain



S03.02-P -16

EVALUATION OF SOIL PHYSICAL QUALITY UNDER DIFFERENT SOIL LAND USES IN A SMALL SICILIAN WATERSHED

Massimo Iovino, Palermo - Italy

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FROM A GEOCHEMICALLY TO A PHYSICALLY-DRIVEN SOIL BLEACHING: THE ROLE OF AGRICULTURAL PRACTICES

David Montagne, Paris - France

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GEOMETRY OF SOIL AGGREGATION

Léon E. Parent, Quebec - Canada

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GULLY EROSION PREDICTION IN A SAHELIAN CONTEXT

Aurore Gay, Orléans - France

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HIGH SCALE EROSION MODELLING FOR MUDDY FLOOD INVESTIGATION

Sarah Annika Arévalo, Freiberg - Germany

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HIGH-RESOLUTION EROSION RISK MAP OF SWITZERLAND IN A 2X2-METER GRID (ERM2)

Volker Prasuhn, Zurich - Switzerland

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IMPACT OF RAPID URBANIZATION ON SOIL DEGRADATION IN ZIARAT WATERSHED GOLESTAN PROVINCE, NORTH OF IRAN

Farshad Kiani, Gorgan - Iran, Islamic Republic of

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IMPACT OF TILLAGE ALONG A SOIL TOPOSEQUENCE IN A TRADITIONAL CEREAL CROP

Maria Jose Marques, Madrid - Spain



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INVESTIGATING SYNDROMES OF AGRICULTURAL LAND DEGRADATION THROUGH PAST TRAJECTORIES AND FUTURE SCENARIOS

Luca Salvati, Rome - Italy

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LONG-TERM EFFECTS OF GYPSUM, SUGAR FOAM WASTE AND DOLOMITIC ROCK SURFACE INCORPORATED INTO A DEGRADED ACID SOIL ON SOIL ORGANIC CARBON, SOIL CHEMICAL PROPERTIES AND CROP PRODUCTION.

Pedro González-Fernández, Córdoba - Spain

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MAPPING SOIL EROSION RISK AT THE LANDSCAPE SCALE BY ADAPTING THE NATIONAL MODEL MESALES WITH PRECISE SOIL AND AGRONOMICAL INPUT DATA

Blandine Lemerrier, Rennes - France

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MAPPING SOIL EROSION RISK USING RUSLE, GIS AND REMOTE SENSING TECHNIQUES

Ahmed Harb Rabia, Damanhur - Elbehera - Egypt

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MODELING SOIL EROSION AND RESULTING SEDIMENT DELIVERY TO SURFACE WATERS AS PRECONDITIONS FOR REGIONAL EROSION CONTROL STRATEGIES

Marcus Schindewolf, Freiberg - Germany

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Fabio Scarciglia, Arcavacata di Rende (CS) - Italy

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QUANTIFICATION OF LESSIVAGE IN SOILS: AN EXPERIMENTAL APPROACH

Sophie Cornu, Aix en Provence - France

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REMOVAL EFFECT OF THE TEPHRA LAYER IN MULCHED IRRIGATED SOILS

Francisco Díaz, La Laguna - Spain



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Maria Concepción Ramos, Lleida - Spain

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SOIL EROSION AND RIVER EXPORTS IN THE LOIRE RIVER BASIN

Aurore Gay, Orléans - France

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Artemi Cerdà, Valencia - Spain

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SOIL INTERRILL ERODIBILITY OF THE SEMI-ARID AREA SOILS: A CASE STUDY IN EAST AZARBAIJAN PROVINCE, IRAN

Abbas Ahmadi, Tabriz - Iran, Islamic Republic of

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Wanyama Joshua Wanyama, Leuven - Belgium

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SOIL PROTECTION AND SUSTAINABLE RURAL LAND DEVELOPMENT IN POLAND

Piotr Sklodowski, Warsaw - Poland

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SOIL TEXTURE AS AN INDICATOR OF ENVIRONMENTAL CHANGES IN AGRICULTURAL LANDSCAPE OF NORTH-EASTERN POLAND

Pawel Sowinski, Olsztyn - Poland

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SPATIAL ANALYSIS OF THE SOIL LOSS FACTORS IN IRRIGATED AREAS OF THE CERRADO REGION OF BRAZIL

Celia Regina Bueno, Jaboticabal - Brazil



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SPATIAL AND TEMPORAL VARIABILITY OF CO₂ SOIL EMISSION IN A MEDITERRANEAN PEACH ORCHARD

Giuseppe Montanaro, Potenza - Italy

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STABILIZATION OF SOIL ORGANIC MATTER BY AGGREGATION AND INTERACTIONS WITH MINERALS IS AFFECTED BY SOIL EROSION

Xiang Wang, Amsterdam - Netherlands

S03.02-P -42

SUBSOIL COMPACTION OF ARABLE LAND IN UPPER AUSTRIA

Erwin Murer, Petzenkirchen - Austria

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SUPERFICIAL AND SUBTERRANEAN SOIL EROSION IN TABASCO, TROPICAL MEXICO:

Violette Geissen, Wageningen - Netherlands

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SUSTAINABLE MANAGEMENT OF POTATO ROTATIONS TO MINIMISE SOIL COMPACTION, SURFACE RUNOFF AND DIFFUSE POLLUTION RISK

Martyn Silgram, Wolverhampton - United Kingdom

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TEMPORAL EVOLUTION OF SOIL ERODIBILITY: ASSESSMENT OF EXPLANATORY FACTORS, AND CONSEQUENCES ON EROSION MODELLING. AN EXAMPLE FROM THE BEAUCE AREA, FRANCE.

Baptiste Algayer, Orléans - France

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TESTING THE "PHYSICAL MODEL CONCEPT" BY SOIL LOSS DATA MEASURED IN SICILY

Vito Ferro, Palermo - Italy

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THE EROSION OF AGRICULTURAL SEEDBANKS

Timothy D. Lewis, Dundee - United Kingdom



S03.02-P -48

THE IMPORTANCE OF ROOTS FOR GULLY EXPANSION IN CEREAL AND OLIVE ORCHARDS

Erik Cammeraat, Amsterdam - Netherlands

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THE LONG-TERM EFFECTS OF THE SOIL MANAGEMENT IN A TOURISM AREA ON CARBON CONTENT AND MICROBIAL ACTIVITY UNDER A HUMID CLIMATE, NORTH OF IRAN

Farshad Kiani, Gorgan - Iran, Islamic Republic of

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THE MAP OF THE MAXIMUM ADMISSIBLE VALUE OF THE CONSERVATION EFFECT FACTOR OF THE CANOPY COVER AS A TOOL FOR EFFECTIVE WATER EROSION PREVENTION IN THE CZECH REPUBLIC

Hana Kristenová, Prague - Czech Republic

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TOWARDS NEW EROSION RISK ASSESSMENT IN NORWAY

Frauke Hofmeister, Ås - Norway

S03.02-P -52

USAGE OF GEOINFORMATION LAYERS IN SOLVING WATER EROSION OF SOIL

Vera Vánová, Prague - Czech Republic



S03.02-P -1

A MATHEMATICAL MODELLING FOR LAND DEGRADATION IN A MINIATURE ARTIFICIAL RAIN MODEL

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The using mathematical methods have specific role in natural studies, whereas there isn't any other substitution among sciences. Earth changes problem is the best sample can make the usage of mathematical method applicable. wind, water and ice have the highest impact on morph changing of earth surface and make the biggest changes in passing of time. Despite we are speaking about astronomical time, But, since the time is a dynamic function, as it changes spatial changes will happen. The changes arise from environmental process in the time framework. Now, if we can design a model with mathematical methods that connect time and space -these two fundamental and important principals-in geomorphic changes .we will have a tool that can categorize the spatial periods with equal change means in evolution phases ,instead of dividing earth evolution periods base on time . this kind of modelling in earth science called ERGODISITY . Of course this concept has complex computational methods and relations in mathematics as Ergodic theorem. In this article we show with this method and with an artificial raining basin model we can state evolution phases base on space instead of time. after getting data from filed model we perform an virtual DEM by using Didger software and also we make interpolations by different methods in surfer software, then virtual Ergodic simulation made by Voxler software and the result confirmed as it mentioned above.



S03.02-P -2

ABANDONMENT OF VINEYARDS AND ITS CONSEQUENCES IN ORGANIC CARBON, SOIL STRUCTURE AND WATER HOLDING CAPACITY

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The study area (Cuenca, Spain) is located in a semiarid vast plain (2-8% slope, annual precipitation 500mm). The Calcisol (FAO) represents the dominant soil of this monotonous landscape of vineyards, few areas remain untouched by human activities. In recent years the abandonment of vineyards has been noticed. We study the characteristics of soils in active and abandoned (4 to 6 years) vineyards, and both are compared with a reference soil of *Quercus ilex* forests in the nearby study site. Soil organic carbon (OC), bulk density (BD), water-holding capacity (WHC), soil stability aggregates, hydraulic conductivity (Q) and number of fungal Colony-forming Units (CFU) as biodiversity indicator, were studied in topsoils. The reference soil yielded $5.2 \pm 2.2\%$ OC, $1.2 \pm 0.1 \text{ g.cm}^{-3}$ BD and up to $0.57 \text{ m}^3\text{m}^{-3}$ of water at field capacity. In contrast, active vineyards exhibited soils with $1.9 \pm 0.6\%$ of OC; $1.2 \pm 0.2 \text{ g.cm}^{-3}$ BD due to tillage, and $0.42 \pm 0.05 \text{ m}^3\text{m}^{-3}$ WHC. The abandoned vineyards experienced a slight increase in OC: $2.9 \pm 0.9\%$, a significant soil compaction: BD 1.6 ± 0.2 and less HWC: $0.41 \pm 0.1 \text{ m}^3\text{m}^{-3}$. The till management in vineyards increased the Q being four to five times higher than values found in forest and almost twice higher than values of abandoned vineyard. Nevertheless, that high Q was not complemented by better WHC. Consequently soil structure in vineyards was weaker, around 40 drops were needed to break soil aggregates in the reference soil, compared to 9 and 4 in abandoned and active vineyards. Soil biodiversity, significantly decreased from 5000 to less than 750 CFU in vineyards.



S03.02-P -3

AGRICULTURAL SOIL ALTERATION DUE TO LAND IMPROVEMENTS IN THE ALPS (AOSTA VALLEY, NW-ITALY)

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Land transformations in the mountain regions generally produce impact on soil chemical, physical and biological properties. Land improvements are often carried out to allow farmers to easily cultivate and increase the mechanizable soils. However, the effects on soils of some common practices like rock removals, levelling and milling are frequently unknown. The aims of this study are: 1) the assessment of impacts of land improvements on soil properties and 2) the detection of the best pedotechniques and practices of restoration. We investigated 3 study areas in the Aosta Valley Region (NW Italy). Soil sampling was carried out in sectors of different age and in a control, where the land improvements were not conducted. Additionally, we evaluated the effect of different organic fertilizers (i.e compost and organic manure) on soil quality during the restoration processes. All soil samples have been analyzed for chemical and physical properties. Specific analyses included water aggregate stability (WAS) and Atterberg limits. Recent improvements (2008) generally resulted in a turbated soil organic carbon profile, with higher values at greater depth than in surface. The land improvements caused a general decrease of the soil organic matter content in comparison with the control, and show a higher susceptibility to erosion. The soils before the amelioration practices could be extremely stony and consequently the use of an allocthonous soil could be necessary. Since these important effects of land improvements on the soil characteristics, the definition of best practices is essential in order to reduce impact, costs and ensure better results.



S03.02-P -4

ASSESSING THE SOIL EROSION RATE OF SLOPING VINEYARDS BY MEANS OF MODIFIED MMF-SAGA MODEL

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The IMAMOTER-CNR monitored a 10-years period of soil erosion in vineyards of the Piedmont Experimental Vine and Wine Centre, in the Alto Monferrato area (NW Italy). To support and continue the monitoring period, this study applies a spatially-distributed soil erosion model in three vineyard areas characterized by different inter-rows practices, i.e. controlled grass cover (GC), conventional tillage (CT) and reduced tillage (RT). For that purpose, we implemented the Modified MMF model as module for the FOSS GIS SAGA. In order to improve model performance, our implementation of this model includes i) the use of a channel network layer, by which the sediment and runoff are concentrated, ii) the use of a multiple flow direction algorithm for sediment and runoff routing, and iii) a time-span parameter which indicates the number of simulation days. In total, 63 runoff and sediment measurements of single or accumulative rainfall events were used during model evaluation. After preprocessing the input data, the model was calibrated separately for spring, summer and autumn season based on the channel network density which in fact follows the tractor paths. Evaluation of model performance was carried out by using the effectiveness coefficient introduced by Nearing. The results show that the differences between measured and predicted soil erosion are in an acceptable range and imply that the Modified MMF model is not only effective as a monitoring tool but can also be used for simulating different conservation scenarios in order to reduce the soil erosion problem in vineyards.



S03.02-P -5

ASSESSMENT OF PHOSPHORUS TRANSFER FROM AGRICULTURAL LANDS TO THE SURFACE WATER IN FRANCE

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Diffuse phosphorus (P) transfer from agricultural lands to surface water contributes to eutrophication. It has increased attention in the last decades, notably due to a real improvement of water treatment from urban areas which induce a higher relative part of agricultural sources. Methodologies are required for water quality assessments at large scale as a part of the implementation of the EU Water Framework Directive. In this context, a methodology is presented which aims to investigate what is the fraction of hillslope P production which reaches the river systems, and finally, to better identify the origin of P observed in rivers. The proposed model combines mobilisation and transfer processes: P and soil particles are firstly mobilised by water erosion, and then they are delivered via surface and sub-surface flow pathways to the river network. The method takes into account the spatial distribution of major properties that control the mobilisation of P by soil erosion and its transfer to the water bodies. Description of P transfer is based on the establishment of connectivity indicators which describe hillslope flow pathways, potential retention, attempting to link basin characteristics to a prediction of phosphorus exports in rivers. The model is calibrated and validated with phosphorus fluxes calculated in French rivers. This study provides insight in the identification of the most influent soil particles and P redistribution processes on the total P fluxes, and the difference between various types of basins.



S03.02-P -6

ASSESSMENT OF THE EROSION RISK IN THE FEDERAL STATE OF BRANDENBURG IN THE CONTEXT OF CROSS COMPLIANCE

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Cross-compliance (CC) is a policy tool that attaches conditions to the receipt of agricultural subsidies/direct payments. Since 2005 all farmers receiving direct payments and managing field blocks with a water or wind erosion risk are subject to restrictions and/or specific soil protection measures. Basis of a comparable and fair risk assessment are consistent data of the main controlling factors with a high spatial resolution. The water erosion risk is estimated with a German adaption of the (R)USLE using soil and topography data in a 25m-grid. The wind erosion risk is derived from soil and wind data considering the sheltering effects of landscape structure in a 10m-grid. Unfortunately, the high spatial resolved assessment with all risk classes is averaged by the weighted mean for a field block, considering only the percentage of the highest risk classes. The real erosion risk is underestimated by this procedure. Discrepancies exist between the minimum standards for CC and effective soil protection resulting in intense discussions between different interests. More suitable is a comparative method (SICOM) to evaluate complex site conditions at different area units as a basis for the estimate of spatial equivalence. Objects with heterogeneous contents can be aggregated to comparison groups and sorted by index, indicators, triple or others. The information can assist the soil protection policy of the EU to achieve the right balance between competitive agricultural production and the respect of nature and environment. The methods are introduced, compared and discussed in its consequences for soil protection.



S03.02-P -7

BREAKDOWN OF SOIL AGGREGATES DEVELOPED ON DIFFERENT PARENT MATERIAL USING LOW INTENSITY ULTRASONIC VIBRATIONS

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Ultrasonic dispersion of soil aggregates is widely used, since it involves no chemical agents and enables further soil characterization such as quantification and characterization of occluded particulate organic matter (POM). However, currently available equipment is difficult to use at very low ultrasonic energy levels. Therefore, Schomakers et al. (2011) recently developed an ultrasonic device for low energy soil applications. The aim of this study is to link the soil aggregate breakdown with physicochemical soil properties, in order to calibrate energy levels that can be applied in different soils while maintaining e.g. microaggregates. Surface soils (0-20 cm) developed on different parent materials (alluvial sediments, volcanic material, serpentinite, limestone, granite) were collected and dry-sieved for 250-1000 μ m-sized aggregates. The study focused on how i) soil organic matter (SOM), ii) iron oxides and iii) clay content affects the breakdown of the aggregates as well as on iv) the characterization of SOM in the studied aggregates. With the new ultrasonic dispersion equipment low energy levels were used in six steps (2-40 J ml⁻¹). Dissolved organic carbon (DOC) was gained by UV absorption at 254nm and Simultaneous Thermal Analysis (STA) was used to characterize SOM. The study showed that breakdown of the aggregates at low energy levels (2 J ml⁻¹) was fastest in soils on alluvial sediments, followed by soils on volcanic material, serpentinite, limestone and granite. These results show that low ultrasonic dispersion is a very successful tool to follow soil aggregate breakdown but it needs to be adjusted to soils on various parent materials.



S03.02-P -8

CARBON LOSSES AND AGROECOLOGICAL ASSESSMENT OF ERODED SOILS UNDER DIFFERENT BIOCLIMATIC ZONES OF RUSSIAN PLANE

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The regularities of organic-mineral profiles formation of eroded Luvisols, Greyzems and Chernozems under different bioclimatic zones of Russian plane were investigated. A number of in humic changes and aggregate content of arable soils under the erosion have been established: the reduced content of CLF and the portion in total Carbon are accompanied by increase of the portion of CCl and it's accompanied by reduction of the ratio of Carbon in light (CLF) and clay (CCl) fractions (CLF/CCl) up to the observed minimum amount, and the quantity of ratio between the Carbon, accumulated in coarse (50-250 μm) and fine (1-50 μm) microparticles (Ccr/Cfn), which change in direction of increase markedly of Ccr. The low CLF/CCl – one of the basic reasons of upper horizon's bulk density increase (on average of $11\pm3\%$). Unfavorable properties of eroded soils are determined their low crop-producing power (~20% of non-eroded soils). The participation of accumulative processes in formation of eroded soils smooth out the negative influence of erosion, partially, and forward the bulk density reduction of soils in zone of prevail sediment accumulation and increase crop-producing power (~30% of eroded soils). The C losses of various organo-mineral fractions of eroded soils from different bioclimatic zones of Russian plane have been estimated. For the first time the system of eroded soils markers has been suggested. The scale of agroecological assessment of zonal eroded soils of Russian plane has been devised. In the base of scale are underlying 5 indexes. The quantitative indices CLF/CCl and Ccr/Cfn are among them.



S03.02-P -9

**CHANGES IN SOIL CARBON AMOUNTS UNDER THE IMPACT OF RAPID GROWTH
URBANIZATION IN NORTHERN IRAN**

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Urbanization is the most drastic form of land use change affecting ecology and ecosystem functioning and services far beyond the limits of cities. To understand the process of urbanization itself as well as its ecological consequences, it is important to quantify the temporal patterns of urbanization. We characterize the effects of temporal patterns of Ziarat village – the tourism region in the Golestan province – using evaluation of land use changes in four land use; forest, pasture, cultivated and urban on changes of soil carbon including total carbon, labile, non-labile carbon, mineral carbon and their relationships by bulk density parameter. The results showed that percent carbon means were 4.94, 3.01, 2.1, and 1.42 in the forest, pasture, cultivated and urban respectively. This parameter was decreased by 39, 56 and 71 % respectively in comparison with the forest. furthermore, Labile carbons decreased in urban, cultivated and pasture land uses by 87, 66 and 54 % respectively and also non-labile carbons decreased in urban, cultivated and pasture by 76, 49 and 34 % respectively. The Bulk density had been increased in cultivated, pasture and urban in comparison with forest. The mineral carbon was increased in urban, cultivated and pasture in comparison with forest. Because Ziarat watershed is the most important drinking water source of Gorgan (the capital of Golestan province), this study demonstrated that trend of soil degradation, carbon emissions and mismanagement caused increasing hazard of urban floods, sediment problem and human health problems in main city of province.



S03.02-P -10

CHANGES OF BULK DENSITY AND AIR-WATER PROPERTIES OF SOILS IN BASINS WITHOUT OUTLETS AS AN EFFECT OF EROSION AND ANTHROPOGENIC DENUDATION, STUDIES FROM NORTH-WESTERN POLAND

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The aim of the study was to investigate changes of physical soil properties caused by natural erosional and depositional processes and anthropogenic activity in basins without outlets in young glacial landscape (north-western Poland). The research was conducted in two toposequences connected with different types of land use (crop field, grassland). Sedimentary basins have been an object of interest for geomorphology, hydrology and pedology. Soil erosion research in basins without outlets in Poland are rare. These objects are those areas which have taken place the constant depositional and erosional processes in. As an effect of natural and anthropogenic denudation processes, soils located in the bottoms of the sedimentary basins are subjected to compression and thus to changes in soil porosity, bulk density and also morphology. Intensity of this occurrence depends on slope length and degree, properties of soil (texture, clay and organic matter content, structure, permeability, drainage), climate (especially rainfall), type of land use, etc. This research are supported by Polish Ministry of Science and Higher Education (research project no. N N305 056240).



S03.02-P -11

CONDITIONS FOR THE OCCURRENCE OF SLAKING AND OTHER DISAGGREGATION PROCESSES UNDER RAINFALL

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Aggregation is a major feature of soil structure. It affects transfer of water and gas through the soil and at the soil surface, plant growth, etc. Under rainfall, seedbed structure evolves, leading to crust development, which affects overland flow and erosion. This evolution depends on both rainfall properties (intensity, drop size distribution, initial wetness) and soil properties (aggregate size distribution, stability). Four major disaggregation processes have been identified : (1) slaking due to air entrapment, (2) micro-cracking due to differential clay swelling, (3) mechanical breakdown due to kinetic energy and (4) clay dispersion. Clay dispersion occurs under sodic conditions. It was previously shown that mechanical breakdown and micro-cracking can actually take place under rainfall. However, slaking has only been demonstrated for aggregate stability tests. To test the occurrence of slaking under rainfall, a experiment was conducted under controlled conditions. It used the rainfall simulation facility of the soil science laboratory (INRA, Orléans. France). Two soils with different textures (a clay loam and a silt loam) were used because of their known difference in sensitivity to slaking, as shown by aggregate stability tests. Initially dry aggregates (1-3 mm and 3-5 mm size ranges) were placed under rainfall (deionized water) for various durations, allowing the measurement of disaggregation through time using a laser diffraction sizer. Four rains with different kinetic energy and rainfall intensity were used. Results allow to distinguish between disaggregation processes and to specifically identify slaking. Using complementary studies from the literature, their conditions of occurrence under rainfall are outlined.



S03.02-P -12

DECENTRALISED POLICY FOR SUSTAINABLE WETLAND RESOURCES IN THE IGULUIBI AND UPPER RIVER RUIZI WATER CATCHMENTS LAKE VICTORIA BASIN UGANDA.

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This study was conducted within the framework of the VLIR-OI project with the aim of making contributions to the Diagnosis and Remediation of Land Degradation Processes in the Riparian Zone of Lake Victoria Uganda in view of reducing sediment pollution of the Lake Waters. The conservation and management of wetlands in Uganda is devolved from the central to the local level, which shifts the main responsibility for wetlands to the local governments. Decentralisation of natural resource management is said to have some considerable benefits for a more sustainable management of the natural resource, but it also has some drawbacks that can hinder successful management. Despite the importance of wetlands for Uganda, they are seriously degrading due to converting them into agricultural farm land. The study seeks to investigate whether or not decentralised governance is beneficial for sustainable wetland management and in which way wetland management can be improved from a stakeholders' perspective in light of the current farming systems and practices and their contributions to land degradation and pollution of the Lake Victoria waters in Uganda. The study used a mixed methods approach that is, qualitative and quantitative and is based on the Institutional theory. Findings revealed lack of coordination, lack of awareness about the decentralised policy by the farmers, lack of enforcement mechanisms and political interference and among the challenges the policy is facing.



S03.02-P -13

EFFECT OF PERSISTENT SUBSOIL COMPACTION ON N₂O EMISSIONS FROM ARABLE SOILS

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Fluxes of nitrous oxide (N₂O) and soil air composition were studied in two field experiments in southern Finland and Sweden, where persistent compaction effects by the heavy wheeling of a clay soil and a sandy clay loam soil in 1981 (Finland) and 1995 (Sweden), were still found in the subsoil. Samples of N₂O emissions and soil air were taken biweekly in 2009-10 both with chambers on the soil surface and gas samplers in the soil profile and analysed by gas chromatography. The annual fluxes of N₂O (mean \pm standard deviation) during Oct 2009 - Sep 2010 in the control and compacted treatments, respectively, were 8.6 ± 3.7 and 9.4 ± 1.0 kg N ha⁻¹ in Finland, and 10.0 ± 4.1 and 8.3 ± 3.8 kg N ha⁻¹ in Sweden, with no significant differences between the treatments. The concentrations of N₂O at the depths of 15, 30, 50 and 70 cm correlated positively with the emission of N₂O from the soil in both fields ($r = 0.4-0.7^{***}$). Compaction tended to increase N₂O in soil air. The oxygen concentrations in the subsoil correlated negatively with the N₂O emission, but only at the Finnish site. The results suggest that despite periods of impaired subsoil aeration and higher concentrations of N₂O in soil air, subsoil compaction does not significantly increase N₂O emissions from these soils to the atmosphere 15-30 years after compaction. This may indicate a minor role of subsoil in the production of N₂O compared with topsoil.



S03.02-P -14

EFFECTS OF EROSION ON GREENHOUSE GAS FLUXES IN A YOUNG MORAINELANDSCAPE OF NE GERMANY

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Little is known about the management-induced erosion on the greenhouse gas (GHG) exchange and carbon (C) budget of arable sites in glacially shaped young moraine landscapes. In an interdisciplinary approach, the CarboZALF-D project investigates the impact of various factors such as erosion on GHG fluxes and C dynamics of such a landscape in NE Germany. We present GHG and C dynamics of maize based on 2-years of measured and modeled fluxes of four erosion-related soil types: a) non-eroded luvisol, b) eroded luvisol, c) pararendzina and d) colluvisol. CO₂ measurements were conducted every four weeks using a non-flow-through non-steady-state closed chamber system (Livingston and Hutchinson 1995) based on Drösler (2005). Measurement gaps were filled by modeling CO₂ fluxes using the Lloyd-Taylor (Lloyd and Taylor 1994) and Michaelis-Menten (Michaelis and Menten 1913) modeling approaches. N₂O and CH₄ were measured bi-weekly using a static chamber system with interval sampling. Results show that soil type (erosion/ deposition) and weather conditions have a strong influence on GHG exchange. Deposition induces increased N₂O emissions and CH₄ uptake. In contrast, erosion clearly decreases ecosystem respiration, gross primary production and C export (harvest). Due to the opposing direction of these fluxes, however, differences between the overall annual C balance of eroded and non-eroded sites are relatively small.



S03.02-P -15

EVALUATING THE IMPACT OF HYDROFOBICITY IN OLIVE GROVES OF SOUTHERN SPAIN

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The effects of hydrofobicity in olive groves were studied in three different olive orchards in Cordoba (Southern Spain), under different soil types (Vertic and Frank). The initial hypothesis is that hydrofobicity exists in olive crops, but it might not be a significant issue for the global hydrological cycle. This study presents the first results of hydrofobicity measurements in the hydrological year of 2011-2012. Samples of topsoil humidity were collected during the dry period, and soil hydrofobicity was measured following the Water Drop Penetration Time method. This was done within a 1 m transect, taking the olive trunk as its centre. Two distinct zones were considered for the measurements: beneath the tree as well as the open rows between trees. Hydrofobicity was found in two of the three sites although the values were not high –the maximum WDPT was 27 minutes-. More research needs to be done in order to complete de measurements under different soil moisture and organic matter conditions.



S03.02-P -16

EVALUATION OF SOIL PHYSICAL QUALITY UNDER DIFFERENT SOIL LAND USES IN A SMALL SICILIAN WATERSHED

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Sustainability of extensive rain fed agriculture needs assessment of land use effects on soil physical and hydraulic properties. Several soil physical quality indices were determined for four adjacent areas in a small Sicilian watershed, that were characterized by a different land use, namely cropland (C), olive grove (O), grassland (G) and eucalyptus plantation (E). Soil texture was similar for the considered areas, even if the no-tilled soils (G and E) showed a higher clay content in the top layer (0-20 cm) than in the lower layer (20-40 cm). The bulk density of the top layer ranged between 1.20-1.43 g cm⁻³ (C < G < O < E), with significant differences between C and E. In the lower layer, it ranged between 1.16-1.43 g cm⁻³ (C < O < E < G), with bulk density of C that was significantly smaller than that of the other land uses. The organic matter content was generally low and comparable for the different areas (in average 1.6%). The near-saturated soil hydraulic conductivity values were significantly higher for no-tilled (G, E) than tilled soils (C, O), whereas the opposite result was found for smaller degrees of saturation. The Dexter's soil quality index assumed similar values in both the top (0.024-0.047) and the lower layer (0.024-0.040), with the higher values associated to tilled soils. According to existing guidelines, the soil physical quality of the selected areas was generally poor independently of the land use. However, the cropland showed a better quality than the other land uses.



S03.02-P -17

FROM A GEOCHEMICALLY TO A PHYSICALLY-DRIVEN SOIL BLEACHING: THE ROLE OF AGRICULTURAL PRACTICES

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To model soil evolution at the century scale, it is necessary to take into account changes in the direction and/or the velocity of pedogenic processes as a result of a change in land use and of agricultural practices. Albic horizons are one of the most widespread soil features and their genesis found to be particularly sensitive to changes in environmental conditions related to agricultural practices. However, the precise genetic pathways involved in the genesis of albic horizons and the impact of agricultural practices on the intensity of this process remained controversial. The intensity of soil bleaching in the E&Bt-horizon of Albeluvisols was quantified using a combination of image analysis and mass balance calculations along an anthropo-chrono-sequence consisting in i) a forested soil, ii) a limed and amended with organic matter cultivated soil unaffected by agricultural drainage improvement, and iii) the same soil affected by drainage. We showed that liming slows down the velocity of soil bleaching and agricultural drainage increases its velocity demonstrating that several agricultural practices might have contrasted impacts. Moreover, soil bleaching is driven by redox processes under forest, but mostly by physical translocation of fine soils particles in the drained soil. This last result demonstrates that several genetic pathways might produce similar soil features. Modelling soil evolution requires thus to model simultaneously several processes whose relative intensity and velocity vary according to small changes in environmental conditions as those resulting for example from various agricultural practices.



S03.02-P -18

GEOMETRY OF SOIL AGGREGATION

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Soil aggregation is a sensitive indicator of soil structure. Soil aggregates are made of closely packed sand, silt, clay, and organic particles. They vary in size from nanoparticles of organo-mineral complexes to large peds. Aggregate-size distribution is measured by sieving under mechanical stress. Mean weight diameter (MWD), developed in 1949, is the usual synthetic measure of soil aggregation. However, MWD is inherently biased and non Euclidean. MWD is scale-dependent and conveys redundant information (one proportion, computed by difference between 100% and the sum of other proportions, can be omitted) that lead to spurious correlations and distort multivariate analysis. The isometric log ratio (ilr) transformation is an unbiased alternative developed by compositional data analysts in 2003. Ilr is based on mass balances of aggregate-size subcompositions orthogonally arranged to portray soil aggregate build-up. Each ilr is a coordinate in the Euclidean space and thus provides geometry to soil aggregation. The Aitchison distance between two compositional vectors x and y ($A(x,y)$) is a synthetic measure of soil aggregation computed across ilr coordinates. Our objective was to relate MWD to $A(x,y)$ distances between two compositions using two published studies on Brazilian soils. The correlation between MWD and $A(x,y)$ is a measure of the bias inherent to MWD since ilr is scale-invariant and free from spurious correlations. Correlation coefficients were 0.99 for the Oxisol but 0.77 for the Alfisol. We suggest discontinuing MWD and to use ilr and the Aitchison distance as measures of soil aggregation. The ilr concept may allow comparisons between studies.



S03.02-P -19

GULLY EROSION PREDICTION IN A SAHELIAN CONTEXT

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In Sahelian region, concentrated overland flow often leads to the formation of gullies. Although this phenomenon is widespread in those regions, research efforts are still needed to be able to model their spatial distribution and the role of the different parameters involved in this process. In this context, the objectives of this study are twofold. The first step is to investigate to what extent the role of Sahelian soil surface crusts (biological and/or physical) on soil surface infiltrability and detachment affect the formation and development of gullies. The second step is to integrate the results of these investigations in a simple geomorphological model to predict gully location at the watershed scale. The evaluation of the resulting model on two test catchments demonstrated that the integration of soil crusting is a key parameter to insure the quality and relevance of gully prediction. The model is able to distinguish between two types of gullies, those whose width range between 0.5m and 4m and those whose width exceeds 4m. The application of the model at the regional scale is however limited by the resolution of available regional digital elevation model (i.e. the 90m resolution SRTM DEM) which only permits the prediction of large gullies. Key words: erosion, gullies, Sahel, biological soil crusts, modelling.



S03.02-P -20

HIGH SCALE EROSION MODELLING FOR MUDDY FLOOD INVESTIGATION

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The flooding of streets and properties by runoff from agricultural land carrying large quantities of sediment, does not only represent an annoyance for the residents (gardens and cellars flooded with mud, impassable street, etc.) but also produces significant cleaning up cost. In the case of heavy rainfall events the occurrence of such muddy floods depends on the one hand on the susceptibility of the adjacent agricultural land to soil erosion, especially during unprotected states in the agricultural year. On the other hand the structure of the settlement area, the characteristics of streets, pavements, ditches, etc. strongly influence the conduction of runoff and hence sediment-deposition areas. In order to implement effective protection measures for areas threatened by muddy floods it is essential to predict the produced runoff during single extreme rain events, the amount of detached soil, and the areas where the runoff and sediment load is transported to. In the presented study a method is developed to implement anthropogenic constructions to surface data and to use this information for the modeling with the process-based soil erosion model EROSION 3D. The results show that with this method it is possible to model a real case of muddy flood as well as to validate on- and off-site protection measures.



S03.02-P -21

HIGH-RESOLUTION EROSION RISK MAP OF SWITZERLAND IN A 2X2-METER GRID (ERM2)

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The high-resolution erosion risk map (ERM2) of Switzerland's utilised agricultural area is based on an modified version of the Revised Universal Soil Loss Equation (RUSLE) using multi-flow algorithm. It shows potential erosion risk based on the locational factors of relief, soil and precipitation – irrespective of particular land use (arable land, permanent grassland or vines) or crop management. Areas at high risk of erosion within a field or on a hillside, such as talwegs for example, are easy to identify on the map. Erosion damage mapping in the field, comparisons with other erosion risk maps and discussions with farmers have confirmed the validity of the map. Altogether, 44 % of the utilised agricultural area in the valley and hilly region was classified as a potential erosion risk on the basis of a 2x2-meter grid. 38 % of all the land in the valley and hilly region is used as permanent grassland, however, and to this extent poses no real erosion risk. A digital map of arable land is not currently available, so the land could not be broken down into arable and permanent grassland. ERM2 now provides a standard basis for assessing the potential erosion risk on field scale for the whole agricultural area of Switzerland. It enables farmers and cantonal advisors to identify in advance the land at risk of potential erosion, assess it jointly in situ and plan the requisite action. It remains essential, however, to carry out a field inspection of the erosion risk modelled.



S03.02-P -22

**IMPACT OF RAPID URBANIZATION ON SOIL DEGRADATION IN ZIARAT WATERSHED
GOLESTAN PROVINCE, NORTH OF IRAN**

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This paper introduces a dynamic systems based method for assessing the impacts of urbanization policy on land use change with reference to the urbanization practice in Ziarat, Golestan province. In this study, the mean weight diameter (MWD), bulk density, soil porosity, density of soil, Soil infiltration rate, organic carbon and calcium carbonate equivalent soil upper layers (0–30 cm) and analysis of them were taken by completely randomized split-plot in the three land uses forest, cultivated and urban in Ziarat watershed and with two the north and west aspect geography, and five replication designed. The results showed that under natural conditions the contents of were largest in the forest, moderate in cultivated and smallest in the villa building area. MWD contents in different land uses intensive decreased in the order of urbanization, deforestation and changed land use. Bulk density of surface soil samples showed that this parameter increased in two land uses cultivated and urban. The soil porosity decreased in urban increased in cultivated land use that was due to tillage. Soil density was signification differences between forest and both lands use cultivated and urban areas. Soil infiltration rate in urban land use was the less than of all lands use that it has been showing intensive degraded soil. Therefore, it is important to recognize the possibility of future contaminant because Ziarat watershed is above Gorgan, this study demonstrated that trend of degradation and mismanagement increase hazard of urban floods and human health.



S03.02-P -23

IMPACT OF TILLAGE ALONG A SOIL TOPOSEQUENCE IN A TRADITIONAL CEREAL CROP

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We investigated the long term impact of tillage in the topsoil of a cereal cultivated slope in Castile (Spain) using two toposequences of ~500 m. These were characterised by a reference site of Quercus sp. forest at the top of the toposequences, followed by homogeneous agriculture soil use along variable slopes (16 ± 12 %) which ended in a flat valley. The variations in soil organic matter (OM), texture, electrical conductivity (EC), and pH were studied. Results yielded differences in OM between the reference topsoil, 3.6 %, and soil samples from the slope close to the valley, 0.7%. Clay fraction increased from 8% found in the reference site, to 19% in the valley, where the illite mineralogy of clays was predominant; pH increased from 6.5 to 7.7 progressively down the slope due to high content of CaCO₃; and EC also increased from 0.6 to 0.9 dS m⁻¹. On the contrary the stability of aggregates in soil samples decreased in the slope up to 90%. Strong correlations between the activity of ¹³⁷Cs and clay content were realized. Higher radioactivity emissions ranging from 2.2 Bq kg⁻¹ to 35.6 Bq kg⁻¹ were found in the forest topsoil, compared to lower values detected along the slope. The activity of ¹³⁷Cs was used to estimate soil loss, using an exponential model. High erosion rates were obtained for both toposequences, 27 ± 14 and 29 ± 7 Mg ha⁻¹ year⁻¹, representing annual erosion rates since the initiation of till agriculture management in the slopes.



S03.02-P -24

INVESTIGATING SYNDROMES OF AGRICULTURAL LAND DEGRADATION THROUGH PAST TRAJECTORIES AND FUTURE SCENARIOS

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Bio-physical and socio-economic drivers are at the basis of land degradation (LD) processes. LD of agricultural land implies loss of biological and economic productivity of cropland, rangeland, and woodlands. The combination of these drivers is at the basis of LD vulnerability assessments/indices, such as ESAI (MEDALUS), ESAs (DesertNet), ESI (LADA-FAO), and LVI (CRA-CMA). In ESAI for instance, vulnerability is jointly evaluated through indices of climate, soil, vegetation/land use quality as well as anthropogenic related factors (e.g. population densities and dynamics, level of land management). Land cover and land use (LULC) are essential elements in the assessment. Past changes in LULC can be analysed together with trends of other drivers, in the investigation of LD "syndromes". Climatic forecasts, population projections, as well as GIS based LULC modelling are then used for projecting future trends, providing indications for sustainable management of agricultural land. This paper contains outcomes of the research project AGROSCENARI (Scenarios of agriculture adaptation to climate change), promoted by the Italian Ministry of Agriculture. It aims at investigating syndromes of LD especially in face of climate change in selected regions in the country. The paper focuses on the analysis of LULC time series derived from existing thematic cartography or archive satellite data extracted through procedures developed ad-hoc. Preliminary results in the analysis of changes in LULC and other drivers and related LD syndromes are discussed for the Emilia Romagna region over the period 1954-2008. Also possible scenarios are investigated in respect to the overall vulnerability to LD



S03.02-P -25

LONG-TERM EFFECTS OF GYPSUM, SUGAR FOAM WASTE AND DOLOMITIC ROCK SURFACE INCORPORATED INTO A DEGRADED ACID SOIL ON SOIL ORGANIC CARBON, SOIL CHEMICAL PROPERTIES AND CROP PRODUCTION.

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Organic carbon and chemical properties were measured in a degraded acid soil (Plinthic Paleixerult) after 13 years of amended with a single application of several materials: sugar foam waste (E), dolomitic rock (C), gypsum (Y) or dolomitic rock and gypsum mixture (CY). The aim was to evaluate its effects on soil and crops. An application of lime (E or C), equivalent to 6.3 t/ha of calcium carbonate, incorporated into the surface at 0-18 cm was enough to increase the pH in water, from an initial value of 5.08 to 6.3 and to maintain the pH above 5.5 for at least 9 years. The gypsum did not increase the soil residual calcium as had been expected. The cultivated control plots presented the lowest calcium contents in the whole profile sampled. All the liming materials increased the exchangeable calcium in the whole profile. In contrast, the exchangeable magnesium decreased. The cultivated control (O) and Y plots had the lowest levels of magnesium and their exchangeable magnesium became depleted in the 40-80 cm horizon. The continuous cultivation and the initial liming did not significantly diminish the mean organic carbon in the 0-18 cm soil profile (2.53 %) with respect to the natural pasture unaltered plots (F). The mean forage yields harvested in the plots treated with E were significantly superior to the C and CY. The Y and O plots showed very low mean productions and both significantly lower than the rest of the treatments but similar to the F soils (954 kg. d.m./ha).



S03.02-P -26

MAPPING SOIL EROSION RISK AT THE LANDSCAPE SCALE BY ADAPTING THE NATIONAL MODEL MESALES WITH PRECISE SOIL AND AGRONOMICAL INPUT DATA

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The MESALES model was developed by Le Bissonnais et al. (2002) to evaluate erosion risk at national scale in France. It combines erosion parameters (land use, crusting, slope, erodibility and climate) into an expert decision tree, to produce an erosion risk level (1 to 5). The objective of this work was to evaluate erosion risk at landscape scale using MESALES and to test the effect of precise input data, notably land use parameter. The study area was a 900ha complex agricultural landscape (NW France), characterized by an oceanic climate, a diversity of soils (Cambisols, Luvisols, Gleysols) developed on granit, schist, metamorphic rocks, deep Aeolian loess and alluvial deposits. The relief is relatively flat except in the zone of contact between granit and schist. Agriculture and land use are dairy production-oriented. Precise data on soils, topography and cultural successions were available, allowing a refinement of MESALES input data without modification on the decision tree. The land use factor was replaced by a number of bare soil days calculated according to observed cultural successions and expert rules on vegetation development. As a result, an estimation of erosion risk was obtained on the studied area, compatible with an aggregation at field level. Improvement of the prediction was mainly due to the slope and land use factors finer resolution. The model can be used to test the effect of climate and/or agricultural practices and land use changes, and could be generalized at regional scale to provide more precise information on soil resource threat.



S03.02-P -27

MAPPING SOIL EROSION RISK USING RUSLE, GIS AND REMOTE SENSING TECHNIQUES

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Soil erosion is one of the major causes of land degradation in arid and semi-arid areas like Ethiopia, including Tigray Highlands, which is highly affected by the risk of desertification. Tackling on-site effects of soil erosion requires understanding of the rates of soil loss as well as identification of the major controlling factors that accelerate or slow down these processes. The study aims to quantify the soil loss by erosion process and to specify the main factor affecting the Erosion development in the study area. The Study area was Kilte Awulaelo District which is situated in the eastern part of Tigray region, Ethiopia. Soil erosion models (such as RUSLE) use mathematical expressions to represent the relationships among various factors and processes occurring in the landscape. The RUSLE analysis has been applied to this case study. ArcGIS™ and Excel software were used for all the calculations procedures of RUSLE values and to produce the soil erosion risk map. The final quantitative RUSLE values showed the loss quantity of soil in t/ha/year, ranging from less than 1 to very high soil loss rates (223.6 t/ha/y). The data shows also that Topography (LS) factor was the most effective factor controlling the erosion process followed by the support practices (P) factor. The study showed that stone bands are successful management practice to conquer the soil erosion dilapidations. This study demonstrates that Remote Sensing and GIS are effective tools in generating spatial and quantitative information on soil erosion studies and risk assessment mapping.



S03.02-P -28

**MODELING SOIL EROSION AND RESULTING SEDIMENT DELIVERY TO SURFACE WATERS
AS PRECONDITIONS FOR REGIONAL EROSION CONTROL STRATEGIES**

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The process based soil erosion simulation model EROSION 3D is applicated on regional scale for the federal state of Saxony/Germany. This survey is aimed on modeling soil loss, sediment transport and deposition resp. sediment input into surface waters for 10years storm event and three scenarios. The available region-wide geo-data were preprocessed to be used in the parameterization interface DPROC. The core of DPROC is a relational data base consisting of measured or estimated specific model soil parameters. These values have been derived by heavy rainfall simulation experiments below field conditions. The experimental results show a significant relation of soil loss from the mechanical impact due to soil tillage. The regional scale simulations identify the Saxonian Loess Belt as hotspot of soil erosion. However considerable amounts can also be expected in certain areas of the low mountain range. Sediment inputs into surface waters correspond to the hotspots of soil erosion. The amounts of soil losses and sediment inputs could be reduced to 90 % in case of consequently and area-wide transformation to conservation tillage practices. Compared to available model results of USLE and PESERA amounts and distribution of soil losses varies. The differences are caused by different input data and especially by lacking an event based consideration, which disregards system maximal impacts. Since erosion is an exclusive non continuous process, those maximal impacts are highly relevant and have to be considered in case of planning and execution of erosion and water protection concepts.



S03.02-P -29

PEDOGENETIC PROCESSES, SOIL HYDROLOGY AND EROSION ALONG A SOIL CATENA IN THE TURBOLO WATERSHED (NORTHWEST CALABRIA, SOUTHERN ITALY)

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This work focuses on the analysis of a soil catena in the Turbolo watershed (NW Calabria, southern Italy), which is representative of widespread zones in this region and in the Mediterranean area, in terms of lithological, geomorphological, pedological and climatic features, and high susceptibility to soil erosion. The Turbolo stream is a left tributary of the Crati river and drains Palaeozoic metamorphic rocks in its western, high-relief, steep sector and Neogene-Quaternary sedimentary terrains in its eastern, hilly, gentler reaches, respectively ranging from about 1015 to 75 m asl. The soil toposequence investigated consists of six soil profiles on an abandoned agricultural land. They developed on Pleistocene marine silty-clays along a N-facing slope, ranging between 85 and 140 m asl in elevation and 5 to 20° inclined, affected by sheet wash, rill and occasional gully erosion. The soil profiles represent Inceptisols with varying juxtaposition of Ap, Bw and Bg horizons, some vertic properties and poor CaCO₃ dynamics. A multidisciplinary approach was applied, spanning from geomorphological and pedological field observations, in situ infiltrometric measurement of hydrological properties, Mercury intrusion porosimetry and chemical-physical laboratory analyses, micromorphological study of thin sections obtained from undisturbed soil samples. The main soil features clearly highlight changes in intensity of major morphodynamic processes along the slope (erosion and reworked soil accumulation), testified by topsoil truncation, varying organic matter and carbonate content. Some interesting relationships are evidenced among particle size distribution, hydraulic conductivity, estimated microporosity, pore size and their effects on water infiltration or runoff and soil erosion.



S03.02-P -30

QUANTIFICATION OF LESSIVAGE IN SOILS: AN EXPERIMENTAL APPROACH

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Lessivage, understood as the vertical transfer of fine particles from a horizon, called eluviated, to another horizon, called illuviated, was never measured to our knowledge due to obvious technical difficulties. Two laboratory experiments focusing respectively on eluviation and on illuviation were designed. Eluviation was experienced on an undisturbed loamy soil column (called L1). Illuviation was experienced on a column made of undisturbed loamy horizon (L1) lying on a second undisturbed monolith of a loamy horizon (called L2) having contrasting mineralogical and physico-chemical properties. For both experiments, rain events of 30 mm were applied with two different intensities: 20 mm/h and 6mm/h. The lower boundary was free drainage during the rain event, and constant pressure head during the infiltration phase. Between two rain events, the soil columns were allowed to dry up in order to recover their initial water content. The water content in the column, the chemistry of the soil solution and the release of particles into the drainage water were monitored. These experiments allowed quantifying eluviation and relating it to preferential drainage, or to the suction applied at the base of the columns and to chemical composition of the soil water. The contribution of these different processes was most probably related to the structure of the soil column. We also determined that 20 to 80 % of the particles released by the L1 horizon were trapped into the L2 horizon allowing for the first time to our knowledge to quantify the intensity of particles fixation in natural soils.



S03.02-P -31

REMOVAL EFFECT OF THE TEPHRA LAYER IN MULCHED IRRIGATED SOILS

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The “arenados” agrosystem, based on the use of basaltic tephra mulch, has been the means to dryland agriculture in the island of Lanzarote (Canary Islands). The dryland “arenados”, which is a soil and water conservation system, is receding because of the introduction of irrigation thanks to new non-conventional water resources. However, a trend has been observed in some zones to remove the mulch layer in order to improve mechanization. This practice can accelerate soil degradation by low quality irrigation water which is the subject of this study. Two field plots were selected which were formerly covered with a basaltic ash layer and remained uncovered for less than five years. The three key-parameters related to soil degradation in the mulched system: soluble salts, exchangeable sodium percentage, and soluble and sorbed boron, showed a fast increase from three to five years after the ash layer removal. The values reached by these parameters surpassed the recommendable levels for plant toxicity and soil structural degradation. These effects, which in the case of the irrigated, mulched agrosystems appear in the mid- or long term, were reached in a short time interval due to the lack of the positive effect of the mulch in terms of evaporation and salt leaching. The mulch layer removal, therefore, is an unadvisable practice.



S03.02-P -32

RUNOFF, SOIL AND NUTRIENT LOSS VARIABILITY WITHIN AGRICULTURAL LEVELLED PLOTS UNDER HIGH INTENSITY RAINFALL

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Field mechanisation carried out in agricultural systems, which include crops like vineyards, have implied land levelling operations. It introduces high soil and crop variability within the plots and further different responses to soil erosion. The present study analyses soil responses in different parts of a mechanized vineyard in the Penedès region (NE Spain). Soil chemical and physical characteristics were analysed at each location as well as the response to high intensity rainfalls (intensities with 5-year return periods). The study was conducted using a rainfall simulation. Runoff and soil mobilised by runoff were collected at 10-min intervals during one hour or the time needed to reach the steady infiltration rate. The evolution of sediment and P and N concentrations in runoff were analysed. The results point out the variability on erosion rates and nutrient concentration in runoff within the plot. Runoff rates varied between 40.5 and 64.6%, while steady infiltration rate ranged between 28 and 10.3 mm/h. Sediment concentration ranged between 29 and 4.2 g/l, respectively, without significant differences within each simulation. Significant differences were observed in N concentration in runoff, ranging between 45 and 5 mg/l, being higher in the areas where greater sediment concentrations were recorded. P concentration ranged between 1.29 and 2.5 mg/l, being about 90% of total P transported as particulate P. This variability runoff and soil erosion variability is mainly due to the different soil depth and soil characteristics created by land levelling.



S03.02-P -33

SOIL EROSION AND RIVER EXPORTS IN THE LOIRE RIVER BASIN

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Sediment fluxes within continental areas play a major role in the global biogeochemical cycles and are often at the source of soil surface degradation as well as water and ecosystems pollution. In a context where a high proportion of the land surface is experiencing significant land use and climate change, it appears important to be able to carry out local and regional distributed sediment (and associated particles) budgets to assess potential future impacts induced by such changes. Several research efforts have already investigated either global budgets at the river basin or continental scale or local detailed budget at the plot to the field scale. However, very few studies have tried to analyse the connectivity between fluxes and storages and to draw the links between the different scales. In this broad context, the objectives of this study are to investigate what is the fraction of hillslope production which reaches the oceans (is SDR a relevant concept or do we need to identify dominant processes at each different scale?). These investigations will be based on catchments for which mean annual sediment loads are estimated from measurements at their outlet. The characterisation of the basin properties through spatialised approach should be developed to describe the sediment redistribution processes over the drained areas. Based on sediment budget, the source-to-sink dynamic of the sediment cycle can be examined by considering the redistribution processes within the landscape and the rivers networks.



S03.02-P -34

**SOIL EROSION ON NEW CITRUS PLANTATIONS IN EASTERN SPAIN TRIGGER
DESERTIFICATION PROCESSES**

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Citrus plantations in Spain were located on lowland areas such as alluvial plains and terraces in order to allow irrigation by flooding. Citrus production is a two centuries old farming in Eastern Spain and due to the location in the lowest basin position sedimentation was widespread. Since the 80's, an increase in citrus plantations on slope were found due to the use of drip-irrigation systems that now are being used in more than 50 % of the citrus plantations. The traditional tillage management to avoid weeds and the use of herbicides is used also in the slope plantations which results in high erosion rates. Measurements done by means of plots (300 m²) under natural rainfall, and on small plots under simulated rainfall (0.25 to 24 m²) show that soil erosion is extremely high on the new plantations. A survey was done to determine the soil erosion on citrus plantations after the extreme rainfall events of October 2007 and 2008. The results confirm the high erosion rates. Soil fertility is also damaged by the soil losses, and the damage caused by large rainfall events trigger Land Degradation processes. This research was funded by the ENV.2009 243857. Land and Ecosystem Degradation and Desertification: Assessing the Fit of Responses Acronym: LEDDRA Grant agreement No. 243857 CONSORTIUM AGREEMENT and CGL2008-02879/BT.



S03.02-P -35

SOIL INTERRILL ERODIBILITY OF THE SEMI-ARID AREA SOILS: A CASE STUDY IN EAST AZARBAIJAN PROVINCE, IRAN

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Due to climatic, geographical and vegetation conditions of East Azarbaijan Province, the soil of this province have been severely exposed to the interrill erosion. On other hand interrill erodibility factor is one of the most important factors for estimation soil erosion with WEPP model. Therefore it is seem that determination of soil susceptibility to the interrill erosion is necessary. For this reason this study was conducted to determination of soil interrill erodibility in five regions of including: Tabriz plain, Kaleybar, Jolfa and Bonab. Samples from 44 soils series were collected. A rainfall simulator with drainable tilting flume (1 × 0.5 m) at slope of 9% was employed and interrill erodibility factors (K_i) were calculated for 20, 37, and 47 mm h⁻¹ rainfall intensities. Results showed that the K_i value for Kaleybar was significantly less than three other regions and there were no significant difference between the interrill erodibility of Tabriz plain, Jolfa and Bonab regions. Results also showed that organic matter and clay content are two important factors controlling the interrill erodibility and soil erosion rate positively correlated with clay content in these regions.



S03.02-P -36

SOIL –LANDSCAPE RELATIONS IN THE SOUTHWESTERN HIGHLANDS OF UGANDA

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A soil survey was conducted to pin-point the major soil types and to determine their properties in upper Rwizi catchment, south western Uganda. A transect was made through the plateau, hill slope, undulating land and valley bottom. Soil profile description and soil classification were done based on the FAO guidelines and the World Reference Base for Soil Resources respectively. The study shows that in the uplands (1530 – 2170 m a.s.l), the soils are predominantly Plinthosols, Regosols, Leptosols and Cambisols. In the undulating landscape (1480 – 1530 m a.s.l), the soils are predominantly Luvisols and Umbrisols. In the valley bottom (1100 – 1480 m.a.s.l), the soils are predominantly Gleysols and Histosols. Skeletic soils present on the steep slopes are more susceptible to soil erosion and are therefore 'hot spot' areas for application of soil conservation measures. Overall, most soils are acidic, have a moderate CEC and are characterized by an omnipresent depletion of exchangeable base cations. The nutrient depleted nature of the soils reveals an extended period of uncontrolled soil erosion. The soils will only yield good crops under a good management. It is recommended that soil and conservation measures are put in place to ensure sustainable utilization of the soils. Key words: Soil - landscape relation, soil erosion, south western highlands, Uganda



S03.02-P -37

SOIL PROTECTION AND SUSTAINABLE RURAL LAND DEVELOPMENT IN POLAND

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The quality of Polish soils belongs to the poorest in Europe. The potential production per hectare of Polish soils has been equal a 0,6 ha potential of arable lands in the European Union. This is a result of the fact that considering the entire area of Poland's arable lands, there are as much as 33% of poor and very poor soils and only 14% high productivity soils. These datas indicate, that with the socioeconomic reasons we have to protect the best productivity soils in Poland first of all. Soil protection laws have formally existed in Poland since 1972. Detailed legal regulations are contained in the Act on Protection of Arable and Forest Land. Its aim the protection of the physical surface of soils. As for December 31. 2010 the size of agricultural lands in Poland equaled to 18.9 million hectares. This results in 0,49 ha per inhabitant. Within the last 50 years, the size of agricultural lands decreased by 2.5 million hectares and the factor per one inhabitant decreased from 0.86 hectare to 0.49 hectare. In the same time the area of forest increased about 10 %. Mainly the poorest soils, formed from sands, permanently dry, were afforested. In next year undoubted are changes in the structure of land use in Poland – the area of agricultural grounds will be diminishing for the benefit of forest are, dwelling areas, communication routes highways, industrial objects and other.



S03.02-P -38

SOIL TEXTURE AS AN INDICATOR OF ENVIRONMENTAL CHANGES IN AGRICULTURAL LANDSCAPE OF NORTH-EASTERN POLAND

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Morainic landscape of north-eastern Poland has diversified relief. Therefore, it is susceptible to translocation of soil material on the slope. This process, termed anthropogenic denudation, plays a key role in modifying and building landforms and soil cover of agricultural slope landscapes. As a result of long-term agricultural use, arable horizon is translocated and deposited at the bottom of the slope. These processes began in Mazurian Lakeland approximately 4000 years BP. Agricultural human activity changed natural soil cover. The pedotransfer of mineral and organic materials from the top of the slope and their accumulation in land depressions influenced the variability of soil surface horizons. Soil texture is an important indicator of soil cover changes in such diversified areas. As a result of these processes texture of deluvial deposits accumulated at the bottom of the slope and in land depression was changed. The study, using catena method, was carried out in Mazurian Lakeland (north-eastern Poland). Thirty soil profiles were made in typical sites: top, middle part and bottom of the slope as well as in land depression. Soil granular size was analysed using hydrometer method of Bouyoucos, modified by Casagrande and Prószyński, separating sand by sieving. Coefficients of granulation were also calculated, i.e. average size of particles, standard deviation, skewness and kurtosis. The study revealed that the texture of deluvial deposits is a derivative of granular composition of eroded areas. Material accumulated in land depressions was fine-grained and well-sorted. Moreover enrichment in silt and clay was noted.



S03.02-P -39

SPATIAL ANALYSIS OF THE SOIL LOSS FACTORS IN IRRIGATED AREAS OF THE CERRADO REGION OF BRAZIL

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Soil loss is a major problem for agriculture, resulting in reduced productivity and increased costs of production. Thus, the aim of this study was to analyze, by the principal components analysis (PCA) and geostatistics, soil loss due to the loss factors associated with the risk of erosion (RE) and the expected erosion (EE) on a Alfisol and a Oxisol located at Brazil Cerrado Region. The PCA indicated three principal components with 67.2% of the original soil samples variance. In the first principal component (28.9%), the interaction of erosivity and land cover factors are directly related to RE and EE in the upper part of the field. In the second component (22.5%), organic matter shows an inverse interaction with RE and EE on the central part of the field. In the third component (15.8%), management practices factor is inversely related to RE and EE showing areas in the field where the performance is intense in the parts of the field under coffee and beans. The RE was lower on parts of the field (mainly beans) with less than 0.25% of the moderate risk. EE showed that 16.5% of the field is inadequate for management practices and land cover, focusing only in the areas with beans crop, which has greater slope. The results indicated that anthropic factors were the more important soil loss factor in the field, once the soil is well structured, and that the field currently soil management for bean is inadequate.



S03.02-P -40

SPATIAL AND TEMPORAL VARIABILITY OF CO₂ SOIL EMISSION IN A MEDITERRANEAN PEACH ORCHARD

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Loss of soil carbon from cultivated land contributes both to soil degradation and global warming. In agroecosystems CO₂ emissions related to fossil fuel energy use are roughly well established, whilst little is known concerning the soil CO₂ emissions at orchards, this hampers development of adequate and environmental friendly policies and orchard management strategies. Therefore, a field trial was conducted in Mediterranean peach orchard in order to explore the seasonal and spatial variations of soil CO₂ flushes. The orchard was managed according to locally conventional practices (i.e. tillage, mineral fertilisation, removal of prunings, drip irrigation). Spatial and temporal variations in CO₂ soil emissions over a 20 m² plot were assessed (LiCor 6400) midday at a 10-15 interval time from January to December. Sampling points (x30) were located at different distances from row line. Soil temperature and moisture were simultaneously assessed. A clear pattern of CO₂ emission rate was detected showing it was at the minimum values of approx. 0.02 $\mu\text{mol m}^{-2} \text{s}^{-1}$ (Jan/Dec) and peaked at 0.2 $\mu\text{mol m}^{-2} \text{s}^{-1}$ (end of May) just before the warmer months. Soil CO₂ emissions were mostly from the in-row, with the inter-row emissions being lower, especially due to reduced soil-water content during the drier months. We concluded that spatial variability of emissions must be taken into account if the accuracy of estimates of large-scale emissions are to be improved. Moreover, the need to include CO₂ soil emissions when some CO₂-related parameters (e.g. carbon footprint) are computed is discussed.



S03.02-P -41

STABILIZATION OF SOIL ORGANIC MATTER BY AGGREGATION AND INTERACTIONS WITH MINERALS IS AFFECTED BY SOIL EROSION

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Soil erosion and deposition drastically affect the distribution of soil organic carbon within a landscape. Moreover, soil redistribution may have a large impact on the exchange of carbon between the pedosphere and the atmosphere. However, little is known how stabilization of organic matter by aggregation and binding to mineral surfaces is affected by soil redistribution. On topsoil (0–5cm) and subsoil samples (5–10cm, 45–70cm, and 160–200cm) from the Belgium Loess Belt we performed aggregate size distribution and density fractionation, determining carbon and nitrogen content of all the size- and density fractions. Stabilization of organic matter against microbial decay as provided by aggregation was evaluated by a 52-days incubation experiment of entire aggregates (8-16mm) in comparison with crushed ones. In the same experiment we additionally tested the effect of oxygen availability on C mineralization. Further, we analyzed lignin as an important component of soil organic matter in the different soils and soil fractions by the CuO oxidation method. Redistribution of organic carbon resulted in its stabilization as indicated by smaller mineralization at the depositional site in comparison to the eroding site and with increasing soil depth. Aggregation and low O₂ availability resulted in decreased carbon mineralization particularly at the eroding site. Our results suggested that carbon will be transport mainly in the form of aggregates. After deposition, organic carbon will be stabilized against further microbial decay particularly by interaction with soil minerals.



S03.02-P -42

SUBSOIL COMPACTION OF ARABLE LAND IN UPPER AUSTRIA

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The objective of this study was to check selected soils in Upper Austria with respect to subsoil compaction. Soil physical investigations were performed at 30 sites representative for the Upper Austrian production area. The sites were selected with respect to the main soil types and the main texture in the subsoil, but not with regard to the soil management. The soil structure was assessed in three categories according to the threshold values of air capacity and saturated hydraulic conductivity. Beneath the plough layer, the subsoil is in critical condition at approximately 30% and in poor condition at 25% of the investigated sites. Statistical analysis showed a significant increase of penetration resistance and subsoil compaction on headland as compared to other parts of the investigated fields. Key words: arable land, subsoil compaction, precompression stress value, penetration resistance, Upper Austria



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SUPERFICIAL AND SUBTERRANEAN SOIL EROSION IN TABASCO, TROPICAL MEXICO:

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We tried to model superficial and subterranean water erosion based on basic environmental variables such as geological formation, soil type or vegetation cover — data potentially available in developing countries. The study region (3500 km²) located in tropical Mexico we collected data by field observations over the entire study area and elaborated a cartography of different erosion features including data from available maps of geological formation, soil type, precipitation and actual and former land use. Data collected in the field such as vegetation cover and inclination were added. 1039 sites were affected by soil erosion with 2435 single manifestations of soil erosion. 482 sites were found with one gully each, 57 sites with erosion rills with a total of 416, 392 sites with one mass movement each, 85 sites with sinkholes with a total of 1122, and 23 sites with one tunnel each. Rendzic Leptosols over Oligocene limestone are strongly affected by karstification, forming sinkholes and tunnels in regions with inclinations of less than 5°. Superficial erosion features are mainly found on rendzic Leptosols over shale sandstone and on eutric or peli-eutric Vertisols on Andesit in areas with inclinations between 5 and 30°. The application of classification trees allowed to successfully predict the occurrence of sinkholes and tunnels. Predictive success of the occurrence of the different forms of superficial soil losses, however, is low. Nevertheless, automated induction of classification trees can be a valuable tool for preliminary data analysis and hypothesis generation in areas with lack of local expertise



S03.02-P -44

SUSTAINABLE MANAGEMENT OF POTATO ROTATIONS TO MINIMISE SOIL COMPACTION, SURFACE RUNOFF AND DIFFUSE POLLUTION RISK

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Potato rotations can involve intensive cultivations, parallel beds on raised ridges which channel water, many (>12) passes with spraying and irrigation equipment, and late harvesting when soils are moist. These factors create a high risk of soil compaction, surface runoff, erosion, and diffuse pollution of surface-applied products (irrigation, N, P, pesticides) to surfacewaters. This five-year project investigates practical cost-effective techniques for managing land before, during, and after potatoes to minimize environmental risks on moderately sloping silty clay and loamy sand soils. Novel sample splitters collect runoff from replicated hillslope sections. Before potatoes, treatments included cultivated stubble, stubble with straw, and cover crops. During potatoes, treatments initially focused on losses from stone and no-stone rows, and the impact of spray and irrigation operations on soil and water conditions. Later seasons evaluated novel management techniques with individual and combinations of angled tines both with and without a newly-patented convex surface profiler to alleviate near-surface compaction and direct water back into the crop, compared against tied ridging and control conditions. Results over several site-years reveal over-winter runoff after cereal harvests was greater down wheelings compared to stubble areas, and that cover crops were more effective ($P<0.05$) than stubble at reducing runoff. During potatoes, runoff represented 17.9% of rainfall plus irrigation from stone rows receiving traffic, but only 5.2% from stone rows without traffic and 1.1% from no-stone rows. The angled tine and convex surface profiler both show promise as practical methods to alleviate soil compaction, and reduce runoff and diffuse pollution risk.



S03.02-P -45

TEMPORAL EVOLUTION OF SOIL ERODIBILITY: ASSESSMENT OF EXPLANATORY FACTORS, AND CONSEQUENCES ON EROSION MODELLING. AN EXAMPLE FROM THE BEAUCE AREA, FRANCE.

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Soil erodibility is a key parameter in soil erosion models. Usually, water erosion models take erodibility as a constant for a given soil. However, many studies showed that erodibility changes during the year in relationship with climate. If the seasonal trends are recognized, the underlying factors and processes remain unclear. To assess the climatic parameters and soil properties causing these variations, a six-month long field monitoring was conducted in the Beauce area (south of the Paris Basin, France). Samples from two soils (a silty clay loam and a silt loam) and from two topographic positions were collected at two time scales: monthly, and a few days apart during the week following significant rain events. Aggregate stability was used as a proxy of soil erodibility. Other measurements were humidity and temperature of soil and air, organic matter content, soil texture, water content, microbial biomass, hydrophobicity, and soil crusting. Aggregate stability showed large variability at both time scales. After significant rain events, aggregate stability showed different trends depending on soil type, rain amount and topographic positions. These differences in aggregate stability imply different erodibilities. The results clearly contradict the common practice of assigning a temporally and spatially-constant erodibility to a given soil. Soil texture, organic matter and microbial biomass could not precisely explain erodibility changes. However, the post-rain desiccation was significantly related to the erodibility increase at the short time step. This result emphasizes the influence of the wetting-drying cycles in soil erodibility variation.



S03.02-P -46

TESTING THE “PHYSICAL MODEL CONCEPT” BY SOIL LOSS DATA MEASURED IN SICILY

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The best possible model to predict the erosion from an area of land has been suggested to be a physical model of the area that has similar soil type, land use, size, shape, slope and erosive inputs. Therefore, a replicated plot has to be considered the best possible, unbiased, real world model. In this paper the physical model concept was tested by using soil loss data collected on plots of different length at the experimental station of Sparacia, in Sicily (South Italy). This investigation supported the conclusions that i) a coefficient of determination between measured and predicted soil loss values of 0.77 has to be considered as the best-case prediction scenario and ii) an uncalibrated deterministic erosion model would not give more accurate results than those obtained by a replicated plot measurement. An effectiveness coefficient of 0.47-0.49 was obtained by applying the original USLE to predict event soil losses at Sparacia. The difference between the value of 0.6, corresponding to what we can expect from an uncalibrated erosion model, and the effectiveness coefficient of the selected model represents the maximum gap that has to be covered to obtain the realistically best estimate of plot soil loss at the event temporal scale.



S03.02-P -47

THE EROSION OF AGRICULTURAL SEEDBANKS

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Agro-ecosystems within Europe are experiencing increased environmental and socio-economic pressures exemplified by intensification of arable farming and increased risk of soil erosion. Arable agro-ecosystems are becoming biologically homogeneous due to farming practice and changes to the seedbank. Specifically, diversity in the weed seedbank has decreased due to the use of herbicides and autumn sown crops (Hawes et al., 2010; Singh and Ghoshal, 2010). Diversity loss has implications for ecosystem resilience and services. Our aim is to investigate the relationships between soil erosion and seed bank dynamics to understand the physical transport processes of weed seeds by water agro-ecosystems. The approach is an experiment field-study at the James Hutton Institute's Balruddery Farm, Scotland, UK . The experiment examines relationships between soil erosion and weed seed redistribution under four tramline treatments. These treatments use different tyre pressures and cultivator tools. A network of 16 gerlach troughs (four treatments in four randomised replicates) was installed at the foot of the tramlines to monitor runoff during rainfall events. Water, sediment and seedbank data were collected after each event. Species data were determined through germination of viable seeds. Seeds were collected after 11 events between November 2010 and April 2011. Over 450 individual seeds were identified along with 21 species. There are statistically significant ($p=0.05$) differences between the treatments for seed mobility in relation to both abundances and species diversity. These results provide novel insights into the structuring role of erosion to influence biodiversity patterns and agro-ecosystem function relating to soil erosion.



S03.02-P -48

THE IMPORTANCE OF ROOTS FOR GULLY EXPANSION IN CEREAL AND OLIVE ORCHARDS

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Gully erosion is now widely recognized as a key process contributing to land degradation, especially in semi-arid areas. However, in spite of numerous studies detailing gully volumes and growth rates, the underlying physical controls are still poorly understood. This study focuses on the interaction between vegetation and gully expansion. It has been observed that many large gullies are stable in length, but keep expanding in width due to sidewall failures. It is analysed how the location and magnitude of these failures is related to the root pattern of olive and cereal crop. We characterized the root distribution by manually counting the roots per diameter class in the field and by determining the root density in the lab. Significant relations with depth and with distance to tree trunk (for the olive orchard) were observed. We measured soil cohesion and root cohesion for each of the diameter classes. The different root cohesion patterns could then be used to explain gully evolution in the two land uses under study: cereal and olive crop.



S03.02-P -49

THE LONG-TERM EFFECTS OF THE SOIL MANAGEMENT IN A TOURISM AREA ON CARBON CONTENT AND MICROBIAL ACTIVITY UNDER A HUMID CLIMATE, NORTH OF IRAN

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Few studies have focused on the impact of the management regime on the quality of soils in forest and tourism ecosystems. Land use changing by deforestation in northern Iran, has been customary and common especially in Golestan province. This is a crucial factor because in this region, the climatic conditions (especially the plentiful rainfall) affected by erosion development. In this research, the influence in the long-term (50 years) of four types of management (forest, pasture, cultivated, new urban with two geographical aspects) in Ziarat watershed, was evaluated by considering different biochemical and microbiological parameters, including general activity of microbial and carbon content. The study of labile C fractions can be provided important information regarding the metabolic potential of the soil microorganisms. Two-way ANOVA and correlation between soil microbial respiration and Labile carbons showed that organic carbon content significantly increased general microbial activity and carbon fractions. Labile carbons decreased in urban, cultivated and pasture land uses by 87, 66 and 54 % respectively and also non-labile carbons decreased in urban, cultivated and pasture by 76, 49 and 34 % respectively. Soil microbial respiration also decreased in urban, pasture and cultivated that was 0.09, 0.14 and 0.22 mg CO₂/g soil day respectively in comparison with forest that was 0.21. There was no significant difference between the western and northern direction. This study demonstrated that trend of soil degradation and mismanagement caused increasing hazard of urban floods, sediment problem and human health problems due to water pollution in main city of province.



S03.02-P -50

THE MAP OF THE MAXIMUM ADMISSIBLE VALUE OF THE CONSERVATION EFFECT FACTOR OF THE CANOPY COVER AS A TOOL FOR EFFECTIVE WATER EROSION PREVENTION IN THE CZECH REPUBLIC

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In the Czech Republic more than 50 % of agricultural land is in risk of water erosion. The main reason of the occurrence of this phenomenon is the land consolidation, disturbance of landscape elements, which started during 1950's in the former Czechoslovakia during communism, and also an inappropriate method of cultivation on arable land (wide-row crops cultivation). Evaluation of erosion processes and their consequences is an important activity of the Research Institute for Soil and Water Conservation. One possible solution, which determines the vulnerability of soil by water erosion, is the map of the Maximum Admissible Value of the Conservation Effect Factor of the Canopy Cover (Cp) which is based on the Universal Soil Loss Equation (USLE). The map is primarily intended to be a basis for a suitable way of farming on the soil blocks or parts of them. The output is raster map which gives information about limit values of Canopy Cover Factor. In case of exceeding the limit value it is necessary to implement the erosion control measures. The map of Cp indicates the limit criteria of Good agricultural and environmental condition (GAEC 2), protects the soil against water erosion and efforts to reduce the negative effects of erosion (flooding, clogging by the washed soil). All the layers of soil and water conservation and the GAEC 2 standard are available to public within the map project "Water and wind erosion of soils CR" at <http://ms.sowac-gis.cz>. Keywords: Soil, Erosion, GAEC 2, Factor of the Canopy Cover



S03.02-P -51

TOWARDS NEW EROSION RISK ASSESSMENT IN NORWAY

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The Norwegian Forest and Landscape Institute (NFLI) provides the Norwegian Soil Information System (NSIS), containing detailed soil data classified according to WRB. At present ca. 50% of the total national agricultural area is covered, with main emphasis in the agricultural areas exposed to erosion. The most frequently used thematic map derived from the soil database is the erosion risk map, implemented in 1990. This map is based on USLE adapted to Norwegian conditions using measurements from Norwegian USLE-plots in South-Eastern Norway. Four erosion risk classes are calculated based on soil parameters, slope gradient and standard weather and slope length factors. The most important impact of soil erosion in Norway is the pollution by nutrients of the fresh- and saltwater resources. Regional Agro-Environmental Systems subsidize different sets of measures to reduce the erosion from agricultural areas. Some of these subsidies are graded according to the erosion risk classes. Since the erosion risk map is available on the internet it can easily be used by both farmers and authorities when planning measures, applying for subsidies and allocating payments. The presentation will give an overview of the derivation and use of the erosion risk map. Besides it will present future perspectives on how these maps can be improved. Special focus has the use of better terrain information and the adaption of the model to the Norwegian winter climate. Erosion research during the last centuries and improved and more available weather and terrain (LIDAR) data provide more precise soil erosion maps in the future.



S03.02-P -52

USAGE OF GEOINFORMATION LAYERS IN SOLVING WATER EROSION OF SOIL

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^[1]Research Institute for Soil and Water Conservation ~ Department of Soil Service ~ Prague ~ Czech Republic

Protection of soil from water erosion is currently highly discussed topic at the European level. In the Czech Republic, Standards of Good agricultural and environmental condition regulate farming on agricultural land, namely the GAEC 1 and 2 standards, which are part of the Cross-Compliance system. The Research Institute for Soil and Water Conservation have developed effective methods for assessing soil erosion vulnerability by calculating the Maximum Admissible Value of the Conservation Effect Factor of the Canopy Cover (Cp), which is based on the Universal soil loss equation (USLE). Individual factors were determined, based on information from the Evaluated soil ecological units (BPEJ) database and calculated by using the CORINE database, Land Parcel Identification System (LPIS) and digital terrain model. Other support tools are being developed to support recommendation of appropriate management on soil block and to determine the suitability of blocks for implementation of erosion control measures. These support tools are primarily geographic layers of drainage lines and soil blocks suitable for measures for seeding/ planting along the contour. Drainage lines were created on the basis of vector-raster algorithm in the GRASS GIS program. Category of suitability for seeding/ planting along the contour measures were created based on the extent of the slopes exposure on the individual soil blocks. Thus 4 categories were identified (appropriate, less appropriate, inappropriate and risky). These support tools serve as background information for farmers and as a tool for monitoring the implementation of GAEC standards. Keywords: erosion, GAEC, Cp, drainage lines



S03.03-P - FOREST FIRE EFFECTS ON SOIL SUSTAINABILITY

Wednesday 04 July 2012 from 17:00 to 18:30. Room Poster Areas

S03.03-P -1

ACCUMULATION OF PYROGENIC POLYCYCLIC AROMATIC HYDROCARBONS IN FIRE-AFFECTED SOILS

Anna Tsibart, Moscow - Russian Federation

S03.03-P -2

AGING OF CHARCOAL IN FIRE-PRONE MINERAL SOILS OF SOUTHERN EUROPE

Heike Knicker, Sevilla - Spain

S03.03-P -3

ASSESSING SOIL WATER REPELLENCY AND ITS EFFECT ON SOIL EROSION IN BURNT PINE AND EUCALYPT STANDS IN NORTH-CENTRAL PORTUGAL

Diana Vieira, Aveiro - Portugal

S03.03-P -4

CATASTROPHIC WILDFIRES IN RUSSIA AT THE 2010 SUMMER AND ITS AFFECT ON SOILS OF FOREST-STEPPE ECOSYSTEMS

Ekaterina Maximova, Saint-Petersburg - Russian Federation

S03.03-P -5

EFFECTS OF FIRE HEATING ON A MEDITERRANEAN ULTISOL QUALITY AND ON CO₂ EMISSION. A LABORATORY STUDY

Ignacio Mariscal-Sancho, Madrid - Spain

S03.03-P -6

FIRECNUTS - WILDFIRE EFFECTS ON CARBON AND NUTRIENT LOSSES BY RUNOFF

Silvia Regina Faria, Aveiro - Portugal

S03.03-P -7

FOREST FIRES AND SOIL EROSION IN EASTERN SPAIN

Artemi Cerdà, Valencia - Spain



S03.03-P -8

HOW LONG LASTS SOIL LOSS AFTER REPEATED FIRES IN A MEDITERRANEAN SHRUBLAND?

Eugenia Gimeno-Garcia, Moncada, Valencia - Spain

S03.03-P -9

KEY SOIL PROPERTIES CONTROLLING OCCURRENCE AND PERSISTENCE OF WATER REPELLENCY AFTER BURNING

Jorge Mataix-Solera, Elche, Alicante - Spain

S03.03-P -10

MEFIDIS CALIBRATION FOR POST-FIRE EROSION AT THE MICRO-PLOT SCALE UNDER SIMULATED RAINFALL IN EUCALYPT PLANTATIONS IN NORTH-CENTRAL PORTUGAL

Diana Vieira, Aveiro - Portugal

S03.03-P -11

PROBABILITIES OF WATER REPELLENCY OCCURRENCE AND PERSISTENCE IN MEDITERRANEAN FORESTS AFFECTED BY WILDFIRES

Merche B. Bodí, València - Spain

S03.03-P -12

QUALITY AND QUANTITY OF ERODED SEDIMENT FOLLOWING PRESCRIBED FIRE IN VALE TORTO CATCHMENT, CENTRAL PORTUGAL

Emilia Urbanek, Swansea - United Kingdom

S03.03-P -13

SHORT AND MID-TERM POST-FIRE EVOLUTION OF SOIL MICRO-FUNGI IN A MEDITERRANEAN FOREST

Giovanni Mastrodonato, Firenze - Italy

S03.03-P -14

SOIL DEGRADATION AFTER FIRE ON AN ALPINE FOREST SOILS IN THE UPPER RHONE VALLEY, SWITZERLAND

Nikolaus J. Kuhn, Basel - Switzerland



S03.03-P -15

SOIL MICROMORPHOLOGY, SLOPE POSITION AND ASH COLOR IMPLICATIONS ON ASH THICKNESS IN THE IMMEDIATE PERIOD AFTER A GRASSLAND FIRE IN LITHUANIA (NORTH-EASTERN EUROPE).

Jorge Mataix-Solera, Elche - Spain

S03.03-P -16

SOLID-STATE ¹⁵N NMR SPECTROSCOPY AS A TOOL TO INVESTIGATE ORGANIC N-PARTITIONING IN FIRE-AFFECTED SOILS

María López Martín, Sevilla - Spain

S03.03-P -17

SPRING GRASSLAND FIRE EFFECTS ON SOIL ORGANIC MATTER, SOIL MOISTURE AND SOIL WATER REPELLENCY IN LITHUANIA (NORTH-EASTERN EUROPE). FIRST RESULTS.

Jorge Mataix-Solera, Elche - Spain



S03.03-P -1

ACCUMULATION OF PYROGENIC POLYCYCLIC AROMATIC HYDROCARBONS IN FIRE-AFFECTED SOILS

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Polycyclic aromatic compounds (PAHs) are priority organic pollutants. Vegetation combustion is considered to be the important source of PAHs in soils. But there is lack of information on their content and composition in fire-affected soils. The objective of this study was to determine PAHs distribution in soils depending on burnt vegetation and soil type. Our research was conducted in three nature reserves of Russia: Norkii, Khakasskii, Polistovskii. The study sites are characterized by different vegetation, soils and fire regime. Soil samples were analyzed for 12 compounds: fluorene, naphthalene, phenanthrene, chrysene, pyrene, anthracene, benz(a)anthracene, benz(a)pyrene, benz(ghi)perylene, retene, coronene, benz(e)pyrene. Identification and quantification was carried out by high resolution Shpol'skii spectrofluorometry. Under conditions of intense scattering of combustion products during wildfires the PAHs accumulation in soils was low. The difference of PAHs concentrations in affected and background soils did not exceed 10 times. Type of burnt vegetation had an effect on pollutants amount in soils. Wildfires in coniferous forests and peat bogs tended to give higher absolute PAHs concentrations in soils than steppe wildfires. PAHs distribution in fire-affected soils also depended on soil type. Mineral soils had maximum of concentration in surface horizon and in peat soils the highest concentrations of pollutants were detected at depths of 5-10 and 10-20 cm. Soils subjected to forest fires contained higher concentrations of chrysene, benz(a)anthracene, retene, phenanthrene, benz(ghi)perylene. Peat-fire affected soils showed prevalence of pyrene, naphthalene, benz(a)anthracene, phenanthrene, chrysene, benz(a)pyrene. Grass combustion during fires favoured the accumulation of low weight PAHs (fluorene, naphthalene) in soils.



S03.03-P -2

AGING OF CHARCOAL IN FIRE-PRONE MINERAL SOILS OF SOUTHERN EUROPE

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Incorporated into the soil, charcoal produced during a vegetation fire is considered as highly recalcitrant and to increase the soil C sink. Recent laboratory experiments indicated that under optimal conditions, plant-derived pyrogenic organic matter (PyOM) can exhibit very short residence times < 100 years. To bring some light onto the fate and stability of PyOM, soil chronosequences with different recovery time after fire were analyzed for soil organic matter (SOM) composition and PyOM content. The respective alterations were related to SOM degradation rates determined in controlled laboratory respiration experiments. The first chronosequence (Histic Humaquept) (Doñana National Park, Southern Spain) was collected directly, 15 and 19 years after a severe fire and from unaffected comparable locations. The fire combusted the whole O layer (0–20 cm) and increased char content in the A horizon. Directly after fire, no PyOM was identified in deeper soil regions. After 19 years, the O layer recovered to 5 cm, but showed only minor PyOM contributions. In contrast, the mineral soil revealed PyOM contents of up to 18% of the total C at depths > 30 cm. This clearly evidences a downward translocation of PyOM within the soil profile. Fast translocation of PyOM was also observed for a Cambisol from Central Spain, where PyOM content in the A horizon, determined by a new approach of virtual fractionation of solid-state ¹³C NMR spectra, decreased from 30% to 24% within 1 and 24 years after fire mostly due to degradation, although erosion processes cannot be excluded.



S03.03-P -3

ASSESSING SOIL WATER REPELLENCY AND ITS EFFECT ON SOIL EROSION IN BURNT PINE AND EUCALYPT STANDS IN NORTH-CENTRAL PORTUGAL

Werlemann Frans^[1], Vieira Diana^{*[1]}, Faria Silvia^[1], Nunes João^[1], Keizer Jan^[1]

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Soil water-repellency (hydrophobicity) is a highly variable (spatial and temporal) property of Eucalyptus globulus and Pinus pinaster forest soils in north-central Portugal and is particularly severe during dry summer conditions. Furthermore, the increasing number of wildfires in Portugal seems to enhance or destroy soil water-repellency, with fire severity and fuel load type being the dominant factors determining changes in soil properties and hydrological responses. This study was done on a catchment of approximately 10 km² and used data from the first second and second year, after a wildfire of medium severity burnt the catchment in 2008, with the objective to obtain a better view on soil water-repellency and its effect on runoff. Due to the highly spatial and temporal variation of soil water-repellency and the time consuming MED method that is used to measure soil water-repellency, continuous measurements throughout the study area of this soil property are hard to establish. Instead, monthly measurements of soil water-repellency are used and aligned with related soil properties like soil moisture and runoff to indicate where soil water-repellency might be present. The inverse relation between soil moisture and soil water-repellency is used to make a function which can estimate continues values for soil water-repellency at different places throughout the study area. The runoff response on precipitation events with different initial conditions, (i.e. high soil moisture - low soil water-repellency and low soil moisture - high soil water-repellency), will be compared to get an idea of the effect of soil water-repellency on runoff and erosion.



S03.03-P -4

CATASTROPHIC WILDFIRES IN RUSSIA AT THE 2010 SUMMER AND ITS AFFECT ON SOILS OF FOREST-STEPPE ECOSYSTEMS

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Forest fires are regularly repeating natural phenomenon that disturb natural balance between separate components of ecosystems and influence on the type of vegetation and dynamics of plant communities. The soil, as a basic component of forest ecosystems, is affected by different impacts of wildfires. Complicated fire conditions in summer of 2010 were caused by extreme climatic effects and low precipitations. The area of soils affected by wildfires assessed as more than 744 000 ha. Forest fires have occupied Moscow, Yekaterinburg, Kaluga, Pskov, Samara and many other regions. The critical situation in the Samarskaya region around Togliatti city results in huge soil degradation in forest-steppe pine forests. The analytical data obtained shows that wildfires lead to serious changes in a soil profile. The most intensive were the processes of humus losses that result from burning of a forest floor and sod (humic) horizon. The average content of organic carbon in the top soils horizons was 1.1 % in ground fire plot, 1.7 % in upper fire plot, while is was 3.40 % in benchmark (fire unaffected) soils. The second process is soil neutralisation (increasing of pH values), resulted from ash accumulation in soils. The absence of forest floor and plant cover leads to intensification of surface erosion process, and destroying of organic matter leads to illuviation of low molecular organic fraction in middle part of profile.



S03.03-P -5

EFFECTS OF FIRE HEATING ON A MEDITERRANEAN ULTISOL QUALITY AND ON CO₂ EMISSION. A LABORATORY STUDY

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*The role of fire as agent of landscape modelling is converting in a serious trouble in recent times, and it is studying from many points of view. We are focused on the effects of soil heating on soil quality, and also we made an estimate of CO₂ emissions based on the soil organic matter (SOM) content that was combusted. The aim of this study was to investigate how the quality of the soil is affected by heating under different conditions. The experimental factors were: (i) the heating temperature (ii) the initial soil moisture and (iii) the type of soil on which the fire occurs. The quality chemical properties selected for analysis were: pH, electrical conductivity (EC) and SOM; the quality physic properties selected were: aggregate stability and soil hydrophobicity. The germination of seeds was also selected as biological property. The study was carrying out with an Ultisol from southwester Spain (Cañamero, Cáceres). The sampling stations were two soils with different cover vegetation; *Quercus suber* L. and *Cistus ladanifer*. The most important factor on post-fire soil quality was found to be the temperature reached. In the case of fire of high intensity ($T^{\circ} = 405^{\circ}\text{C}$ during 7 min) most of the 90% of SOM content in soil samples (0-5 cm depth) were combusted if soils were dry before the heating. Moisture seems to be involved at the time of the initial ignition and with the highest tested moisture (20%) the SOM content was only affected by fire of the high intensity.*



S03.03-P -6

FIRECNUTS - WILDFIRE EFFECTS ON CARBON AND NUTRIENT LOSSES BY RUNOFF

Keizer, Jan Jacob^[1], Faria Silvia Regina^{*[1]}, Pinto, Renata^[1], Varela María Eufemia^[1], Prats, Sergio^[1], Nunes, João Pedro^[1], Malvar, Maruxa^[1], Ferreira, Raquel^[1], Campos, Isabel^[1], Caria, Margarida^[1], Martins Martinho^[1], Machado, Ana Isabel^[1], Cerqueira, Mário^[1], Nunes Maria Isabel^[1], Abrantes Nelson^[1], Esteves, Valdemar^[2]

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Whilst it is well documented that wildfires can have major impacts on hydrological and erosion processes, the associated transport of organic matter and nutrients have received considerably less research attention. The FIRECNUTS project (PTDC/AGR-CFL/104559/2008) addresses these research gaps by studying the export of organic carbon and selected nutrients (N, P, major cations) in a recently burnt forest area in north-central Portugal (Sever do Vouga). To this end, overland flow is being measured and sampled at a 1- to 2-weekly basis on five burnt slopes with contrasting forest types (eucalypt vs. Maritime Pine plantations) and geologies (schist vs. granite), whereas stream flow is being monitored continuously at the outlet of an entirely burnt catchment of approximately 25 ha dominated by eucalypt plantations. For reference, also a neighboring, long-unburnt eucalypt plantation is being studied. Key findings hitherto include: (i) the hydrological response at the catchment scale is strongly influenced by past human activities, i.e. the construction of various, abandoned ponds where sedimentation of up to a depth of 1 m and with a pronounced layering has been recorded since the wildfire in summer 2010; (ii) nitrate loads of overland flow decrease more markedly with time-since-fire than total dissolved phosphorus loads; (iii) micro-plot and slope-scale exports of K clearly exceed those of Na, Ca and especially Mg (iv) organic carbon concentrations of sediments (collected by sediment fences) differ more markedly between two adjacent eucalypt stands with contrasting geologies than with time-since-fire at each of these sites.



S03.03-P -7

FOREST FIRES AND SOIL EROSION IN EASTERN SPAIN

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Forest fire are recurrent in Eastern Spain due to the land abandonment that took place 50 years ago. The forest and shrubland developed a high connectivity as a consequence of the lack of grazing and ploughing. After a forest fire the lack of vegetation and the impact of fire on the soil results in an increase in the soil and water losses. It is also known that the vegetation recovery contribute to a decrease in the surface wash and few year later the soils losses are similar to the pre-fire conditions. A review of the data collected during the last three centuries show that soil erosion after forest fire is not always high, and that the recovery is efficient as the soil losses reach negligible values after some years. It should be highlighted the impact of ash during the immediate post-fire period as act as a mulch to control the soil losses. The review will allow to suggest new research topics.



S03.03-P -8

HOW LONG LASTS SOIL LOSS AFTER REPEATED FIRES IN A MEDITERRANEAN SHRUBLAND?

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One of the primary consequences of forest fires in Mediterranean ecosystems is the rapid and significant increases in runoff and sediment yield, due to the coupled effect of vegetation destruction and changes in soil properties. The impacts of forest fires on water erosion include greater peak flows and soil loss until the recovery of a certain level of vegetation cover. In Mediterranean ecosystems, the first autumn-winter period following a forest fire in summer is the most vulnerable period to water erosion. Afterwards, runoff and erosion rates generally decrease rapidly. This work studies the effect of recurrent fires with different severities on sediment yields, through sixteen years (from 1995 to 2011), to evaluate the durations of the windows of disturbance. The study has been made at La Concordia Experimental Station (Valencia, Spain), which includes nine erosion plots (20 m x 4 m). In 1995, experimental fires were carried out with high and moderate severities (three plots each treatment). Fires were repeated in 2003 on the same plots, but they severities were low (in the six plots). In both experimental fires, the remainder three plots were left unburned. Results show that the effect of repeated fires on soil loss rates are related to a combination of fire severity, climatic conditions, local soil properties and rates of vegetation regeneration. Whereas after 1995 fires, the window of disturbance lasts two years, following the repeated fires this period lengthened for three years.



S03.03-P -9

KEY SOIL PROPERTIES CONTROLLING OCCURRENCE AND PERSISTENCE OF WATER REPELLENCY AFTER BURNING

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Fire induced soil water repellency (WR) is controlled by many different factors (temperatures reached, amount and type of fuel, etc). Some soil properties may determine the occurrence and intensity of this property in burned soils. In this research, experimental laboratory burning have been carried out using soil samples from different sites and collected under different plant species. Samples collected at different sites are different in some soil properties, while soil samples taken from same site differ only in quantity and quality of soil organic matter, since they were collected under different plant species. Four sites were selected for this study. Soil samples under 3-4 different plant species were collected depending on the site, and comprising: *Pinus halepensis*, *P. pinaster*, *Quercus coccifera*, *Q. suber*, *Rosmarinus officinalis*, *Juniperus oxycedrus*, *Erica australis*, *Pistacia lentiscus* and *Olea europaea*. All soil samples were heated in muffle furnace at 200, 250, 300 and 350 °C with no addition of any fuel load. WR was measured using the water drop penetration time test (WDPT). The results showed significant differences between soil types and plant species, indicating that some soil properties may act as key factors controlling the development and persistence of WR reached, with burned soil samples ranging between wettable and extremely water repellent. Main soil properties controlling the response were clay and organic matter content, but also the quality of organic matter, since soil samples from same site and with similar organic matter content, but taken beneath different plant species showed different WR values after burning.



S03.03-P -10

MEFIDIS CALIBRATION FOR POST-FIRE EROSION AT THE MICRO-PLOT SCALE UNDER SIMULATED RAINFALL IN EUCALYPT PLANTATIONS IN NORTH-CENTRAL PORTUGAL

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Wildfires, through their effects on soil, vegetation and litter cover, can lead to changes in hydrological processes. Over the past decades, wildfires in Portugal have devastated around 100.000 ha per year, with dramatically higher figures for dry years like 2003 and 2005. The need for a model-based tool for assessing erosion risk following wildfire and, ultimately, guiding post-fire land management, like ERMiT for the Western U.S.A., is evident in the case of Portugal. Following the summer 2003, the EROSFIRE project set out to develop such an erosion prediction tool tailored to the specificities of post-fire conditions in Portugal's forests. Field rainfall simulation experiments (RSE's) were selected as principal method for gathering the data required for testing the suitability of existing models, in particular MEFIDIS, for predicting erosion in recently burnt areas. A key element in the experimental design was to repeat the RSE's at various occasions during the first one or two years after fire. The proposed work will assess how well MEFIDIS can predict overland flow and associated sediment losses that were produced by the RSE's. This will concern six eucalypt plantations in the north-central Portugal that were burnt by moderate-severity wildfires and differed in pre-fire ground operations. Preliminary MEFIDIS results were encouraging. The seasonal variation of overland flow at two of the study sites could be reproduced satisfactorily by taking soil water repellency into account in model calibration. This was done by mimicking the infiltration-reducing effect of water repellency, using the Ksat and thetas parameters of MEFIDIS' infiltration equation.



S03.03-P -11

PROBABILITIES OF WATER REPELLENCY OCCURRENCE AND PERSISTENCE IN MEDITERRANEAN FORESTS AFFECTED BY WILDFIRES

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*Water repellency (WR) is a soil property varying in space and time at different scales. Here we estimate the probability of WR occurrence and its respective persistence at a series of plant succession stages after fire for calcareous soil under Mediterranean type forest (Sierra de Enguera, Eastern Spain). WR persistence was measured using the Water Drop Penetration Time test and classified in 5 categories. Four sites were studied, two of them burned in 1979, the third in 1979 and 1991, and the fourth in 1979 and 2008. All sites were sampled immediately after the fire in April 2008 and a further 18 times until July 2009, and in August 2011. Generalized Linear Models were used for statistical analysis. Multinomial logistic regression for ordinal response was conducted for each site to assess the probability of the different WR categories to occur through the relevant factors analysed: vegetation type (*Pinus halepensis*, *Quercus coccifera*, *Rosmarinus officinalis*, bare soil), soil moisture content and depth (surface and 1cm). Overall, WR was present at moisture contents below 40%. *Pinus* and *Quercus* covered soil exhibited more frequently WR than *Rosmarinus*, being *Pinus* the most persistent. The higher occurrence and persistence (extreme in some cases) at both depths occurred in the mature sites (burned in 1979), and the first summer after the 2008 fire. In this site, WR disappeared the following year at the surface, whilst slight WR remained at 1cm depth. The site burned in 1991 has the lowest occurrence, only at the surface and was slight.*



S03.03-P -12

QUALITY AND QUANTITY OF ERODED SEDIMENT FOLLOWING PRESCRIBED FIRE IN VALE TORTO CATCHMENT, CENTRAL PORTUGAL

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Fires are known to be destructive not only with respect to the aboveground biomass, but they also cause soil degradation especially as a result of soil water erosion. Heavy rainfall, especially shortly after the fire, can remove both large quantities of topsoil together with ash and semi-burnt material. Many studies investigated the quantity of sediment removed after fire but its quality including organic matter (OM) and nutrients has received much less attention. Particulate OM is known to be very prone to erosion due to its low density and the fact that it is not bound to the minerals, but less is known about erodibility of black carbon, which is the more recalcitrant form of OM produced by burning. Within the EU-funded DESIRE project concerned with mitigating land degradation, the detrimental effects of wildfire have been investigated. A small catchment in central Portugal was subjected to experimental fire and its impact on hydrology and erosion investigated. Sediment losses have been monitored before and after the burn at the hillslope scale using sediment fences. The eroded material has been collected on approximately bimonthly intervals up to 2 years after the fire. In addition to the total amount of eroded material, the content of soil nutrients (Ca, Mg, K, P, N) and soil organic carbon (total, oxidation resistant) have been investigated annually from samples of in situ soil in the contributing areas upslope of the sediment fences, and from samples of eroded material trapped in sediment fences.



S03.03-P -13

SHORT AND MID-TERM POST-FIRE EVOLUTION OF SOIL MICRO-FUNGI IN A MEDITERRANEAN FOREST

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Fire is one of the main factors that shape Mediterranean forest ecosystems. Numerous studies dealing with the post-fire dynamics of vegetation or biota were carried out, but only a few ones of them were focused on soil fungal community, despite the crucial role the latter plays in the resilience of the ecosystem. The aim of this study was to investigate the short and mid-term evolution of soil micro-fungal community in a Mediterranean forest in Tuscany, Central Italy, burnt by a wildfire of moderate to high intensity. We sampled the charcoal layer and the below top 2.5 cm of mineral soil, which are those affected by the highest temperatures. An adjacent unburnt control area, similar to the burnt one for every feature, was also monitored for comparison. In particular, we checked the number of developed colonies (Colony-Forming Units/g), the diversity and the role of the micro-fungal community every three months and one year long. The structure of the community was estimated by the dilution plating method using a potato dextrose agar (PDA) as medium and identified by visual assessment under microscope. The findings show a significant fire-induced quantitative decrease of soil fungi. The recovery of the fungal community was rapid, maintaining however substantial differences compared to the control area, probably also due to the different vegetation developed after the fire. Key words: fungi, forest fires, soil, charcoal, ecosystem recovery.



S03.03-P -14

SOIL DEGRADATION AFTER FIRE ON AN ALPINE FOREST SOILS IN THE UPPER RHONE VALLEY, SWITZERLAND

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On April 26th 2011 a fire destroyed a 101 ha-sized area of forest near the city of Visp in the Canton Valais in Switzerland. Forest fires in this part of the Alps are unusual, but expected to increase in frequency as a consequence of warmer climate and a build-up of fuel in the protected forests. The fire destroyed both trees and duff layer. During the summer 2011, runoff and mud flows in the major gullies dissecting the slopes showed a significant increase during thundershowers. This is attributed to the burning of the duff layer, which led to a reduction in infiltration capacity. In addition, the unprotected mineral soil tends to form a crust, which leads to further runoff. Overall, the fire has increased the erosion risk which may lead to a permanent degradation of the forest if the currently relatively closed, but shallow soil cover is removed by water erosion. In this study, preliminary results of soil analysis and the risk of a permanent soil damage associated with the increased erosion are presented. They highlight that the relatively new phenomenon of fires in the Swiss Alps generates a threat to the forest cover.



S03.03-P -15

SOIL MICROMORPHOLOGY, SLOPE POSITION AND ASH COLOR IMPLICATIONS ON ASH THICKNESS IN THE IMMEDIATE PERIOD AFTER A GRASSLAND FIRE IN LITHUANIA (NORTH-EASTERN EUROPE).

Pereira Paulo^[1], Mataix-Solera Jorge^{*[2]}, Ubeda Xavier^[3], Cerda Artemi^[4], Cepanko Violeta^[5], Vaitkute Dovile^[5], Pundyte Neringa^[5], Pranskevicius Mantas^[5], Zuokaite Egle^[5]

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Soil microtopography and slope position and ash colour (fire severity), have important implications on ash thickness in the immediate period after the fire. However there is a lack of studies about it. The aim of this work it is evaluate the ash thickness and distribution after a grassland fire in Lithuania. We designed an experimental plot in west faced convex-concave slope with 19% of inclination. Ash thickness was measured along four parallel transects with 20 m of distance separated by 1 meter of distance. In each transect we measured ash thickness at the resolution of 20 cm. In each measured point we observed ash color and the soil microtopography were ash was accumulated (micro-flat, micro-top, micro-slope and micro-depression). The analyzed slope was not regular, thus we divided (from the top to the bottom) it in flat top, slope, slope, flat medium and flat bottom. After the fire ash was mainly black, followed by light and dark grey, brownish and white. The results showed significant difference at a $p < 0.0001$ between ash thickness and soil micro-morphology and fire severity. This means that after the fire the ash distribution is strongly shaped by the mentioned parameters. Ash thickness was higher in micro-flat and micro-depression and lower in micro-top (soil micromorphology), higher in slope medium and lower in flat-top and flat-bottom and lower in (slope position) and higher in brownish and black ash and lower in light-gray and white ash (ash-thickness).



S03.03-P -16

SOLID-STATE ^{15}N NMR SPECTROSCOPY AS A TOOL TO INVESTIGATE ORGANIC N-PARTITIONING IN FIRE-AFFECTED SOILS

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Fire can be seen as major factor for soil degradation in Mediterranean soil systems. Whereas an impact of charcoal on the soil organic carbon (SOC) pool is well recognized, the effect of fire on the soil organic nitrogen (SON) is often neglected. The change of the amount and quality of the organic matter input into soils after the fire is expected to alter the N-bioavailability and thus the N-competition and the N-partitioning between plants, soil (micro)organisms and sequestration of N into soil organic matter (SOM). One of the few tools, which can be used to characterize the bulk SON represents solid-state ^{15}N NMR spectroscopy. However, due to the low natural abundance of ^{15}N and its nuclear properties, its sensitivity is about 50 times lower than solid-state ^{13}C NMR spectroscopy. The problems encountered with the low sensitivity of this technique are the main reason why it is still scarcely applied in soil science. In the present study, we combined routine and advanced solid-state ^{13}C and ^{15}N NMR spectroscopy with wet chemical analysis to characterize the organic N in the density and particle size fractions of fire-affected soils from the Sierra de Aznalcóllar, Southern Spain. First results confirmed that both, the quality and quantity of N are affected in all particle size fractions. Ongoing respiration experiments will allow elucidating the stability of those alterations.



S03.03-P -17

SPRING GRASSLAND FIRE EFFECTS ON SOIL ORGANIC MATTER, SOIL MOISTURE AND SOIL WATER REPELLENCY IN LITHUANIA (NORTH-EASTERN EUROPE). FIRST RESULTS.

Pereira Paulo^[1], Mataix-Solera Jorge^{*[2]}, Ubeda Xavier^[3], Cerda Artemi^[4], Cepanko Violeta^[5], Vaitkute Dovile^[5], Pundyte Neringa^[5], Pranskevicius Mantas^[5], Zuokaite Egle^[5]

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The effects of fire in Lithuania grassland soils are poorly known and research is needed in order to understand the effects of fire in an ecosystem commonly visited by spring fires. The aim of this work it is presents the first results of the effects of a spring grassland fire in soil organic matter (SOM), soil moisture (SM) and soil water repellency (SW). After the fire we design a plot with 400 m² (20x20m) in the burned and unburned area and we collected 25 samples in each plot. The data presented here are from the two first sample campaigns, after the fire and 2 months after the fire. The results shown that immediately after the fire SOM increased significantly ($p < 0.0001$) in the burned area. Two months after, SOM remained significantly high ($p < 0.0001$) in the burned plot. Between periods we identified a significant increase of SOM ($p < 0.05$) in control plot and no changes were observed in the burned area. After the fire SM was not significantly different between the two plots. However, 2 months after, SM was significantly high in the control plot ($p < 0.0001$). Between periods we observed a significant increase ($p < 0.0001$) in control area and a significant reduction in burned plot. Soil WR after the fire and two months after the fire was significantly ($p > 0.0001$) high in the burned plot. Between periods we observed a significant reduction ($p > 0.0001$) of soil WR in the burned plot. In control plot no significant changes occurred.



W03.01-P - SOIL DEGRADATION IN THE MEDITERRANEAN: A NEVER ENDING STORY THAT STILL NEEDS SOLUTIONS

Wednesday 04 July 2012 from 17:00 to 18:30. Room Poster Areas

W03.01-P -1

AGRICULTURE AND SUSTAINABLE LAND USE OF SOME POLLUTED SOILS IN EGYPT

Gamil Ageeb, Cairo - Egypt

W03.01-P -2

ASSESSING THE ROLE OF SOIL VARIABILITY ON SOIL AND GROUNDWATER POLLUTION AT REGIONAL SCALE USING UNSATURATED FLOW AND TRANSPORT MODELING AND STOCHASTIC APPROACH

Antonio Coppola, Potenza - Italy

W03.01-P -3

CENTRAL ANATOLIAN TERRESTRIAL SAND DUNES: ENHANCING CARBON SEQUESTRATION BY INDIGENOUS VEGETATION

Erhan Akça, Adiyaman - Turkey

W03.01-P -4

DEVELOPMENT OF SOIL INDICATORS FOR OLIVE OIL MILLS WASTE DISPOSAL IN THE MEDITERRANEAN REGION

Sid Theocharopoulos, Athens - Greece

W03.01-P -5

DIAGNOSIS OF SOIL DEGRADATION STATE, BY SALINIZATION AND SODISATION, IN THE IRRIGATED PERIMETER OF THE MINA (NORTHWEST ALGERIA)

Mohammed Benkhelifa, Mostaganem - Algeria

W03.01-P -6

IMPACTS OF LAND RESOURCES AND SOIL DEGRADATION ON FUTURE DEVELOPMENT OF THE MEDITERRANEAN REGION

Pandi Zdruli, Bari - Italy



W03.01-P -7

PARTICIPATIVE IMPLEMENTATION METHODS FOR SUSTAINABLE SOIL AND WATER CONSERVATION IN SEMI-ARID SE SPAIN

Albert Solé-Benet, Almeria - Spain

W03.01-P -8

PROBLEMS OF SOIL DEGRADATION, ALTERNATIVES OF CONTROL AND SOIL PROTECTION IN ALBANIA

Sherif Lushaj, Tirana - Albania

W03.01-P -9

PUSH AND PULL DRIVERS OF SOIL SEALING- BASED DESERTIFICATION IN SPAIN

Maria Jose Marques, Madrid - Spain

W03.01-P -10

SOIL DEGRADATION FOLLOWING LAND CONVERSION OF NATIVE MEDITERRANEAN SHRUBLAND TO AVOCADO (PERSEA AMERICANA MILL. VAR. HASS) ORCHARDS IN CENTRAL CHILE.

Eduardo Arellano, Santiago - Chile

W03.01-P -11

THE INTERSECTION OF HYDROLOGICAL MODELING WITH PEDOLOGICAL INFORMATION FOR PREDICTING SOIL (AND WATER) DEGRADATION AT APPLICATIVE SCALES

Horst H. Gerke, Müncheberg - Germany

W03.01-P -12

URBAN GROWTH (1956-2006) AND SOIL DEGRADATION IN THE METROPOLITAN AREA OF VALENCIA, SPAIN

Juan Sánchez Díaz, Moncada (Valencia) - Spain



W03.01-P -1

AGRICULTURE AND SUSTAINABLE LAND USE OF SOME POLLUTED SOILS IN EGYPT

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The investigation deals with contaminated soils cover a considerable area in Egypt. Five soil profiles representing the most dominant soils close to the main textile factories in Kafr El Dawar and El Mahala cities, north of the Nile Delta of Egypt. The profiles are chemically, physically, micromorphologically and mineralogically studied. The data showed that these soils are deep to very deep, clayey textured (mostly fine clay), salt-free to extremely affected by salts, natural to mildly alkaline and have low content of both calcium carbonate and gypsum. Soils are classified as Typic Haplotorrerts and Typic Salitorrerts, (Soil Survey Staff, 1998). The concentration of some metal contaminants suggests that these contaminants are mostly transported and deposited by water or weathered in situ under an aqueous environments. Micromorphological studies indicated that metal contaminants - bearing components of industrial origin existed in soil material as nodules, of different shapes. They referred to chemical formations of aluminosilicates and represented primary particles emitted by industrials. Secondary components, being transformed in soil, existed as diffuse nodules and dark soil aggregates, containing metal contaminants in more dispersed forms that can be easily mobilized. The clay mineral composition of these soils is mostly montmorillonite.



W03.01-P -2

ASSESSING THE ROLE OF SOIL VARIABILITY ON SOIL AND GROUNDWATER POLLUTION AT REGIONAL SCALE USING UNSATURATED FLOW AND TRANSPORT MODELING AND STOCHASTIC APPROACH

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This study mainly aims to developing a regional-scale simulation approach for vadose zone flow and transport that use real soil profiles data. A stochastic approach will be applied to account for the effect of vertical heterogeneity on variability of water flow and solute transport in the vadose zone. The approach relies on available datasets coming from different sources (detailed pedological information, Hydrological properties in different soil horizons, Water table depth, Spatially distributed climatic temporal series, and Land use) and offers quantitative answers to soil and groundwater vulnerability to non-point source of chemicals and pathogens at regional scale within a defined confidence interval. The study area is located in the Metaponto agricultural site, Basilicata Region -South Italy, covering approximately 12000 hectares. Three generic pollutants will be considered for simulation purposes: 1. A very persistent pesticide (low degradation rate, high mobility); 2. A less persistent and less mobile pesticide; 3. A low mobility heavy metal. Distributed output of soil pollutant leaching behaviour, with corresponding statistical uncertainties, will be visualized in GIS maps. Of course, this regional- scale methodology may be extended to any specific pollutants for any soil, climatic and land use conditions. Also, as the approach is built on physically based equations, it may be extended to the predictions of any water and solute storage and fluxes (i.e., groundwater recharge) in the vadose zone. The approach may become a powerful decision support tool for guiding activities involving soil and groundwater resources and, more in general, for managing environmental resources.



W03.01-P -3

CENTRAL ANATOLIAN TERRESTRIAL SAND DUNES: ENHANCING CARBON SEQUESTRATION BY INDIGENOUS VEGETATION

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Struggle against desertification, which is a result of misuse of lands, is a challenging experience that needs site specific management plans suitable by considering the natural components in target area, and, with the success of the projects, revenue of conservation studies even in an arid land is sustainable with appropriate land management studies as performed in Karapinar. Assessment of the changes in natural resource quality also requires long term monitoring. This study outlines the changes achieved in soils and vegetation quality in a sand dune area of Central Turkey maintained since 1960s. Results revealed that natural vegetation provided maximum recovery in soil and vegetation quality by increasing soil organic matter and plant nutrients than afforested sites. This 50 year project set an important guideline for conservation studies which may be undertaken at similar sites of the world.



W03.01-P -4

DEVELOPMENT OF SOIL INDICATORS FOR OLIVE OIL MILLS WASTE DISPOSAL IN THE MEDITERRANEAN REGION

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One of the main objectives of the LIFE+ project: “Strategies to improve and protect soil quality from the disposal of Olive Oil Mills Wastes (OOMW) in the Mediterranean-PROSODOL”, was to establish a set of quality indicators to monitor soil degradation, safeguard soil quality and health and help measures and actions to be taken in order to protect and maintain the natural resources and ecosystems. A pilot area in the island of Crete, Greece, where the disposal of OOMW occurs mainly on soil and in evaporation ponds was studied for almost two years and more than 16,000 soil analyses were conducted. This study revealed that not all the soil parameters are affected by the disposal of OOMW. Some parameters like exchangeable Ca remain unaffected, other parameters like Cl⁻, NH₄⁺, SO₄²⁻, PO₄³⁻, NO₃⁻, microbial activity, were subjected to seasonal variation. Some parameters were substantially changed for short time after ceasing wastes disposal. Finally, there were parameters like organic matter, exchangeable K, available Fe, that exhibited major changes strongly depended on OOMW disposal. Thus, eight soil parameters, i.e. electrical conductivity, organic matter, total N, total polyphenols, available P, exchangeable K, available Fe, and soil pH (mainly for acidic soil types) are proposed as soil indicators suitable to monitor, access and describe the soil degradation status of Mediterranean soils, due to OOMW disposal.



W03.01-P-5

DIAGNOSIS OF SOIL DEGRADATION STATE, BY SALINIZATION AND SODISATION, IN THE IRRIGATED PERIMETER OF THE MINA (NORTHWEST ALGERIA)

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Abstract Secondary salinisation, the major and rapid cause of soil degradation in Algeria, affects about 10 to 15% total area of irrigated areas. The irrigated perimeter of Mina located 350 km west of Algiers has 10600 hectares and is one of the most affected by secondary salinisation phenomenon. In this study, we conducted a state diagnosis of soils salinisation and sodisation on one of the most contaminated plots of this perimeter spanning 18 hectares, based on two scales of analysis: - electromagnetic conductivity scale in situ by the EM38 which allowed us to deduce with correlation via ArcGIS, maps of electrical conductivity of saturated paste extract (ECspe) and exchangeable sodium percentage (ESP), - structural stability scale that allowed us to map the index of structural stability test according to the fast wetting by immersion. The reading and interpretation results show that the accumulation salts in the soil profile is done under the joint effects of irrigation water and that of capillary rise. In relation to the land use map (cereals, olive and pomegranate) and the water quality of irrigation (5,39 dS.m-1), the current hydro-agricultural management (irrigation conduct and drainage efficacy) explains largely, salts accumulation in soils profile and the low yields. In addition, the intersection of ESP and structural stability cards, gives a thematic map of sensitivity to soils physical degradation, which can constitute a very relevant tool for optimizing the hydro-agricultural management of agro-system. Key words: soil degradation, salinisation, sodisation, structural stability, perimeter of Mina



W03.01-P -6

IMPACTS OF LAND RESOURCES AND SOIL DEGRADATION ON FUTURE DEVELOPMENT OF THE MEDITERRANEAN REGION

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The Mediterranean region possesses about 854 million ha of total land but only 118 million ha of them (or 14%) are suitable for agricultural production; this figure in the Middle East and North Africa drops at 5 percent. Libya cultivates less than 2 percent of its territory and Egypt and Algeria less than 4. Soil degradation in the form of salinisation, water and wind erosion, sand encroachment, overgrazing, deforestation, compaction, organic matter decline, sealing, and littoralisation are severe in many countries. High soil organic matter (SOM) mineralization rates consequently lower inherent soil fertility and studies show that 74 % of the soils in Southern Europe have less than 3,4 % SOM (2% OC). Salinity and sodicity are also naturally widespread throughout the region in more than 10 million ha with Spain covering 3,4 million ha followed by Turkey with 2 million ha, Libya 1,5 million, Algeria 1 million and Greece with 600,000 hectares. Other studies suggest that 30 per cent of semiarid Mediterranean drylands are affected by desertification and 31 per cent of the region's population suffer from severe degradation. The economic costs of soil degradation are significant in Egypt estimated between €2.7 and €5.1 billion per year (or 3.2-6.4% of GDP), €1.5 billion per year (or 3.6% of GDP) in Algeria and €1.2 billion per year (or 3.7% of GDP) in Morocco. Climate change could worsen the situation. Finally, action is urgently needed to reverse the situation and endorse sustainable land and water management.



W03.01-P-7

PARTICIPATIVE IMPLEMENTATION METHODS FOR SUSTAINABLE SOIL AND WATER CONSERVATION IN SEMI-ARID SE SPAIN

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In collaboration with stakeholders five soil and water conservation techniques (SWCT) were selected, implemented and monitored in the upper Guadalentin on loamy-clay soils. Four of these techniques were on rainfed almonds: reduced-tillage (a), green-manure (b), straw-mulch (c), water-harvesting (d). The fifth technique is reduced-tillage (e) in a cereals field, and is compared to conventional mouldboard tillage. For each technique three replicated open runoff plots and control plot (in a, b and e) were installed to monitor soil and water loss by runoff and erosion. Soil water content (?? at two depths (in b, c and d) and water inflow as supplemental water (in d) were monitored. Crop yield and net farmer benefits were assessed in all plots. First results after 3 years are presented. In almond fields, a and b reduced soil and water loss by 60% as compared to the control plot. In the cereal field, results indicate reduced erosion rates (56%) and reduced runoff (30%) under reduced tillage. The highest almond yield was found in d, followed by b. In field d an increase of 24% of ? was observed whereas ? in a and b did not deviate from control plots. Mulching did not show a significant effect on ?. Four out of five selected SWCT seem to have a positive effect on soil and water conservation, and are beneficial for crop yield and farm income. Whereas reduced-tillage also results in lower production costs, green-manure, mulching and water-harvesting require initial and/or maintenance costs.



W03.01-P -8

PROBLEMS OF SOIL DEGRADATION, ALTERNATIVES OF CONTROL AND SOIL PROTECTION IN ALBANIA

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About 85 percent of the country's territory is under natural and human induced soil degradation stresses, including deterioration of land cover, overgrazing, illegal forest cutting and massive urbanization often at the expense of the best soils, landslides, chemical pollution, loss of organic matter, nutrients, and soil biodiversity, salinization, acidification, flooding and all form of water erosion. Erosion only affects 24 percent of the national territory (on average 37t/ha/year soil loss), while more than 60 percent of the remaining land is highly vulnerable to erosion. After 1990 illegal forest cutting destroyed about 300,000 ha forest. The hydrographic network of Albania is very intensive. Studies using watershed sediment assessment methods indicate that the rivers network transports each year approximately more than 60 million tons of fine materials. Saline soils located in the western coastal area cover about 30,000 ha (in 1990 they were 10,000 ha). They have expanded mostly due to abandonment and lack of investments. Naturally occurring acid soils cover about 70,000 ha and magnesial (smonitsa) high Mg content soils occupy an additional area of 12,000 ha. Numerous chemical pollution sites, including heavy metals, are identified around the country especially in nearby industrial factories and mining centres. Albania needs to tackle soil degradation without delay and soil conservation practices must be endorsed. The country should draft and implement a national strategy and Action Programme for Soil Protection. The poster will display facts, figures, photos as well as good examples of sustainable land management.



W03.01-P -9

PUSH AND PULL DRIVERS OF SOIL SEALING- BASED DESERTIFICATION IN SPAIN

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Desertification has traditionally been associated to population and agricultural pressure in dry regions, being considered a poverty-causing scourge in these places. However, under certain conditions, urban sprawl resulting from a bad use of accumulated wealth and development can be a more active and irreversible desertification driving force. During the last three decades, land use changes have been very intense in Spain. Agricultural area has decreased (more than 3.5 Mha), releasing land for forest (forest lands have increased 2.85 Mha) and urban sprawl (non agricultural land, most of them liable to be developed, has increased in half a million ha). This trend is present in several UE countries, but Spain is the most affected by urban sprawl (+0.6 % relative variation of artificial land during 1990-2006). Remarkably, not only marginal lands or dense populated areas, but also high quality agricultural lands have experienced soil sealing processes. The releasing of land from agriculture to urban uses has been achieved through a push-pull dynamics strongly related to the economic and policy contexts. The low and decreasing profitability of Spanish farming is the single most important push factor. Nevertheless, this and other push factors are dwarfed by the magnitude of some pull drivers like industrialization and more recently, urban development and the increasing demands of a booming tourist sector. In our study we will revise this push pull dynamic considering different natural, economic, social and policy issues.



W03.01-P -10

SOIL DEGRADATION FOLLOWING LAND CONVERSION OF NATIVE MEDITERRANEAN SHRUBLAND TO AVOCADO (*PERSEA AMERICANA* MILL. VAR. HASS) ORCHARDS IN CENTRAL CHILE.

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Land use changes from forest to agriculture affect soil physical and chemical properties through soil management and surface soil rotation and removal. During the last decade, in the Chilean Mediterranean region thousands of hectares of native shrubland have been converted to agriculture to establish avocado orchards planted in steep hills. The main objective of this study was to evaluate changes in soil quality, with emphasis in soil carbon, six years following conversion from native shrubland to avocado orchards in the Coastal range piedmont of central Chile (33°45' south, 71°24' west). A twin plot approach was used to compare the effect of land use change. The pairing criteria were defined based on location, aspect, slope and surface soil type. At the beginning of the study, surface soil samples were collected from each stratum to measure bulk density, soil texture, pH, CEC, soil carbon and nitrogen, aggregate stability and the size of the carbon pools associated to each particle size. Field soil respiration, temperature, and water content have been measured every month, for one year, across the twin plots using a non-dispersive infrared gas analyzer (EGM-4, PP-system). Preliminary results indicated no difference between the two areas sampled within the native shrubland. In the avocado plots, the terraces showed significantly greater organic matter content compared to the furrows. Differences in soil quality parameters were significantly higher in the native shrubland in relation to the avocado soils, indicating high levels of soil degradation six years land conversion.



W03.01-P -11

**THE INTERSECTION OF HYDROLOGICAL MODELING WITH PEDOLOGICAL INFORMATION
FOR PREDICTING SOIL (AND WATER) DEGRADATION AT APPLICATIVE SCALES**

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Soil textural and structural properties are described by hydraulic and transport parameters in predictive models of flow and transport. In case of degradation, soil properties are undergoing changes and model parameters cannot be treated as being constant. The parameters are then a function of time and of the soil structural state. Modified water fluxes and solute transport rates again affect the soil structural properties as a feedback reaction, which in the longer run manifests itself in more-or-less characteristic pedologic features. In this overview, examples of initial pore structure changes, pedon scale modifications of soil structure and soil horizons, and field scale lateral redistributions will be given. Pedotransfer functions and hydropedology are among current approaches that attempt to include pedology. Structural models in combination with upscaling procedures are increasingly being discussed that are able to provide the information that can be used for determining adequate macroscopic scale hydraulic model parameters. Still the quantitative modeling of the soil pore structure and changes due to degradation and incorporation in hydrological modeling remains a great challenge.



W03.01-P -12

URBAN GROWTH (1956-2006) AND SOIL DEGRADATION IN THE METROPOLITAN AREA OF VALENCIA, SPAIN

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Soil degradation processes resulting from human activities is considered to be the most important environmental threat in Mediterranean countries. One of the most important processes, occurring mainly in coastal areas, is soil loss through surface sealing due to urbanization and infrastructure construction. This process is not well understood in terms of actual soil consumption and detailed area distribution. The aim of this study is to understand the urban growth dynamics from the mid-1950s to 2006 in the Metropolitan Area of Valencia, eastern Spain, and its impact on soils. Remote sensing data and Geographical Information Systems (GIS) are particularly helpful in land use/cover analysis. Photo interpretation of aerial photographs dated from 1956, 1984, 1998 and 2006 was performed to establish the urban use changes at a detailed scale (1:10,000). Map analysis based on GIS was applied to obtain land use changes and to overlap urban growth with existing land capability maps. Indicators to assess the degree of environmental sustainability (land consumption by soil sealing) have also been applied. Results show that there has been a highly dynamic process produced by the extent of land developed as urban, commercial and residential areas. In 1956 only 3,520 hectares (9.5% of the overall study area) were occupied by urban use. In 2006 the total sealed surface was of 10,945 hectares, around 30% of the studied area. In the Metropolitan Area of Valencia much of the land converted to urban use was once a highly productive agricultural land.



S04.01-P - APPLICATION OF PROXIMAL SOIL SENSING (PPS) IN SOIL SCIENCE

Thursday 05 July 2012 from 17:00 to 18:30. Room Poster Areas

S04.01-P -1

A PEDOLOGICAL DESCRIPTION OF DANISH TOPSOILS USING VISIBLE-NEAR INFRARED SPECTRA

Maria Knadel, Tjele - Denmark

S04.01-P -2

ANALYSIS OF SOIL PHOSPHORUS BY NEAR INFRARED REFLECTANCE SPECTROSCOPY

Dalel Abdi, Quebec - Canada

S04.01-P -3

BEST-PRACTICE FOR IN SITU PH MEASUREMENT BY ISFET ELECTRODES IN SATURATED AND UNSATURATED SOIL

Niels Emil Sørensen, Aarhus - Denmark

S04.01-P -4

CHARACTERIZATION OF SOILS AND SEDIMENTS USING VIS-SPECTROSCOPY

Eileen Eckmeier, Bonn - Germany

S04.01-P -5

CHEMICAL PROPERTIES OF SOILS IN ALPINE AREA (NORTHERN ITALY) AS EVALUATED BY DIFFUSE REFLECTANCE SPECTROSCOPY (DRS)

Claudio Colombo, Campobasso - Italy

S04.01-P -6

COMBINING DISTRIBUTED SOIL MOISTURE MONITORING AND GEOPHYSICAL MEASUREMENTS FOR STUDYING HILLSLOPE HYDROLOGICAL PROCESSES.

Edoardo Martini, Leipzig - Germany

S04.01-P -7

COMPARISON OF CONVENTIONAL AND SPECTRAL METHODS TO DETERMINE TPH IN SOIL

Eyal Ben Dor, Tel Aviv - Israel



S04.01-P -8

DETERMINATION OF SOIL SALINITY AND WATER CONTENT USING FDR SENSORS

Agnieszka Szyplowska, Lublin - Poland

S04.01-P -9

DEVELOPMENT OF A REGIONAL-SCALE LIBRARY OF NEAR INFRARED REFLECTANCE SOIL SPECTRA FOR ALTERNATIVE ASSESSMENT OF SOIL CHARACTERISTICS IN SOUTHERN BELGIUM

Valérie Genot, Gembloux - Belgium

S04.01-P -10

DIFFUSE REFLECTANCE SPECTROSCOPY FOR MONITORING OF ARABLE SOILS CHEMISTRY IN THE NATIONAL SCALE

Cezary Kazmierowski, Poznan - Poland

S04.01-P -11

DIGITAL SOIL SALINITY MAPPING WITH ELECTRICAL RESISTIVITY DATA IN IRRIGATED PADDY FIELDS FROM NIGER

Issifou Adam, Rennes - France

S04.01-P -12

ELECTRICAL RESISTIVITY TOMOGRAPHY TO DETECT THE EFFECTS OF TILLAGE IN A SOIL WITH A VARIABLE ROCK FRAGMENT CONTENT

Roberta Rossi, Potenza - Italy

S04.01-P -13

ESTIMATING SPATIAL VARIATIONS OF APPARENT SOIL ELECTRICAL CONDUCTIVITY USING ELECTROMAGNETIC INDUCTION TO INVESTIGATE SOIL PHYSICAL PARAMETERS AND CROP YIELD IN A MIXED CROPPING SYSTEM IN WESTERN THAILAND

Sebastian Rudolph, Jülich - Germany

S04.01-P -14

EVALUATION OF SOIL BIODIVERSITY IN GERMANY: FIRST RESULTS

Frank Glante, Dessau - Germany

S04.01-P -15

HIGH RESOLUTION MAPPING OF SOIL ORGANIC MATTER QUALITY IN A HISTOSOL PROFILE WITH IMAGING SPECTROSCOPY

Markus Steffens, Freising - Germany



S04.01-P -16

HIGH-RESOLUTION DIGITAL SOIL MAPPING COMBINING LIDAR AND PROXIMAL SENSOR DATA BY RANDOM FOREST MODELLING

Didier Michot, Rennes - France

S04.01-P -17

HYPERSPECTRAL IMAGING CHARACTERIZATION OF AGRICULTURAL TOPSOIL ARSENIC CONCENTRATION WITH AD HOC CONTAMINATED SOILS

Silvia Rita Stazi, Viterbo - Italy

S04.01-P -18

LINKING GEOPHYSICS AND SOIL FUNCTION MODELLING

Janine Krüger, Halle - Germany

S04.01-P -19

MAPPING SOIL CLAY CONTENTS IN DUTCH MARINE DISTRICTS USING GAMMA-RAY SPECTROMETRY

Marthijn Sonneveld, Wageningen - Netherlands

S04.01-P -20

METHANE BIOFILTRATION PERFORMANCE OF SOIL AND SOIL-LIKE CONSTRUCTIONS

Olga Lisovitskaya, Moscow - Russian Federation

S04.01-P -21

MODELING NITROGEN TRANSPORT AND TRANSFORMATION IN SOIL-PLANT SYSTEM

Ali Erfani Agah, Leuven - Belgium

S04.01-P -22

MODELLING SPATIAL PATTERN OF SOIL ORGANIC MATTER USING VNIR SPECTROSCOPY AND GEOSTATISTICS IN AN AREA OF SOUTHERN ITALY

Gabriele Buttafuoco, Rende CS - Italy

S04.01-P -23

PREDICTION OF SOC CONTENT BY VIS-NIR SPECTROSCOPY AT EUROPEAN SCALE USING A MODIFIED LOCAL PLS ALGORITHM

Marco Nocita, Ispra - Italy



S04.01-P -24

PREDICTION OF SOIL BULK DENSITY BY FTIR AND NIR SPECTROSCOPY

A H Jean Robertson, Aberdeen - United Kingdom

S04.01-P -25

PREDICTION OF SOIL NITROGEN SUPPLY AND SOIL QUALITY PARAMETERS USING NEAR INFRARED REFLECTANCE SPECTROSCOPY IN HUMID TEMPERATE REGIONS OF CANADA

Mervin St. Luce, Ste-Anne-de-Bellevue, Quebec - Canada

S04.01-P -26

PROXIMAL SOIL MEASUREMENT WITH VISNIR SPECTROMETER DIRECTLY DURING CEREAL COMBINE HARVEST

Tomasz Wojciechowski, Poznan - Poland

S04.01-P -27

QUANTIFYING CARBON IN CHARCOAL-AFFECTED SOILS AT MOUND KILN SITES: FROM ANALYTICAL RESULTS TO A LARGER APPROACH BY REMOTE SENSING

Brieuc Hardy, Louvain-la-Neuve - Belgium

S04.01-P -28

SEASONAL MONITORING OF SOIL SALINITY BY ELECTROMAGNETIC CONDUCTIVITY IN IRRIGATED SANDY SOILS FROM A SAHARAN OASIS

Ismaïel Berkal, Rennes - France

S04.01-P -29

SOIL DIGITAL MAPPING WITH REDUCED SOIL SAMPLES UNDER AGRO-SILVO-PASTORAL SYSTEMS

Carlos Alexandre, Evora - Portugal

S04.01-P -30

SOIL SPECTRAL LIBRARY APPROACH TO EVALUATE THE POTENTIALS OF SOIL ORGANIC CARBON STORAGE DUE TO SUSTAINABLE LAND MANAGEMENT IN THE HIGHLANDS OF ETHIOPIA

Tadele Amare Kassie, Bern - Switzerland



S04.01-P -31

SPATIAL STOCHASTIC MODELING OF TOPSOIL ORGANIC CARBON CONTENT OVER A CULTIVATED PERI-URBAN REGION, USING SOIL PROPERTIES, SOIL TYPES AND A DIGITAL ELEVATION MODEL

Jonas Hamiache, Paris - France

S04.01-P -32

SPATIAL VARIABILITY ANALYSIS OF SOIL PHYSICAL AND CHEMICAL PROPERTIES IN AN EXPERIMENT FIELD IN SISTAN PLAIN, SOUTHEAST OF IRAN

Masoomah Delbari, Zabol - Iran, Islamic Republic of

S04.01-P -33

SPECTRAL ESTIMATION OF SOIL PROPERTIES IN SIBERIAN TUNDRA SOILS AND RELATIONS WITH PLANT SPECIES COMPOSITION

Harm Bartholomeus, Wageningen - Netherlands

S04.01-P -34

TERRAIN ATTRIBUTE BASED MAPPING FOR A SOIL-LANDSCAPE DETAILED ALBANIA SOIL MAP

Zamir Libohova, Lincoln - United States

S04.01-P -35

TESTING OF DIFFERENT METHODS OF SOIL VIS-NIR SPECTRA PROCESSING FOR PREDICTION OF AVAILABLE NUTRIENTS CONTENT

Lubos Boruvka, Suchdol - Czech Republic

S04.01-P -36

THE COMPARESION OF CONVENTIONAL METHOD AND LCC TOOL FOR N MANAGEMENT IN RICE

Sekineh Vaseghi, Savadkooh - Iran, Islamic Republic of

S04.01-P -37

THE SOIL AND WATER MONITORING NETWORK OF GEOLOGICAL SURVEY OF FINLAND

Pekka Hänninen, Espoo - Finland

S04.01-P -38

TOPSOIL ORGANIC CARBON PREDICTION USING VIS-NIR-SWIR REFLECTANCE SPECTRA AT LAB, FIELD AND SATELLITE LEVELS OVER A PERIURBAN REGION

Emmanuelle Vaudour, Thiverval-Grignon - France



S04.01-P -39

X-RAY FLUORESCENCE SENSING OF SOIL PHOSPHORUS FOR PRECISION MANAGEMENT AND ENHANCED NUTRIENT USE EFFICIENCY.

Thanh H. Dao, Beltsville, Maryland - United States



4th International Congress **EUROSOIL 2012** Soil Science for the Benefit of Mankind and Environment Fiera del Levante, Bari Italy - 2-6 July 2012



S04.01-P -1

A PEDOLOGICAL DESCRIPTION OF DANISH TOPSOILS USING VISIBLE-NEAR INFRARED SPECTRA

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Spectroscopy is widely recognized as an effective tool for the analysis of soil constituents. It is an efficient alternative to conventional laboratory analysis that is cumbersome, time consuming and expensive. The majority of studies on the use of spectroscopy focus on the multivariate calibration of spectra to soil properties for their prediction. However, information derived from spectra only can also be used for describing the soil and how it varies across a landscape. The reason is that spectra contain information on the fundamental composition of soil: its organic matter and minerals. In this study we use visible near infrared (vis-NIR) spectra to describe topsoils across Denmark. We used 693 agricultural topsoil samples (0–30cm) from the Danish soil collection and measured them with a vis-NIR spectrometer. Spectra were collected in the range between 350–2500nm. We interpreted the soils by gleaned the organic and mineralogical information from the spectra. To summarize the information content in the spectra we performed a principal component analysis (PCA). The first three PC's, which explained 94% of the spectral variability, were used in a k-means clustering to help with interpretation. Soil properties of the clusters were described using the mean spectrum of each class. The kriging maps of the first three PCs and a cluster map derived from ISO clustering of these maps were used in the final discussion. The resulting four clusters represent clayey, sandy, silty and organic soils, respectively. Their distribution reflects the general pattern of soil variability in Denmark.



S04.01-P -2

ANALYSIS OF SOIL PHOSPHORUS BY NEAR INFRARED REFLECTANCE SPECTROSCOPY

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*Near infrared reflectance spectroscopy (NIRS) is a rapid, inexpensive, and accurate analytical technique for a wide variety of materials and its use is increasing in soil science. Our objective was to examine the potential of NIRS to estimate soil P as extracted by two methods [Mehlich 3 (M3P) and water (Cp)], soil total P (TP), annual plant P uptake (P_{up}), and annual P budget [P_{bud} = applied P - P uptake]. We used 448 air-dried soil samples taken from a long-term experiment (1999-2006) with several N and P fertilization rates applied to timothy (*Phleum pratense* L.) in eastern Canada. Calibration equations were developed using 80 % of the samples and the partial least squares regression while the remaining 20 % of samples were used for validation. Predictive ability of NIRS was measured using coefficients of determination (R²) and ratios of performance deviation (RPD). Predictions of M3P, Cp, P_{up}, and P_{bud} were considered poor (R² < 0.70, RPD < 1.75) but they were considered reliable for TP (R² = 0.75, RPD = 1.98). Presumably, the NIRS predictive ability is better when the soil P measure is strongly related to organic C. Further research could assess the NIRS potential to predict soil organic P.*



S04.01-P -3

BEST-PRACTICE FOR IN SITU PH MEASUREMENT BY ISFET ELECTRODES IN SATURATED AND UNSATURATED SOIL

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Precise and reproducible measurements of soil pH are of paramount importance in agronomical, environmental and soil science studies. For decades it has been measured in a soil-water solution in the laboratory due to fragile electrodes and reproducibility considerations. Based on a need for faster but still reliable and precise soil pH measurements for e.g. soil surveying we have tested and developed a best-practice protocol for implementing the new robust ISFET (Ion-sensitive field) electrodes for measuring soil pH in situ. Our tests showed that in unsaturated soil the ISFET electrode measurement have lowest standard deviations if a hole with the same diameter as the probe is drilled first and filled with 2 ml deionized water and leaving it for 60 seconds for stabilizing. Applying this protocol to 65 topsoil samples from an Danish forest showed that measured in situ soil pH by the ISFET method was fully comparable to laboratory pH measurements obtained in 1:1 soil-water by standard laboratory methods on 2-mm sieved. Vertical profiles of in situ subsoil pH of saturated bog sediment were obtained by inserting the ISFET electrode through an outer plastic pipe, which was pushed into the undisturbed sediment. In this strongly reduced soil the largest analytical error was drift in the electrode. Thus frequent re-calibration was necessary in these measurements. This study highlights that soil pH measurements are possible in situ with standardized methods and that results in unsaturated topsoils are comparable with laboratory obtained results.



S04.01-P -4

CHARACTERIZATION OF SOILS AND SEDIMENTS USING VIS-SPECTROSCOPY

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Soil colours reflect soil characteristics, and the correlations between soil colour and soil components like charred organic matter or iron hydroxides can be measured using spectrophotometrical data. The development of a quantitative spectroscopic method based on soil colour spectra would enable the measurement of large amounts of samples, e.g. to investigate environmental or archaeological research questions on a regional scale. The aim of our study is the assessment of soil profile information using VIS-spectroscopy, with a main focus on archaeological soil features, and to establish spectrophotometry as a rapid and reliable tool for the analysis of soils and sediments. Soil colour spectra were obtained in the 360 to 740nm range, in 10nm steps, using a field-spectrophotometer (CM-700d) and a lab spectrophotometer (CM-5). The spectrophotometric data was calibrated against soil sample sets that have been analyzed on iron, carbonates, organic carbon, and pyrogenic carbon (BPCA). The set of archaeological samples that covers material from the Early Neolithic to the Roman period was collected at excavations in the loess-covered regions of NW- and E-Germany. Models were build based on partial least squares regression. Additionally, we evaluated different colour index values (e.g. Redness Rating), as well as the effects of soil moisture and texture.



S04.01-P -5

CHEMICAL PROPERTIES OF SOILS IN ALPINE AREA (NORTHERN ITALY) AS EVALUATED BY DIFFUSE REFLECTANCE SPECTROSCOPY (DRS)

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Diffuse reflectance spectroscopy (DRS) in the UV-VIS-NIR (300-2500 nm) region was applied as a rapid screening method to study the organic matter distribution and clay content along eight soil profiles sampled in the Andossi Plateau (Valchiavenna, Italian Central Alps), between 1800 and 2000 m a.s.l. Due to very different pedogenetic factors, soil types include Regosols, Cambisols, Umbrisols, Podzols, and Histosols. Partial Least Square (PLS) regression was used with explanatory purpose in order to find few underlying factors, accounting for most of the variation in both predictors and responses, and to individuate the spectral wavelengths more able to put in evidence variation in the soil properties. Soil spectra were first restricted to 380-2450 nm interval, to eliminate noise at edges of each spectrum. Then, to reduce the effect of random noise and improve signal-to-noise ratio, data were filtered using the Savitzky-Golay algorithm. First-order derivative spectra were finally calculated from the smoothed reflectance spectra. PLS regression was run independently for each soil property. Leave-one-out cross-validation was used to select the optimal number of factors to retain. First results showed that three factors were able to explain 99.8% of the variance in the spectra and 64.05% of the variance in the soil data for TOC, whereas four factors accounted for over 99% of predictor variation and about 80% of the response variation for clay. Knowledge of the spatial distribution TOC can be used to obtain important information on soil properties in order to improve soil management and conservation in mountain systems.



S04.01-P -6

COMBINING DISTRIBUTED SOIL MOISTURE MONITORING AND GEOPHYSICAL MEASUREMENTS FOR STUDYING HILLSLOPE HYDROLOGICAL PROCESSES.

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Knowledge of soil water content at the field to catchment scale is important, e.g. for water management, hydrological studies, and for calibration and validation of soil water balance models. Fast, precise, and ideally in-situ, measurements may be obtained from soil moisture monitoring networks. For an optimal setup of such a network, detailed knowledge of soil spatial variability is required and may be acquired from geophysical measurements. The aim of this work is to set up a soil moisture monitoring network, to obtain time series of soil moisture content from different depths along a hillslope in a small catchment in central Germany. The study area is characterized by different soil types and topographic conditions. Significant interflow processes along the slope are hypothesized. For the catchment, a semi-detailed soil map is already available, and a geophysical survey was carried out using different proximal sensors for mapping apparent soil electrical conductivity (ECa) from different depths. The hillslope was explored using three EMI sensors (EM38-DD, EM38-MK2 and EM31-MK2, Geonics Ltd., Canada) and a gamma-ray spectrometer (GF Instruments, Czech Republic). The existing soil map in combination with geophysical maps, are used for geostatistical analysis of the site's soil textural heterogeneity and, finally, for the adjustment of the positions of the measurement nodes of the soil moisture monitoring network. Several SPADE sensors (Sceme.de, Germany) will be installed along the hillslope, which will be used for continuous monitoring of soil moisture content and soil temperature. Starting from spring 2012 the first results from the soil moisture monitoring network are expected.



S04.01-P -7

COMPARISON OF CONVENTIONAL AND SPECTRAL METHODS TO DETERMINE TPH IN SOIL

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The commonly used analytic method for assessing Total Petroleum Hydrocarbons (TPH) in soil, EPA method 418.1, is usually based on extraction with 1,1,2-Trichlorotrifluoroethane (Freon 113) and FTIR spectroscopy. This method is widely used for initial site investigation, due to the relative low price per sample. It is known that the extraction efficiency varies depending on the extracting solvent and other sample properties. A novel method for determining TPH by reflectance spectroscopy that was developed in the Tel Aviv University's Remote Sensing Laboratory was compared to the traditional methods. This study's goal was to compare the results of spectroscopy and three independent laboratories certified to determine TPH level via EPA 418.1 method; and to evaluate the reliability of this method as a screening tool for site evaluation. Results showed that spectroscopy can yield results as good as the more expensive and labor intensive traditional methods. Other traditional method's problems and biases are also discussed.



S04.01-P -8

DETERMINATION OF SOIL SALINITY AND WATER CONTENT USING FDR SENSORS

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Fast, accurate and reliable measurements of the soil water content and salinity are of a great significance to agriculture, environmental sciences, climatology and many other fields. The dielectric properties of soils are strongly affected by their water content and salinity, thus providing a method of estimating these important soil parameters. The frequency domain reflectometry (FDR) sensors obtain the real and imaginary parts of the dielectric permittivity directly and independently for each applied frequency. This is a clear advantage over TDR probes, which approximate the real part of the dielectric permittivity from the velocity of an electromagnetic impulse and determine the electrical conductivity from the signal attenuation. Furthermore, the TDR measurements do not account for the dielectric loss of the material. This study presents the laboratory measurements of the water content and salinity of five mineral soils using the FDR probe with two 3 cm parallel rods and a vector network analyzer, in the frequency range from 10 to 500 MHz. Results provided by such a probe pertain to greater volume of the material than in the case of a standard open-ended coax sensor. Moreover, this technique allows to obtain not only bulk electrical conductivity of the sample, but may also estimate soil water conductivity. Further development of this probe should enlarge the measurement frequency range, improve the quality of data and ultimately provide a handheld field FDR device for fast and exact on-site measurements, more accurate and less expensive than the TDR sensors.



S04.01-P -9

DEVELOPMENT OF A REGIONAL-SCALE LIBRARY OF NEAR INFRARED REFLECTANCE SOIL SPECTRA FOR ALTERNATIVE ASSESSMENT OF SOIL CHARACTERISTICS IN SOUTHERN BELGIUM

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Near infrared reflectance spectroscopy (NIRS) is emerging as a rapid, low-cost, and reproducible method for the prediction of some soil properties. Prior to routine application, calibration model has to be built and validated. As this usually constitutes an expensive and time consuming step of data acquisition, we studied the question of model generalization and continuous data acquisition at wider scale by transferring the spectral library from one laboratory to several others. The initial models were elaborated upon local PLS regression on set of 1 300 soil samples to predict total organic carbon, total nitrogen, clay content, and cation exchange capacity. Ideally, the library should be continuously implemented new samples in order to cover more and more situations. Every laboratory has been adding its unpredicted samples in the data base and after two years the soil spectral library contains more than 10 000 soil spectra and associated reference analysis. Around 70 % of the crop soil samples are well predicted (SEP = 0.08 g 100g⁻¹ TOC based on a validation set of 2 000 soil samples). This study illustrates the interest of developing soil spectral library in a large, but defined, territory to be used by several laboratories working with the same reference analysis procedure and using a standardized protocol to prepare and scan the soil samples.



S04.01-P -10

**DIFFUSE REFLECTANCE SPECTROSCOPY FOR MONITORING OF ARABLE SOILS
CHEMISTRY IN THE NATIONAL SCALE**

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The goal of the study was to investigate the possibility of application of visible and near infrared diffuse reflectance spectroscopy (VNIR-DRS) measurements to monitoring of arable soils chemistry. Fifty one soil characteristics were determined in 212 soil samples which were collected during the program "Monitoring of Chemistry of Arable Soils" conducted in 2005 on cropland in Poland. Reflectance r of soil samples was measured at the wavelength range from 350 nm to 2500 nm, at 1-nm intervals, using a ASD FieldSpec Pro spectroradiometer with the attached Source Probe Mug-Lite. DSR data were transformed into root of r , $1/r$, absorbance, first and second derivative of r , Kubelka Munk units and its derivative and continuum removal values. Correlation between reflectance r and soil properties were calculated for the total dataset. From spectral data only total forms of Ca and Sr can be estimated with very high R^2 values (0.945 and 0.844 respectively), however statistically significant relationships ($R^2 > 0.70$) were observed between reflectance data and soil total concentration of Ni, Mg, Cr, Li, K and Co. Soil reflectance data can not be used to predict soil reaction, C:N ratio, P₂O₅, K₂O and S-SO. The most useful mathematical transformation of spectral data for modelling soil properties were second derivative of raw data, first derivative of absorbance and Kubelka-Munk unit and continuum removal. The results of the study confirm the significant relationships between DSR data and various soil chemical properties, what makes possible to use these techniques for costs reduction and time saving in soil monitoring.



S04.01-P -11

DIGITAL SOIL SALINITY MAPPING WITH ELECTRICAL RESISTIVITY DATA IN IRRIGATED PADDY FIELDS FROM NIGER

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Salinization threatens the sustainability of several irrigated paddy fields of western Africa. To reclaim saline soils and to improve the management of irrigated paddy fields, it is necessary to evaluate and to monitor the soil salinity in space and time. Proximal soil sensing by bulk electrical resistivity (ER) measurements can help to survey the soil salinity. The study aims to map at high resolution the salinity of Vertisols from paddy fields of an 8 ha experimental site located at Kollo along the Niger River (Niger). The survey combines ER data and electrical conductivity measurements of 1/5 diluted aqueous extract of soil (EC 1/5). EC 1/5 measurements were realized on soil samples collected at 3 depths on 140 points. ER measurements were implemented at different investigation depths on 420 positions. This procedure was applied in May 2008 and again in March 2011 after a major flooding of the study area by the Niger River. We built an inference model of EC 1/5 using a regression trees method for 3 prediction depths. The predictive data were the ER measurements, their ratio and a qualitative description of land use. The map of predicted EC1/5 revealed strong lateral salinity gradients (from 0.3 to 5 dS.m⁻¹) with prediction RMSE comprised between 0.73 and 0.77 dS.m⁻¹. Vertical variations of salinity were also significant and their shape could be explained by land use, mainly irrigation intensity. Comparisons of the 2008 and 2011 salinity maps indicated very stable spatial patterns and unlighted the high resilience of the system.



S04.01-P -12

ELECTRICAL RESISTIVITY TOMOGRAPHY TO DETECT THE EFFECTS OF TILLAGE IN A SOIL WITH A VARIABLE ROCK FRAGMENT CONTENT

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Resistivity tomography is a promising tool for non destructive characterization of ploughed layers. Ambiguity in interpretation though is a limiting factor. Resistivity is influenced by a number of properties that fall in the same ranges of values; at a given site, though, one factor can be dominating if its within field variation is large enough compared to other properties. We tested if resistivity tomography was able to detect the effects of tillage even in presence of background heterogeneity. Field Experiments were conducted at Ce.Spe.Vi. (Pistoia, Italy 43° 55'13.32"N; 10°, 54', 31.18"E) on a silty loam soil. Two-dimensional DC resistivity tomography was performed with an Iris Syscal Pro ten-channel receiver resistivity meter (IRIS INSTRUMENTS, Orléans-France) on 3 transects across two replications of 2 management systems (BM= ploughed at 30 cm and SA=Set-Aside) on a soil which had been left uncultivated for 15 years. Resistivity was regressed against soil properties obtained by destructive sampling. Resistivity was strongly correlated to rock fragments content ($r=0.68$) and was significantly higher in tilled plots where a greater amount of rock fragments was found. Resistivity was sensitive to clay ($r= -0.45$) , a linear trend in resistivity across the field ($R^2=0.64$) was consistent with a decreasing clay content ($R^2=0.47$). In other papers ER variations due to tillage are attributed to porosity, whether measured or hypothesized. Here we found that it is partially explained by a higher rock fragment content possibly linked to kinetic sieving.



S04.01-P -13

ESTIMATING SPATIAL VARIATIONS OF APPARENT SOIL ELECTRICAL CONDUCTIVITY USING ELECTROMAGNETIC INDUCTION TO INVESTIGATE SOIL PHYSICAL PARAMETERS AND CROP YIELD IN A MIXED CROPPING SYSTEM IN WESTERN THAILAND

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Apparent soil electrical conductivity (ECa) is an indirect measure for various soil physical and chemical parameters which can be obtained at large scales at high resolution and with low effort by using electromagnetic induction (EMI) techniques. Over the last years, the EM38 has been the most popular instrument of choice for precision agriculture application. The enhanced EM38-MK2 with additional coil spacing seems to be more appropriate to detect variations in shallow layers than the previous version. In our study we used the more sophisticated EM38-MK2 to investigate the spatial heterogeneity of apparent soil electrical conductivity (ECa) in a mixed cropping system in Western Thailand, with the objective to associate these patterns to geological conditions, crop water up-take, grain yield variability and biomass production of maize and chili.



S04.01-P -14

EVALUATION OF SOIL BIODIVERSITY IN GERMANY: FIRST RESULTS

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According to the German Law on Soil Protection (1998), one of the natural functions is the soil is its ability to act as a habitat for organisms (mainly invertebrates and microbes). So far, this function is not considered when assessing the quality of soils, e.g. in the context of landscape planning. Therefore, in a project supported by the German Federal Environmental Agency (UBA), the following issues were addressed: - Critical compilation of existing concepts and approaches in the area of biological soil classification and assessment; - Assembly of a data-base on soil biodiversity in Germany, in particular collection of data from German Permanent Soil Monitoring Sites (BDF) and from literature (Collembola, Oribatida, Lumbricidae, Enchytraeidae and microbes); - Preparation of recommendations for the implementation of soil biological monitoring concepts and methods in Germany. In this contribution, an overview on the results is given. After a short description of the data base (structure, content), the biogeography of individual species as well as of ecological groups is presented. In addition, ecological profiles of relevant species from different groups have been prepared. Most importantly, the composition of communities (i.e. species) for different biotope types is shown, meaning that the preconditions of reference values (= normal operating range species and communities) have been developed. Finally, recommendations concerning suitable organism groups and standard methods (including – mainly microbial – genetical indicators) for a nation-wide soil biodiversity monitoring program are given.



S04.01-P -15

HIGH RESOLUTION MAPPING OF SOIL ORGANIC MATTER QUALITY IN A HISTOSOL PROFILE WITH IMAGING SPECTROSCOPY

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Quantity and quality of the organic matter (OM) are crucial for many soil physical and chemical properties. In most studies their assessment is not adequately considered and spatial heterogeneities are completely neglected on the pedon scale. There is a demand for a fast, non-invasive technique measuring the OM quantity and quality with a high spatial resolution. We tested the applicability of VIS-NIR imaging spectroscopy to discriminate and map the chemical composition of SOM with a high spatial resolution in an undisturbed soil profile. We took a 30 cm-long rectangular soil column of a folic Histosol (Tangelhumus) under an alpine Norway spruce forest in south-eastern Germany using a stainless steel box (100x100x300 mm). A hyperspectral camera (400-1000 nm in 160 spectral bands) with a spatial resolution of 63x63 μm per pixel was used for data acquisition. We took images of three vertical cuts through the soil profile, each separated laterally by 25 mm. Reference samples were taken at representative spots and analysed for SOM quantity and quality with a CN elemental analyser and by solid state ^{13}C NMR spectroscopy. Principal component analyses and supervised spectral angle mapper classifications were applied on the image to discriminate OM particles and patterns with different chemical composition. We are able to automatically discriminate, classify and map the chemical composition of the SOM in a whole soil profile with a high spatial and spectral resolution. Imaging spectroscopy is a fast and powerful technique to map the SOM quality in whole soil profiles.



S04.01-P -16

HIGH-RESOLUTION DIGITAL SOIL MAPPING COMBINING LIDAR AND PROXIMAL SENSOR DATA BY RANDOM FOREST MODELLING

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This study evaluated a Random Forest (RF) approach with a regression kriging to model the spatial distribution of soil depth in a complex agricultural landscape combining proximal soil sensing data and auxiliary data derived from a DEM at a metric resolution. To train and validate the RF trees, 194 soil descriptions were made on a study site of 7 ha located in an agricultural hedgerow landscape characterized by a complex soil organisation with an increase of A horizon thickness uphill from hedges due to colluvial deposition. The morphology of the study site was quantified by building a metric DEM from a LIDAR. Soil observations were completed with an electrical resistivity (ER) survey at 3 depths of investigation (0.5, 1 and 2 m). For each soil observation, visible and near-infrared (Vis-NIR, 450-2500nm) spectra and γ -ray spectra were recorded. Soil depth is predicted by a RF modelling using the following predictors : (a) parameters derived from DEM (elevation, slope, plan and profile curvature, flow length, flow accumulation, flow direction); (b) ER at 3 depths of investigation; (c) parameters derived from γ -ray spectra (K, Th, total count, principal component) ; (d) soil colours parameters (Munsell Hue and Value, RGB) and principal components obtained from Vis-NIR spectra; and a regression kriging is applied. The RF modelling explained 36.5% of the total variance. Predicted soil depth ranges from 0.43m to 1.99 m and the prediction quality is characterized by an EM= -0.02m and a RMSE = 0.43m.



S04.01-P -17

HYPERSPECTRAL IMAGING CHARACTERIZATION OF AGRICULTURAL TOPSOIL ARSENIC CONCENTRATION WITH AD HOC CONTAMINATED SOILS

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Agricultural soil characterization is an important tool to plan productivity and quality of products. It is conventionally performed through physical-chemical analyses, which is costly and time consuming. Hyperspectral imaging is a technology that provides elevated information content while being rapid, non-destructive. It allows an increase of samples numerosity to fit the need for adequate time-spatial mapping of heterogeneous soils. Hyperspectral sensors collect information as a hypercube based on a digital image (spatial information) associated to spectral reflectance values (spectral information) for processing and modelling. Although heavy metals are spectrally neutral in the VIS-NIR spectrum, the spectral signatures of minerals that bind heavy metals can be used for the indirect detection of metal dispersion in soils using spectral data. The objective of this research is to develop a tool based on hyperspectral imaging for the rapid estimation of the topsoil arsenic concentration, to be used for on-the-go soil contaminated mapping. Twenty soil samples have been contaminated ad hoc with Arsenic standard in concentrations ranging from 1 to 400 mg of As per kg of soil. Samples were scanned using VIS-NIR spectrophotometer (InSpec–Spectral Scanner, 400-970 nm). A range of Partial Least Squares regression models derived from spectral arrays were tested on their ability to predict As concentration. The result of the best performing model fitted with a validation set of data with: a correlation coefficient between observed and measured values of 0.83, a root mean square error of 99.6 and a ratio of percentage deviation of 1.78.



S04.01-P -18

LINKING GEOPHYSICS AND SOIL FUNCTION MODELLING

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The iSOIL project aims at reliable mapping of soil properties and soil functions with various methods including geophysical, spectroscopic and monitoring techniques. The general procedure contains three steps (i) geophysical monitoring, (ii) generation of soil property maps and (iii) process modelling. The objective of this work is to demonstrate the mentioned procedure with a focus on process modelling. It deals with the dynamics of soil water and the direct influence on crop biomass production. The new module PLUS extends CANDY to simulate crop biomass production based on environmental influences. A soil function modelling with an adapted model parameterisation based on data of ground penetration radar (GPR) was realized. This work shows an approach to handle heterogeneity of soil properties with geophysical data used for modelling. The field site Wagna (Austria) is characterised by highly heterogenic soil with fluvioglacial gravel sediments. The variation of thickness of topsoil above a sandy subsoil with gravels strongly influences the soil water balance. GPR detected exact soil horizon depth between topsoil and subsoil. The extension of the input data improves the model performance of CANDY PLUS for plant biomass production. The example demonstrates how geophysics provide a surplus of data for agroecosystem modelling which identifies and contributes alternative options for agricultural management decisions. iSOIL - "Interactions between soil related sciences – Linking geophysics, soil science and digital soil mapping" is a Collaborative Project (Grant Agreement number 211386) co-funded by the Research DG of the European Commission within the RTD activities of the FP7 Thematic Priority Environment.



S04.01-P -19

MAPPING SOIL CLAY CONTENTS IN DUTCH MARINE DISTRICTS USING GAMMA-RAY SPECTROMETRY

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Conventional soil sampling methods to obtain high-resolution soil data are costly. Recently, gamma ray spectrometry has emerged as a promising technique to overcome these obstacles. The objective of this study was to investigate the prediction of soil clay contents using gamma-ray spectrometry in three marine clay districts in the Netherlands: the southwestern marine district (SMD), the IJsselmeerpolder district (IJPd) and the northern marine district (NMD). The performance of linear regression models was investigated at field (<1 km²), regional (1–1000 km²) and district (>1000 km²) scales and for all the Dutch marine districts together. For this study, a database was available with 1371 gamma-ray spectra measured on arable fields in marine clay districts during the period 2005–2008 and these were all linked to laboratory analyses of clay contents. At the field scale, linear regression models based on ⁴⁰K, ²³²Th, or a combination of these revealed much smaller root mean squared error (RMSE) values (2–3%) compared with a model based on the field mean (8–10%). At the district scale, the regression models for the SMD and IJPd, which have comparable sediments, performed better than for the NMD. This indicates that the prediction of clay contents in late Holocene marine sediments may be made with gamma-ray spectrometry provided that the origin of the parent material results in a unique fingerprint.



S04.01-P -20

METHANE BIOFILTRATION PERFORMANCE OF SOIL AND SOIL-LIKE CONSTRUCTIONS

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*Due to intensive methane concentration increase in atmosphere the actual task is its utilization. The perspective way is biofiltration – the process of methane biological treatment to CO₂ and subproducts by methanotroph microbial community. The objective is to assess methane biofiltration of natural soil (humic horizon of albeluvisol) and human-made soil-like constructions (differed by organic matter type: low-moor peat and livestock compost). Experiments were taken during 3 summer months under 24±1.5°C average daily temperature, Wair=30±10%, twice a week watering according the average precipitation in Moscow. Substrates were placed in columns of 0.15x0.15x0.30 m equipped with bottom pipes for gas sampling. Methane injected regularly in 2.5 % vol. Gas concentration was analyzed at chromatograph. Methane consumption rate (MCR, g*10⁻⁶*g⁻¹*d⁻¹) increased in the row: peat (13.3±2.1), compost (20.4±3.7), topsoil (23.3±2.1) column. For soil-like constructions the first week MCR was 3 times lower other period values. Topsoil demonstrated stable MCR, what means methanotrophs community is developed but in other substrates it is required time to be fully distributed. It was observed CO₂ growth in peat (production rate is 1.35±1.0 g*10⁻⁶*g⁻¹*d⁻¹) and compost (5.4±0.2) constructions; however in topsoil CO₂ production rate was stable in time (0.0±0.5). There are considered to be 2 types of CH₄ biofiltration: partial oxidation without CO₂ generation in topsoil and full oxidation leading to CO₂ producing in constructions. Thus the mechanism of CH₄ conversion to CO₂ or sub-products is organic substrate driven process, which proper choice allow to utilize CH₄ maximally safe.*



S04.01-P -21

MODELING NITROGEN TRANSPORT AND TRANSFORMATION IN SOIL-PLANT SYSTEM

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Abstract Scarcity of fresh water has led to use municipal wastewater as an alternative source for irrigation water. Nitrates can leach from cultivated areas and regular use of fertilizer and wastewater in irrigated agriculture cause potentially degradation of groundwater quality. Soil water flow and nitrogen dynamics during the growing period were simulated by Hydrus-1D for a cultivated soil in North-East Iran. Simulations were compared to experimental data from a randomized completely blocked design with five irrigation treatments with different sources of nitrogen was applied. The results showed that urea moves readily with the infiltrating irrigation water, potentially moving this nitrate source away from the soil zone with maximum root density. For all strategies, urea did not accumulate in the soil profile, but quickly decreased with time after irrigation by hydrolysis and associated conversion to ammonium. Because of its adsorption to the soil, most of the ammonium remained near the surface with low concentrations. On the other hand, nitrate mass accumulated in the soil profile and moved down to depths deeper than 150 cm. Nitrate concentrations are high because nitrate remains in solution; it is also very mobile. Slightly smaller leaching percentages were computed for the urea–ammonium–nitrate wastewater compared to the nitrate-fertilizer and manure. The results of the simulations showed that the municipal wastewater reclaimed by secondary treatment plants can be used as valuable source of irrigation without causing contamination of groundwater. *Key words:* Municipal wastewater; Nitrogen leaching; Hydrus-1D; fertilize and manure application



S04.01-P -22

MODELLING SPATIAL PATTERN OF SOIL ORGANIC MATTER USING VNIR SPECTROSCOPY AND GEOSTATISTICS IN AN AREA OF SOUTHERN ITALY

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Soil organic matter (SOM) has beneficial modifying effects on soil properties for plant growth and production. Moreover, SOM changes carbon dioxide concentrations in the atmosphere and can influence climate warming. Modelling and mapping spatial variability of SOM is an important issue because of spatial variability of SOM content. Conventional methods for SOM determination are based on laboratory analyses and are costly and time consuming. Soil spectral reflectance is an alternative approach for SOM determination and has the advantage to be rapid, non-destructive and inexpensive. The aims of the paper were to test the use of laboratory spectrometry in the visible and near-infrared (VNIR) spectral range, as a tool (i) to develop a prediction model for SOM content and (ii) to model and map SOM in an area of southern Italy using geostatistical methods. The study area was the Turbolo watershed (Calabria, southern Italy), which is representative of Mediterranean areas having a high susceptibility to soil degradation. Topsoil samples were collected at 215 points. Partial least squared regression (PLSR) analysis was used on only 161 samples to establish the relationships between spectral reflectance and SOM. The optimum number of factors to retain in the calibration model was determined by cross validation. Results were satisfactory with high coefficient of determination ($R^2=0.84$) and with a value of residual predictive deviation (RPD) more than of 2.4. The SOM spatial pattern of variability was determined and multi-Gaussian kriging was used to map SOM.



S04.01-P -23

**PREDICTION OF SOC CONTENT BY VIS-NIR SPECTROSCOPY AT EUROPEAN SCALE
USING A MODIFIED LOCAL PLS ALGORITHM**

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Visible near infrared soil spectroscopy (VNIRS) has been shown to be an efficient tool for the prediction of soil organic carbon (SOC) at fine scales. However, when applied to regional or country scales, VNIRS did not provide sufficient accuracy as an alternative to standard laboratory soil analysis for SOC monitoring. Under the framework of LUCAS project of the Joint Research Centre (JRC), about 20,000 samples were collected all over European Union. Soil samples were analyzed for several physical and chemical parameters, and scanned with a Vis-NIR spectrometer in the same laboratory. The scope of our research was to predict SOC content at European scale using LUCAS spectral library. We implemented a modified local partial least square regression (I-PLS) including, in addition to spectral distance, other potentially useful covariates (geography, texture, etc.) to select for each unknown sample a group of k predicting neighbors. The dataset was divided into tuning (20%), training (50%), and validation (30%) subsets. The tuning subset was used to find the most performing combination of model parameters. The best model was then calibrated and validated on training and validation subsets. The results indicated a fair prediction ability (RMSE: 5-6 g C kg⁻¹) of the I-PLS models at continental scale, which compares well with other tested multivariate methods. Although such accuracy means that spectroscopic models cannot be used for SOC monitoring on a point by point basis, the results indicated that VNIRS might be a useful tool to predict the mean SOC level at larger scales.



S04.01-P -24

PREDICTION OF SOIL BULK DENSITY BY FTIR AND NIR SPECTROSCOPY

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Bulk density measurements are crucial to assessing changes in soil carbon stocks but often these vital measurements are lacking, particularly for legacy data. Developing quick, cost-effective and accurate methods of predicting bulk density is essential to allow the use of legacy data as a baseline for monitoring, and for rapid assessments for future monitoring. IR spectroscopic analysis of a soil sample is a quick and cost effective method of acquiring its chemical profile. The spectroscopic data then has the potential to be used to predict soil bulk density. Two IR spectroscopic methods were compared for the prediction of soil bulk density, Fourier Transform Infrared (FTIR) spectroscopy, using the mid infrared range, and Near Infrared (NIR) spectroscopy. Analysis was carried out on a spatial dataset of soils sampled on a 20km grid throughout Scotland, as part of the National Soil Inventory of Scotland (NSIS). Samples were from 183 different sites and had % C values ranging from 1- 50%. Samples for FTIR were air dried and finely milled and had spectra recorded on a Bruker Vertex 70 FTIR spectrometer using a DATR accessory. Samples for NIR analysis were air dried and 2mm sieved and had spectra recorded on a FOSS NIRS 5000 using a transport module sampling accessory. Calibrations against measured soil bulk density values (mainly from triplicate 210cm³ volume cores) were developed for both sets of data and showed correlations with $R^2 > 0.75$ and errors comparable with pedotransfer functions.



S04.01-P -25

PREDICTION OF SOIL NITROGEN SUPPLY AND SOIL QUALITY PARAMETERS USING NEAR INFRARED REFLECTANCE SPECTROSCOPY IN HUMID TEMPERATE REGIONS OF CANADA

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Soil nitrogen (N) supply in humid temperate regions is difficult to predict since it varies due to soil physio-chemical properties, agricultural management history and climatic condition. We evaluated near infrared reflectance spectroscopy (NIRS) prediction of soil N supply [corn (*Zea mays* L.) N uptake], total N, organic C, C/N ratio, NH₄ and NO₃, and how predictions were affected by soil homogeneity. Soil samples were collected from 2000 to 2009 from 52 sites across Canada. The total set ($n = 282$) was divided into fine- ($\geq 35\%$ clay; $n = 101$) and coarse-textured ($< 35\%$ clay; $n = 181$) subsets. Modified partial least squares regression was used to develop prediction models based on 80% of samples, followed by validation on the remaining samples. Models were evaluated using the coefficient of determination (R^2) and ratio of performance deviation (RPD). For the total set, predictions were reliable for total N, organic C and C/N ratio ($0.7 = R^2 = 0.9$, $1.75 = \text{RPD} = 3$), and less reliable for NH₄, NO₃, and soil N supply ($R^2 < 0.7$, $\text{RPD} < 1.75$). Prediction accuracy for all parameters, except NO₃, increased with soil homogeneity (i.e. from total to texture subsets). Soil N supply was reliably predicted ($\text{RPD} > 2.00$) for the texture subsets. This study demonstrated the possibility of developing reliable NIRS predictive models for soil N supply in soils of similar texture. In conclusion, NIRS can be a useful tool in fertilizer N recommendations and has the potential to replace standard methods of soil analysis.



S04.01-P -26

PROXIMAL SOIL MEASUREMENT WITH VISNIR SPECTROMETER DIRECTLY DURING CEREAL COMBINE HARVEST

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Observed development of proximal techniques allow to find more and more applications of proximal sensing at different levels of food production and processing. One of them is the proposed use of proximal sensing systems in selective cereal harvesting. In this systems grain flow is separated based on its measurements in grain channel. Harvesters with grain sensors are commercially operated already but automation of separation process is still under development. One of the proposals for increase the reliability of a separating unit control algorithm is to add additional information about the soil environment. Technique which can be used here is the proximal soil probes with spectrometric measurement systems. The concept of the cereal harvester soil sensing unit, the calibration methods and examples of field probe measurements obtained during combine harvest are included. Soil and agronomic factors affecting the soil probe working quality during harvest in 2011 year are also presented.



S04.01-P -27

QUANTIFYING CARBON IN CHARCOAL-AFFECTED SOILS AT MOUND KILN SITES: FROM ANALYTICAL RESULTS TO A LARGER APPROACH BY REMOTE SENSING

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It is now largely accepted that biochar has the potential for increasing soil's carbon pool with several environmental benefits such as mitigating the GHG emissions and increasing soil fertility. As biochar is likely to be introduced into the soil in large quantities in several regions of the world in the future, there is a clear interest in building new tools in order to quantify charcoal in the soil by faster and less expensive ways than conventional sampling methods. In Wallonia (Belgium), mound kiln sites are circular or elliptic dark spots that can be seen on bare soil of ancient forested areas. Soil black color is due to charcoal enrichment from ancient wood charring activity by the mound kiln method. In this survey, we focus on carbon content at mound kiln sites in a cultivated area located near Gembloux, in the loessic silt belt of central Belgium. First we studied the evolution of carbon concentration in the plowing layer along perpendicular transects across two mound kiln sites and we estimated total carbon surplus by numerical integration. Then we established the relationship between carbon concentration and soil response in the visible and NIR spectra using aerial photographs. Based on this result we defined a relative carbon index exploiting the luminance attenuation induced by charcoal in the red wavelength in order to calculate carbon surplus at mound kiln site from VIS-NIR luminance. The impact of surface humidity is discussed as a limit for model calibration.



S04.01-P -28

SEASONAL MONITORING OF SOIL SALINITY BY ELECTROMAGNETIC CONDUCTIVITY IN IRRIGATED SANDY SOILS FROM A SAHARAN OASIS

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Salinization is a major threat to food production and soil quality in irrigated agricultural systems developed in arid conditions, namely in oasis ecosystems. Poor irrigation water quality and deficient water management at field and ecosystem scales appear to be the most important factors of this progressive degradation. It is therefore necessary to develop an efficient soil salinity monitoring approach which enables to adjust irrigation strategies over time. The aim of this study was to test the ability of electromagnetic conductivity surveys to describe changes of salinity in space and time in the context of sandy soils of an irrigated palm grove in the Ouargla oasis (Algeria). Four field campaigns have been conducted at different seasons between 2009 and 2010 using an EM38 electromagnetic conductivity device completed by calibration and validation datasets using classical soil salinity assessment tests. Models of salinity prediction at different depths have been constructed using classification trees and different sets of explaining factors, using more or less site specific descriptors, have been compared to evaluate the genericness of the prediction models. Results demonstrate the ability of the monitoring procedure to detect salinity seasonal evolution within the soil profile. Comparison with piezometric data and local irrigation practices suggest that the fluctuations of the water table at oasis scale are the main controlling factor of soil salinity evolution. Electromagnetic conductivity surveys coupled with tree regression prediction appear therefore as an efficient and convenient soil salinity monitoring approach and are useful to infer the underlying processes.



S04.01-P -29

SOIL DIGITAL MAPPING WITH REDUCED SOIL SAMPLES UNDER AGRO-SILVO-PASTORAL SYSTEMS

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Soil depth (SD), clay content (SCC) and soil organic carbon (SOC) determine land use systems response but are quite expensive to be mapped in high definition. This study uses proximal sensing, tree canopy influence and cokriging to explore soil sampling reduction in soil digital mapping for low income land use systems. It applies to 5.34 ha of “montado” in central-south of Portugal with rolling morphology and mostly Regosols, Cambisols and Leptosols. Soil probing followed stratified random sampling of areas outside (OC) and under tree canopy (UC), giving 70, 79 and 64 points for SD, SCC(0-50 cm) and SOC(0-30 cm). Soil was surveyed with Dualem1 for ECa. Correlation between ECa, SD, SCC and SOC were 0.687, 0.586 and 0.448. SOC averages differ significantly for UC and OC (83 Mg/ha and 41 Mg/ha). Cokriging with ECa as auxiliary variable was performed for subsamples (N=32, 16, 8 and 4) and results were validated with complementary subsamples (N=32). Completely random and stratified subsampling were applied (slope position and tree canopy influence for SOC). Averaging seven replicas, CK reduced RRMSE (Root Mean Square Error/mean) by less than 0.05 relatively to OK. However, CK allows just a limited increase in RRMSE (<0.05) for SD and SOC when soil subsamples are reduced to N=8, if SD is stratified by slope position and SOC predicted by stratified CK (UC and OC). The same limited increase in RRMSE applies to CK of SCC with soil subsamples as small as N=4 if subsamples are stratified by slope position.



S04.01-P -30

SOIL SPECTRAL LIBRARY APPROACH TO EVALUATE THE POTENTIALS OF SOIL ORGANIC CARBON STORAGE DUE TO SUSTAINABLE LAND MANAGEMENT IN THE HIGHLANDS OF ETHIOPIA

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Rapid and inexpensive technologies like soil spectroscopic are important for Ethiopia to achieve break through against poverty and environmental degradations. Soil spectroscopy was studied for diversified soil types, ecologies and landscapes to predict soil organic carbon. Soil samples were acquired from National Soil Laboratory of Ethiopia and through intensive field sampling. A total of 1884 samples were analyzed chemically and spectrally. Data were compressed by selecting at 10 nm intervals through 390 to 2420nm. Outlier and relation of samples were evaluated using Principal Component Analysis while models were developed by Partial Least Square Regression with Unscrambler X 10.1. For each watershed 20% of the samples were selected and set aside for prediction while calibration and validation models were developed with the remaining 80%. Depending on the number of samples per watershed, cross validation or test set validation was used. The stability of models was evaluated by coefficient of determination (R^2), error (calibration and validation) and ratio performance deviation (RPD). The R^2 (%), RMSEP(%), RPD and correlation(%) between predicted and measured values respectively were: at Anjeni(87.81, 0.441, 3.05, 71.96), Bale(86.18, 0.519, 2.69, 84.69), Basketo(88.55, 0.567, 2.9673.27,), Benishangul(91.28, 0.295 ,3.39, 96.23), Kersa(82.44, 0.439, 2.39,75.85), Kolatembien (75.05, 0.439, 1.92,74.5), Maybar(83.71, 0.571, 2.48, 90.83), Megech (84.89, 0.149, 2.57, 76.98) and Wondogenet(85.72, 0.521, 2.65, 88.88) watersheds. The performance of soil spectroscopy was successful and in a range of very good to excellent for most sites. Keywords: Ethiopian highland, Partial Least Square Regression (PLSR), Soil Organic Carbon, Sustainable Land Management, Visible-Near infrared spectroscopy



S04.01-P -31

SPATIAL STOCHASTIC MODELING OF TOPSOIL ORGANIC CARBON CONTENT OVER A CULTIVATED PERI-URBAN REGION, USING SOIL PROPERTIES, SOIL TYPES AND A DIGITAL ELEVATION MODEL

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Though many cultivated soils in peri-urban areas are threatened by urbanization pressure, peri-urban agriculture is likely to develop through recycling urban organic waste compost on these soils. Monitoring the effects of applying organic amendments requires that topsoil organic carbon (SOC) content be spatially assessed. Within the framework of the French Gessol3 Scientific Call (Prostock project), this study aims at estimating SOC contents using point sampling data over the peri-urban surroundings of Versailles (France), covering a large periurban area (221 km²) characterized by cereal cropping systems and contrasting soil types. It also aims at spatially quantifying prediction error uncertainties, in order to compare them with those obtained through remote sensing estimation methods (Vaudour et al., symposium 04.01). Our data consist of common quantitative soil variables (physical and chemical properties, granulometry) and soil types at 141 point sites, and a digital elevation model. The various estimation methods must deal with many missing data. Specific pedological knowledge was used to correct and model some variables. Our estimation methods were the following: regression kriging, kriging and cokriging with external drifts, and bayesian spatial estimation. For each method, emphasis was put on assessing statistical estimation uncertainties. Results were cross-checked accordingly to the current year soil samples in the study area. The estimation results and uncertainties are discussed regarding to the variables included into the models, and compared with other works about cultivated regions of equivalent area. Predictions with the best models and variable sets result in validation errors in a similar range to those obtained with satellite-based models.



S04.01-P -32

SPATIAL VARIABILITY ANALYSIS OF SOIL PHYSICAL AND CHEMICAL PROPERTIES IN AN EXPERIMENT FIELD IN SISTAN PLAIN, SOUTHEAST OF IRAN

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Knowledge of inherent spatial variability of soil physical and chemical properties is needed for a precise site-specific management. Geostatistical interpolation methods have gained a lot of attention in recent years as they are able to estimate soil physical and chemical properties at unknown locations with considering the spatial correlation between measured values. The primary aim of this study is to investigate the spatial variability of some soil physical and chemical properties including sand, silt, clay, lime, gypsum, EC, pH, Ca²⁺, Mg²⁺, Na⁺, ESP and SAR over an 85 ha experiment agricultural field in Sistan plain, southeast of Iran. The spatial distribution pattern of soil attributes are then predicted using kriging approach. Soil samples were collected from two depths (0–15 and 15–30cm) at 123 sites. Spatial correlation of soil properties were investigated through semivariogram analysis. The results showed that among soil properties considered, the percentage of lime has almost no correlation in space while others show a degree of spatial correlation. The spatial structure of soil properties follows either a spherical or an exponential model. The results also indicated that spatial continuity generally increases with depth.



S04.01-P -33

SPECTRAL ESTIMATION OF SOIL PROPERTIES IN SIBERIAN TUNDRA SOILS AND RELATIONS WITH PLANT SPECIES COMPOSITION

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Predicted global warming will be highest in the Arctic and will severely affect permafrost environments. Due to its large spatial extent and large stocks of soil organic carbon, changes to carbon fluxes in the Arctic will have significant impact on the global carbon cycle. Present soil properties are an important factor for potential medium-term vegetation development. Because of the difficult access to the Arctic area and the high costs for chemical analysis of soil samples, we investigated the possibilities to use field spectroscopy for fast assessment of the major soil properties. During a summer 2008 field campaign, soil samples at different levels within the soil core, including frozen parts, were collected. Furthermore, vegetation species and cover descriptions were made. First, soil properties as derived from a subset of the samples in the laboratory were related to the spectral reflectance properties using partial least squares regression (PLSR), spectral indices and stepwise multiple linear regression (SMLR). PLSR yields reliable soil model calibrations for C and K, while moderately accurate models could be constructed for pH and N. SMLR using wavelengths known from vegetation studies having a proven physical relation with C or N, yields high calibration accuracies for Total C ($R^2_{lab} = 0.96$, $R^2_{field} = 0.813$) and Total N ($R^2_{lab} = 0.805$, $R^2_{field} = 0.58$). and outperforms the results achieved by PLSR by far. Using these fits soil properties are estimated for a large dataset, that was used to analyze the relation between soil properties and plant species composition.



S04.01-P -34

TERRAIN ATTRIBUTE BASED MAPPING FOR A SOIL-LANDSCAPE DETAILED ALBANIA SOIL MAP

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Currently Albania has a national soil database at 1:250,000 scale and more detailed soil database for the coastal areas only at scale 1:50,000. Inceptisols and Alfisols cover approximately 50% of the area followed by Mollisols and Entisols with about 15%. The terrain in Albania is complex and steep making it ideal for mapping soils based on terrain attributes derived from elevation data. There is need for more detailed soil maps for resource management. The objective of this research was to produce a detailed soil map at scales 1:24,000-1:50,000 based on landscape models using terrain attributes and landform classification schemes derived from ASTER 30m elevation data. Initially, geologic parent material maps and climate were used to divide the country in similar regions. Terrain attributes were used to further divide each region in similar landforms that were further classified into landform components that typically are associated with specific soils. This classification provided the first raster based map that could be used for field planning of soil survey and validation.



S04.01-P -35

TESTING OF DIFFERENT METHODS OF SOIL VIS-NIR SPECTRA PROCESSING FOR PREDICTION OF AVAILABLE NUTRIENTS CONTENT

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Visible and near-infrared (VIS-NIR) diffuse reflectance spectroscopy is a progressive emerging method used for prediction of soil properties. It is a relatively accurate and less expensive alternative compared to the traditional soil survey. This study analyzed the relationship between soil reflectance properties and the content of available nutrients (Ca, K Mg, P) in soils. Two sample sets were used. First set consisted of 62 soil samples collected from 5 agricultural plots managed by the company Agropodnik Hradec Králové in Eastern Bohemia. Second set of 105 samples was collected in central Bohemia on a field managed by the farm of the Czech University of Life Sciences Prague. Available nutrient contents were determined by Mehlich 3 extraction. Moreover, soil pH and soil organic carbon were also determined in the samples. Laboratory soil reflectance spectra in the range of 350 to 2 500 nanometres were measured in the laboratory on dry solid soil samples with spectrometer FieldSpec® 3. For the description of the relationship between spectra and soil properties, step-wise multiple regression, principal component regression (PCR), partial least squares regression (PLSR), regression trees, and artificial neural networks (ANN) were used. The results showed that the success of prediction of soil properties depended largely on the statistical method used. In most cases, the PLSR method performed pretty well. The best prediction was obtained for available K. The relationship between soil spectral features and soil nutrients differed in different regions, that is in different soil conditions.



S04.01-P -36

**THE COMPARISION OF CONVENTIONAL METHOD AND LCC TOOL FOR N MANAGEMENT
IN RICE**

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Fertilizer N is one of the major inputs in rice production. Since the plant growth reflects the total N supply from all sources, plant N status will be a good indicator of N availability to crops at any given time. Leaf colour chart (LCC) is simple portable diagnostic tool, to determine the timing of N top dressing. Field experiments were carried out to compare the effect of N split application and LCC, on the grain yield of Fajr variety. The experiments were conducted in 2009 in Rice Research Inistitute - Amol. Result showed that grain yield of LCC treatments were higher than split treatments. The highest grain yield was in LCC5 treatment that showed 76.6% increase relative to zero-N control . In split treatments, yield increase was observed up to 90 kgN/ha.



S04.01-P -37

THE SOIL AND WATER MONITORING NETWORK OF GEOLOGICAL SURVEY OF FINLAND

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The Geological Survey of Finland has a network of automatic soil and groundwater monitoring stations since 2001. At present this network includes 5 water and 24 soil stations. 22 of the stations are connected to office server via GSM-modem. Added to this 18 stations have been closed. These stations represent different soil types, from clays to tills and gravels, and climate conditions, from south 59°51' to north 69°30' and elevations from 4 m to 464 m a.s.l., in Finland. The soil stations are instrumented for observations of soil temperature, volumetric water content and electrical conductivity at several levels from soil surface down to one meter, exceptionally three meters. The water stations monitor water level, temperature, electrical conductivity and optionally pH, redox potential and dissolved oxygen. The aims of these monitoring stations are to investigate the water movement processes, the role of soil types, organic matter and frost as well as predict and model the influence of climate change. So far we have noticed that snowmelt water is able to percolate through partially frozen soil. Soil macro-pores outweigh the impact of soil type on soil water infiltration, yet the soil type has an effect on the water holding capacity. Winter soil temperature does not depend on (the air) temperature sum but is governed by the thickness of snowpack. The soil water content has strong time stability, i.e. the pattern of spatial variability does not change with time.



S04.01-P -38

TOPSOIL ORGANIC CARBON PREDICTION USING VIS-NIR-SWIR REFLECTANCE SPECTRA AT LAB, FIELD AND SATELLITE LEVELS OVER A PERIURBAN REGION

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Within the framework of the French Gessol3 Programme (Prostock project), this study aims at comparing various observation scales for predicting topsoil organic carbon (SOC) content using Vis-NIR-SWIR reflectance spectra successively collected at the lab, in bare agricultural fields or extracted from atmospherically corrected multispectral SPOT images of very high (2.5 m) and medium low (20 m) spatial resolutions. The spatial coverage is that of a large periurban area (221 km²) characterized by cereal cropping systems and contrasting soil types. Considering either regional (entire periurban area) or local (a 6 ha-experimental field) scales, a series of 500-1000 bootstrapped datasets of calibration/validation samples were generated amongst a total of 165 sampled sites and used to predict SOC contents. At the regional scale, Partial Least Squares Regression (PLSR) lab and field-based SOC models resulted in median validation Root Mean Square Errors (RMSE) values of ~3 g.kg⁻¹ and ~4 g.kg⁻¹ respectively (=0.95 g.kg⁻¹ locally for lab-based models), while multiple linear (ML) image-based SOC models resulted in median validation RMSE values between ~4-6.6 g.kg⁻¹. Using an additional independent set of pixels with bare soils, ML models applied to the SPOT images were 'post-validated' resulting in validation RMSE values of ~4-5 g.kg⁻¹ at the regional scale and ~3 g.kg⁻¹ locally. Image-based models thus resulted in acceptable validation errors, in possible agreement with the need to spatially monitor SOC contents of regional territories. However, having higher validation bias and error uncertainty than lab or field-based models, they should be considered with caution.



S04.01-P -39

X-RAY FLUORESCENCE SENSING OF SOIL PHOSPHORUS FOR PRECISION MANAGEMENT AND ENHANCED NUTRIENT USE EFFICIENCY.

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The knowledge and ability to respond timely to actual field distribution and in-season fluctuations in available phosphorus (P) and other essential nutrients during a growing season are essential to enhancing efficacy of the inputs. Soil nutrient sensors that are based on molecular or atomic properties of the soil or plant matrices upon interacting with electromagnetic radiation are scarce, although spectroscopic methods can be element-specific, quick, and non-destructive. We investigated the feasibility and operational conditions for X-ray fluorescence spectroscopy (XRFS) in the sensing of soil P and other low atomic number ($Z < 20$) elements. Low-Z elements included mineral nutrients such as K, S, Cl, Ca, and Al. Energy-dispersive XRFS simultaneously yielded the spatial distribution of the nutrients in a field site based on a geo-referenced grid. Distinct clusters of extractable P fractions appeared to be associated with variations introduced during manure applications, variations in soil type and topographic positions. Significant correlation between ligand-exchangeable inorganic P_i or the all-inclusive bioactive P and soil elemental P determined by XRFS (XRFS-P), coupled with the high throughput of XRFS increased measurement density and supported management of extractable P as a regionalized variable. Site-specific knowledge of P status obtained with such a sensor and a priori calibration of available P to XRFS-P can result in up-to-date knowledge of nutrient status. The precision management approach help mitigate adverse effects of changing weather conditions on crop nutrient use efficiency, while minimizing negative impacts of nutrient management practices on environmental quality.



S04.02-P - REMOTE SENSING TECHNIQUES FOR SOIL CHARACTERIZATION AND MONITORING

Friday 06 July 2012 from 17:00 to 18:30. Room Poster Areas

S04.02-P -1

ANALYSIS OF THE REPRESENTATIVENESS OF LAND USE IN FRANCE BY THE FRENCH SOIL MONITORING NETWORK

Line Boulonne, Orleans - France

S04.02-P -2

EFFECTIVENESS OF SOIL AND WATER CONSERVATION IN THE USAMBARA MOUNTAINS, TANZANIA

Geert Sterk, Utrecht - Netherlands

S04.02-P -3

GENERATING LAND COVER/USE TIME SERIES FROM ARCHIVE SATELLITE DATA FOR LAND DEGRADATION ASSESSMENTS: A PROCEDURE BASED ON IMAGE SEGMENTATION AND HYBRID CLASSIFIERS

Tomaso Ceccarelli, Rome - Italy

S04.02-P -4

GIS-BASED LANDSLIDE SUSCEPTIBILITY MAPPING USING ANALYTICAL HIERARCHY PROCESS AND FREQUENCY RATIO IN ZIARAT (IRAN)

Hirad Abghari, Urmia - Iran, Islamic Republic of

S04.02-P -5

IDENTIFICATION OF EROSION PROCESSES DYNAMICS USING THE EROSION RESPONSE UNITS (ERU'S) CONCEPT RELETED TO THE SEDIMENT TRASPORT IN A LIGURIAN RIVER BASIN.

Claudia Scopesi, Genova - Italy

S04.02-P -6

INPUT OF ATMOSPHERIC DUST AND SOLUBLE ELEMENTS INTO A SAND DUNE ECOSYSTEM IN THE NEGEV, ISRAEL AND ITS CONTRIBUTION TO THE NUTRIENT STATUS OF DESERT BIOLOGICAL SOIL CRUST

Vincent Felde, Giessen - Germany



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RELATION BETWEEN SOIL SALINITY AND AGRICULTURE AROUND THE NATURAL PARK OF "EL HONDO DE ELCHE Y CREVILLENTE" (ALICANTE, SPAIN)

Jose Navarro-Pedreño, Elche - Spain

S04.02-P -8

A MULTITEMPORAL EXTENSION OF TS-VI METHOD FOR THE EVALUATION OF SURFACE SOIL MOISTURE OVER HETEROGENEOUS LARGE AREAS

Katia Fontanelli, Sesto Fiorentino (FI) - Italy

S04.02-P -9

A NOVEL APPROACH FOR SOIL MAPPING OF WRB UNITS

Endre Dobos, Miskolc - Hungary

S04.02-P -10

AN EXPEDITIOUS RISK ANALYSIS OF INTENSE RAINFALL EVENTS IN LOW MOUNTAIN RANGES OF CENTRAL GERMAN UPLANDS UNDER THE ASPECT OF A SUSTAINABLE AND DECENTRALISED FLOOD RETENTION

David Bertermann, Erlangen~Nuremberg - Germany

S04.02-P -11

DEVELOPMENT OF ENVIRONMENTAL INDICATORS FOR ESTIMATING VULNERABILITY TO LAND DEGRADATION

Vito Imbrenda, Tito Scalo (PZ) - Italy

S04.02-P -12

*EVALUATION OF SURFACE SOIL MOISTURE FROM SATELLITE AND GROUND-BASED MEASUREMENTS**

Bogusław Usowicz, Lublin - Poland

S04.02-P -13

EXAMINATION OF THE RELATIONSHIPS BETWEEN SOIL FERTILITY INDICATORS ESTIMATED TO HUNGARIAN ARABLE LANDS AND VEGETATION INDICES MEASURED WITH REMOTE SENSING

Kocsis Mihály, Keszthely - Hungary

S04.02-P -14

FIELD MEASUREMENT OF SOIL CARBON FOR ACCOUNTING PURPOSES

Kanika Singh, Sydney - Australia



S04.02-P -15

INTEGRAL QUANTIFICATION OF SOIL WATER CONTENT AT THE INTERMEDIATE CATCHMENT SCALE BY GROUND ALBEDO NEUTRON SENSING (GANS)

Carlos Andres Rivera Villarreyes, Potsdam - Germany

S04.02-P -16

MAGNETIC RESONANCE IMAGING AND RELAXOMETRY AS TOOLS TO INVESTIGATE WATER DISTRIBUTION IN REPACKED SOILS

Paméla Faure, Champs-Sur-Marne - France

S04.02-P -17

MAPPING SPATIO-TEMPORAL RELATIONSHIPS BETWEEN SOIL PROPERTIES AND REMOTE SENSING-DERIVED INFORMATION FOR SCOTLAND.

Laura Poggio, Aberdeen - United Kingdom

S04.02-P -18

OPERATIONAL MONITORING OF SOIL MOISTURE FROM SPACE: AN OVERVIEW OF THE TU WIEN PRODUCT SUITE

Angelika Xaver, Vienna - Austria

S04.02-P -19

REMOTE SENSING APPLICATION IN EVALUATION OF SOIL CHARACTERISTICS IN DESERT AREAS

Seyed Kazem Alavipanah, Tehran - Iran, Islamic Republic of

S04.02-P -20

REMOTE SENSING OBSERVATIONS AND GEOELECTRICAL SURVEYS IN A CRITICAL COASTAL AREA AFFECTED BY SOIL SALINITY

Antonio Satriani, Tito Scalo (PZ) - Italy

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SOIL ORGANIC MATTER MONITORING ON LOCAL SCALE BY AIRBORNE IMAGING SPECTROSCOPY: A CASE STUDY ON APULIA LAND

Valeria Ancona, Bari - Italy

S04.02-P -22

SUB-SURFACE IMAGING USING ELECTRICAL IMPEDANCE TOMOGRAPHY: A MODELLING APPROACH FOR ELECTRICAL IMPEDANCE DATA INTERPRETATION

Robert Hayes, Manchester - United Kingdom



S04.02-P -23

THERMAL AND SOLAR-REFLECTIVE REMOTE SENSING METHODS FOR MAPPING SUSTAINABLE FARMING RELEVANT SURFACE SOIL PARAMETERS

Andreas Eisele, Potsdam - Germany

S04.02-P -24

THERMOMAP – AREA MAPPING OF SUPERFICIAL GEOTHERMIC RESOURCES BY SOIL AND GROUNDWATER DATA

David Bertermann, Erlangen-Nuremburg - Germany

S04.02-P -25

USE OF LANDSAT 7 IMAGE FOR THE DETERMINATION OF ABANDONED LAND IN BOSNIA AND HERZEGOVINA

Tihomir Predic, Banja Luka - Bosnia and Herzegovina

S04.02-P -26

USING RADIOMETRIC TEMPERATURE FOR SOIL AND VEGETATION ENERGY FLUXES ESTIMATION IN MEDITERRANEAN DRYLANDS

Francisco Domingo, Almeria - Spain

S04.02-P -27

USING SOIL LANDSCAPE RELATIONS AND REMOTELY SENSED INFORMATION FOR DIGITAL SOIL MAPPING IN SOUTHERN BASILICATA

Michael Maerker, Florence - Italy

S04.02-P -28

USING THE WORLDVIEW2 SATELLITE DATA TO MAP SEVERAL PROPERTIES OF POST-GLACIAL SOILS

Krzysztof Kusnierek, Poznan - Poland



S04.02-P -1

ANALYSIS OF THE REPRESENTATIVENESS OF LAND USE IN FRANCE BY THE FRENCH SOIL MONITORING NETWORK

Boulonne Line^[3], Elodie Voisin^[3], Céline Ratie^[3], Marine Gourrat^[3], Aurore Toiser^[4], Jolivet Claudy^[3], Dominique Arrouays^[3], Marion Bardy^[3]

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Soil monitoring networks are developed at European scale for soil protection and sustainable management objectives, according diverse sampling strategies. The French Soil Monitoring Network (RMQS) is based on a systematic 16 * 16 km grid, counting 2200 plots and covering various land uses (from arable land to natural land) and a range of soil types. To set up the network, a preliminary study established the aforementioned minimal density as required for a systematic grid-based network offering an adequate compromise for settlement costs and duration. The first sampling campaign was carried out from 2001 to 2009. In order to check the possibility to extrapolate the RMQS results at the national level, the present study investigates the representativeness of the land use distribution of monitoring sites with regards the whole French land cover. We have compared the regional and national distributions of land use for RMQS sites with land use provided by 1) Corine Land Cover database and 2) national agricultural statistics, including detailed and annual data concerning crops, grasslands and woodlands. On the whole, the study shows a good representativeness of the RMQS as regards land use. Local differences between these distributions are discussed.



S04.02-P -2

EFFECTIVENESS OF SOIL AND WATER CONSERVATION IN THE USAMBARA MOUNTAINS, TANZANIA

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The highlands in Tanzania are seriously affected by soil erosion. Considerable efforts have been undertaken to reduce the amount of erosion through soil and water conservation measures, but only minimal adoption of the promoted measures has been achieved. The aims of this study were to assess soil erosion risk in the Usambara Mountains of Tanzania, and to locate existing soil and water conservation measures from remote sensing. An erosion risk map of the entire district was created by using a Landsat ETM+ image and a digital elevation model. In two selected 10 x 10 km areas, land use maps were created from WorldView images using two standard pixel based methods and an object based, nearest neighbourhood method at two different scale levels. The pixel based methods that were used were a minimum distance to means and a maximum likelihood classification method. Existing bench terraces and grass strips were located by using object based image analysis and the land use map with the highest accuracy, which in this case was the map created with the maximum likelihood classification method. The percentage of agricultural area that contained soil and water conservation measures ranged from 2.9% to 19.75% for the two 10 x 10 km areas. The Universal Soil Loss Equation was used to quantify the erosion in the 10x10 km blocks. Areas containing soil and water conservation measures had an average soil loss of 39.8-52.0 t ha⁻¹ yr⁻¹. The effectiveness of the soil and water conservation measures was 42-58%.



S04.02-P -3

GENERATING LAND COVER/USE TIME SERIES FROM ARCHIVE SATELLITE DATA FOR LAND DEGRADATION ASSESSMENTS: A PROCEDURE BASED ON IMAGE SEGMENTATION AND HYBRID CLASSIFIERS

Ceccarelli Tomaso^{*[1]}, Rinaldo Simone^[1], De Angelis Antonella^[1], Bajocco Sofia^[1], Salvati Luca^[2], Perini Luigi^[1]

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Land cover and land use (LULC) are essential elements in the assessment of vulnerability to land degradation (LD). Land cover is an input in these assessments either because it has a direct effect on LD or because it is associated with unsustainable land uses. Trajectories of LULC occurred in the past can therefore provide key information for analysing degradation processes and generating scenarios for the future. However, LULC data sets (from satellite imagery, aerial photographs and thematic cartography) are few and often not comparable in terms of time series, spatial resolution, and thematic content. Since 2008 the USGS Landsat archives (TM and ETM+), provides free access to multi-spectral data going back to the mid-eighties with a spatial resolution which is suitable for analysing land degradation processes. A procedure for generating coherent land cover/use time series from archive satellite data for land degradation assessments is described in the poster, based on image segmentation and hybrid classifiers. It consists of a pre-processing of satellite data, an initial segmentation and classification of a reference image based on an integrated, object oriented classification, the down-dating (or up-dating) of the above classification by a further segmentation and the final change detection of LULC. It has been developed in the context of the research project AGROSCENARI (Scenarios of agriculture adaptation to climate change), promoted by the Italian Ministry of Agriculture. Results as well as open research questions are discussed.



S04.02-P -4

GIS-BASED LANDSLIDE SUSCEPTIBILITY MAPPING USING ANALYTICAL HIERARCHY PROCESS AND FREQUENCY RATIO IN ZIARAT (IRAN)

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Abstract: Study and provide a Landslide susceptibility mapping is important basis for reducing their damages. In this study, landslide susceptibility map of Ziarat watershed was prepared using the frequency ratio (FR) and Analytical Hierarchy Process (AHP) methods with the help of Geographical Information Systems (GIS). To confirm the practicality of the tow susceptibility maps were compared with a landslide activity map containing 46 active landslide zones. For this purpose, at first the important factors in landslaid hazard zoning of the ziarat watershed were studied, and the, landslide inventory, lithology, slope angle, slope aspect, land use, distance to river, distance to road and distance to the fault, elevation and rain were used to create the susceptibility maps. Then their maps and landslides distribution with using GIS and GPS were improved and classified. In the end, the study area was classified into five types of relative landslide susceptibility: high-hazard, very high, moderate hazard, very low and low regions. The obtained results in this study also showed that the land cover, Lithology, and Linear data layers were found to be important factors in the study area. AHP method gave more realistic maps of the actual distribution of landslide susceptibility, than the frequency ratio (FR). **Keywords:** Landslide, Frequency ratio, Analytical hierarchy process, GIS, Ziarat watershed.



S04.02-P -5

IDENTIFICATION OF EROSION PROCESSES DYNAMICS USING THE EROSION RESPONSE UNITS (ERU'S) CONCEPT RELETED TO THE SEDIMENT TRASPORT IN A LIGURIAN RIVER BASIN.

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Water management is an important issue in Mediterranean areas such as along the Ligurian coast. With respect to the management of sediment transport of rivers, the understanding of the dynamics of integrated soil erosion processes in a river basin is of crucial importance. This study regards the delineation of response units and the quantification of sediment transport in the Teiro river catchment (Liguria, Italy). The study was carried out with particular attention on the identification of sediment source areas. For this purpose the concept of Erosion Response Units (ERUs) was adopted to identify areas affected by different types of erosion and mass wasting processes. A first quantification was carried out in a sub-catchment affected by forest fire. We collected relevant pedological and environmental information. Moreover, non invasive field methods like inductive geoelectric methods were applied to derive soil depth. Infiltration capacities were measured with a constant head permeameter. This data is utilized as input information for the quantitative erosion modelling based on ERU concept. Therefore we regionalized the soil relevant parameters using a stochastic gradient boosting approach, terrain analysis and remote sensing data. The models assessing rill-interrill erosion and shallow landsliding are implemented in a GIS and results are shown in a spatially distributed way. To assess rill-interrill erosion a Unit Stream Power approach was used whereas a infinite plane slope stability model accounts for shallow landslides. The analysis and the correlation of the results show the contribution of soil loss in the basin and the related sediment transport.



S04.02-P -6

INPUT OF ATMOSPHERIC DUST AND SOLUBLE ELEMENTS INTO A SAND DUNE ECOSYSTEM IN THE NEGEV, ISRAEL AND ITS CONTRIBUTION TO THE NUTRIENT STATUS OF DESERT BIOLOGICAL SOIL CRUST

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*The input of atmospheric dust is a great source of nutrients in arid environments. In the NW Negev desert in Israel, formerly mobile sand dunes are stabilized by biological soil crusts. These crusts strongly influence matter fluxes and cause or enhance redistribution of deposited material in the ecosystem. On the other hand, the stability of the intact biological soil crust, as well as the recovery of disturbed crust is connected to element fluxes such as the input of fines, soluble salts and carbonates, which derive from wet and dry deposition. Aim of the recent study is to quantify the input of dust and soluble elements. In the period from March 2011 until October 2013, along a transect with four stations from Nizzana (50 km from the Mediterranean) to the Gaza Strip, atmospheric deposition is sampled with funnel-bottle-type samplers, placed in interdunal valleys below different shrub species (*Retama raetam* and *Anabasis articulata*) as well as in the interspace. Sampling in the field takes place monthly and in Gaza and Nizzana also immediately after single rain events, to investigate the composition of rainwater in the area. Parameters measured are Na⁺, K⁺, NH₄⁺, Ca²⁺, Mg²⁺, Cl⁻, NO₃⁻, SO₄²⁻ and dust deposition. First results indicate that the input of dust, as well as the elemental composition systematically varies with shrub cover and the amount of annual rainfall. It is therefore very likely that the stability and recovery rate of the soil crust also differs along the gradient.*



S04.02-P -7

RELATION BETWEEN SOIL SALINITY AND AGRICULTURE AROUND THE NATURAL PARK OF "EL HONDO DE ELCHE Y CREVILLENTE" (ALICANTE, SPAIN)

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Salinity is one of the major problems affecting soils in the world. There are several strategies to avoid the soil affections. One of them is to select adequate plants for agriculture resistant to salt affected soils. In this study, we have analyzed a wide area (about 80 square kilometers) around the natural park of "el Hondo de Elche-Crevillente", in the south of the province of Alicante (Spain). Remote sensing techniques and soil laboratory analysis were used to study the salinity of the soils and its relation with the distribution and the kind of plants cultivated. The natural park of "El Hondo" comprised two large reservoirs (Levante and Poniente) and many several ponds and small lagoons around them. The main use of the soil in this area is agriculture and many drainage infrastructures (most of them constructed in the early 18th century) transformed the old marshes into irrigated agricultural land. The actual location of "El Hondo" wetland corresponds to the most persistent wet areas of an old lagoon that were difficult to dry. The "El Hondo" Natural Park is included in the RAMSAR list of wetlands of global importance and in the NATURE-2000 network of the European Union. The results showed that plants cultivate around the natural park have been selected along years due to their resistant to soil salinity. A Soil salinity gradient was determined from the reservoirs to the external limit of the study area. This research is supported by the Ministerio de Ciencia e Innovación CGL2009-11194.



S04.02-P -8

A MULTITEMPORAL EXTENSION OF TS-VI METHOD FOR THE EVALUATION OF SURFACE SOIL MOISTURE OVER HETEROGENEOUS LARGE AREAS

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Soil moisture is a key state variable in many environmental processes, that controls the water and energy balance at the land surface-atmosphere interface. Soil moisture changes both spatially and temporally and cannot be easily evaluated at large scales. Recent advances in remote sensing have allowed soil moisture estimation over wide areas and monitoring continuously over time. Optical and thermal infrared remote sensing data, by virtue of their fine spatial resolution and their broad coverage, can be combined for estimation of surface soil moisture. The potential of obtaining information about soil moisture at the Earth surface through the relationship between remotely sensed surface temperature (Ts) and vegetation index (VI) has been long investigated by several authors and many variants have been proposed. In the present study a multitemporal approach of the well known Ts-VI method is proposed for the evaluation of the surface soil moisture over a large heterogeneous area in Central Italy. Long-term historical series of Landsat TM-ETM+ data have been processed in multitemporal sequence, according to surface homogeneity criteria in order to characterize the natural variability of the environment. Then Ts and VI data have been extracted and combined to analyze the spatial pattern and temporal evolution of surface soil moisture. The preliminary results of the multitemporal Ts-VI method proposed herein show a better agreement with rainfall data than the standard one.



S04.02-P -9

A NOVEL APPROACH FOR SOIL MAPPING OF WRB UNITS

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The traditional way of international dataset development is based on the harmonization/correlation of the different origin national datasets into a common language, called WRB. Only the semantic information is translated to the closest units of the WRB, the spatial domain - the polygon – is taken as it is without any modification and adjustment, which introduces significant error to the final dataset. Instead of translating the complex name of soil class names of the national soil datasets into a prefix- reference soil group-suffix name complex, the semantic content of the classification name is disaggregated into significant diagnostic horizons, features and materials representative for the area. Legacy data of different characteristics is used to develop a signature file having two categories, existence or non-existence of the certain diagnostic. This dataset is used later as training dataset for probability classification on a multitemporal MODIS and SRTM image. Several classifications to produce diagnostics and a simplified classification tree was set up to define the most probable reference soil group. The result of this approach is a multilayer image file having information on the likelihood of occurrence of all diagnostics and the most probable reference soil group for each pixels. Having this information a complete WRB name can be developed, while keeping all additional qualitative information represented by the diagnostic in the dataset as well.



S04.02-P -10

AN EXPEDITIOUS RISK ANALYSIS OF INTENSE RAINFALL EVENTS IN LOW MOUNTAIN RANGES OF CENTRAL GERMAN UPLANDS UNDER THE ASPECT OF A SUSTAINABLE AND DECENTRALISED FLOOD RETENTION

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Due to the increasing settlement pressure and pressure of utilisation on flood-threatened surfaces and due to the climate change an accumulation of flood events is to be expected. Against this background applicable strategies are required in practice to mitigate such events or to even prevent them. The key aim of the research activities is the development of a standardised and expeditious risk analysis of intense rainfall events in low mountain ranges of Central German Uplands under the aspect of sustainable and decentralised flood retention. According to the current state-of-the-art of flood models land use changes have no influence on the slow-flowing large flood events in widespread watersheds. On the contrary small swift-flowing floods in small watersheds can be influenced by land use or management changes. Thus, the focus of the research work is aimed on these small quick floods. However, also differentiated information for the solution of flood problems in large watersheds can be reached by the summation of statements about small watersheds. The development of a standardised planning method (incl. the GIS implementation) for the optimization of the drain regulation serves for the reduction of the flood danger. Land use and vegetation is so optimized in adaptation to soil and land management and by taking into account prevailing drain roads that an essential contribution to the regulation of the surface run-off can be performed. The aimed procedure has to use above all the combination of soil and vegetation data which are valued as relevant to allow a quick application.



S04.02-P -11

DEVELOPMENT OF ENVIRONMENTAL INDICATORS FOR ESTIMATING VULNERABILITY TO LAND DEGRADATION

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In recent years, land degradation is increasingly impacting in many parts of the world, including developed countries and vulnerability assessment is the main goal in a decision support system for halting/preventing degradation phenomena. In this study performed in Southern Italy we used the indicator- based ESAs (Environmentally Sensitive Areas) methodology, which combines information on soil, climate, vegetation and anthropic pressure to identify areas prone to degradation distinguishing different levels of vulnerability. Datasets from DISMED project were used to estimate the contribution of soil properties and climate conditions to the overall vulnerability. Census data were used to define land management indicators. Corine Land Cover 2000 and morphological features (DEM with 90m-resolution) were introduced to elaborate a new mechanization index able to provide a realistic picture of the investigated territory (coherence between areas of intensive agriculture and vulnerability levels). NDVI MODIS satellite time series (2000-2010) were adopted to evaluate trends in photosynthetic activity and to analyze vegetation phenological patterns (through landscape metrics indicators), improving the effectiveness of the implemented indicators in the early detection of ongoing degradation processes. On the whole, the use of satellite data facilitated the discrimination of the prevalent factors among the involved driving forces highlighting the major role of land management in generating vulnerability (about half of the investigated area), whose pattern generally follows the arrangement of the most vulnerable areas, largely belonging to intensive farming zones. This analysis can help in developing effective prevention/conservation measures adapted to each specific area.



S04.02-P -12

EVALUATION OF SURFACE SOIL MOISTURE FROM SATELLITE AND GROUND-BASED MEASUREMENTS*

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Soil moisture (SM) is one of the key variable ECVs (Environmental Climate Variable) which controls the water and energy exchanges at the soil-vegetation-atmosphere interface and affects climate on small and large temporal and spatial scales. The land surface is one of most important interfaces contributing in water movement to and from the atmosphere and determining the water cycling. The importance of SM is so high that this ECV is recommended by GCOS (Global Climate Observing System) to any attempts of evaluating effects the climate change, and therefore it is one of the goals for observing the Earth by the ESA SMOS Mission (Soil Moisture and Ocean Salinity), globally. SMOS provides its observations by means of the interferometric radiometry method (1.4 GHz) from the orbit. In parallel, ten ground based stations are kept by the Institute of Agrophysics in area of the Eastern Wall in Poland, in order to validate SMOS data and for other ground based agrophysical purposes. Operationally, the research programs on the ground are motivated by including complex relations between soil moisture and processes of the mass and energy transfer, helpful for validating SMOS data and useful for evaluating effects of the climate change on the environmental hydrological state conditions in terms of absolute physical measures. This paper will present a comparison and analysis of data obtained from ground-based and satellite measurements in Poland. *The work was financially supported in part by the ESA Programme for European Cooperating States, No.98084 „SWEX-R, Soil Water and Energy Exchange/Research”, AO3275.



S04.02-P -13

**EXAMINATION OF THE RELATIONSHIPS BETWEEN SOIL FERTILITY INDICATORS
ESTIMATED TO HUNGARIAN ARABLE LANDS AND VEGETATION INDICES MEASURED WITH
REMOTE SENSING**

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The aim of the research was to examine the relationships between the land quality indices calculated to soils and the remote-sensed vegetational indicators. These vegetational indicators how can be use to the estimation of the fertility of soils, how far supporting of the potential fertilities calculated to soils, application of these indicators in land quality in which degree can help the determination of the potential soil fertilities and, the indicators how can be correct the efficiency of estimations were examined. As fertility indicator the simplified D-e-Meter points were used, which were calculated to the smallest separable Hungarian arable-land soil typology units. D-e-Meter points to the tillaged areas were determined on the base of large scale (1:100.000) databases (AGROTOPO, National Pedological and Crop Production Database (NPCPD; in Hungary AIIR). The potential soil fertility data estimated to soil typology units were correlated with vegetational indicators measured with remote sensing. The correctness of the estimated fertilities and the relationships between calculated simplified D-e-Meter points and vegetational indicators were examined with different regression relations.



S04.02-P -14

FIELD MEASUREMENT OF SOIL CARBON FOR ACCOUNTING PURPOSES

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Soil carbon controls the magnitude of soil fertility, food security and is the main component of the future carbon trading scheme; thus making it a reasonably valuable commodity in the agriculture sector. Field measurement of soil carbon for accounting purposes needs analytical techniques that are accurate, fast, economical and less tedious. Infrared spectroscopy has been shown to be able to predict the organic and inorganic components of soil. This research work investigates the calibration of the Vis-NIR spectroscopy (visible - near infrared) instruments for rapid measurement of soil C in the field by building a calibration set for an agricultural area in NSW, Australia. To build the spatial soil carbon spectral library, a Conditional Latin hypercube sampling was conducted using four covariates i.e. topography, gamma radio metric data, landuse and the predicted soil carbon to encompass spatial soil carbon variability. This covered the three major bioregions of New South Wales, Australia, namely the south eastern highlands, south western slopes and Brigalow belt south (area of 158,000 km²). The scanning was done through the soil profile using two Vis-NIR spectroscopy instruments to get a set of Vis-NIR reflectance spectra under field conditions. Based on the correlations between the spectra and laboratory measured values, the predictions are used for calibration of the instruments and for validation of the regional scale digital soil carbon map.



S04.02-P -15

INTEGRAL QUANTIFICATION OF SOIL WATER CONTENT AT THE INTERMEDIATE CATCHMENT SCALE BY GROUND ALBEDO NEUTRON SENSING (GANS)

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Nowadays only few methods are on the way to close the gap of soil moisture measurements between point scale and remote sensing scale. One new measurement methodology for integral quantifications of soil moisture at this intermediate scale is the Ground Albedo Neutron Sensing (GANS). The potentiality of this non-invasive approach is the deeper measurement depth (few decimeters) compared to remote sensing instruments and large horizontal coverage (a footprint ca. 600 m diameter) compared to other field measurements (e.g. geophysics, TDR, FDR, etc.). The measurement volume is due to good correlation between ground albedo of natural neutrons at the air/ground interface and soil water content, and this is based on the crucial role of hydrogen as neutron moderator. This study evaluated applicability of GANS in three locations with different altitudes in Germany. The monitoring activities were conducted under different vegetative situations (cropped and bare field) and different seasonal conditions (summer, autumn and winter). Additionally, soil moisture classical devices (FDR) and meteorological data were used to test new approach. The results show that soil moisture measurements by means of ground albedo neutrons are reliable. Root mean square error between new approach and network of FDRs was only 0.03. New approach was unaffected by crop biomass and penetration depth was at least 40 cm in loamy sand. In this context, this methodology shows the potentiality to compensate the lack of information at the intermediate scale and a promising approach to validate remote sensing estimations.



S04.02-P -16

MAGNETIC RESONANCE IMAGING AND RELAXOMETRY AS TOOLS TO INVESTIGATE WATER DISTRIBUTION IN REPACKED SOILS

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Proton NMR methods allow to access to precious information for the soil scientist, like water content and its distribution in soil pores ranging from a few nm to mm, in spite of difficulties due to porous soil structure and to magnetic field inhomogeneities arising from the presence of various species (ions, paramagnetic like iron). Proton NMR apparatus permit to determine spatially resolved soil water content (imaging), or to estimate water distribution in soil microstructure as a function of pore size (relaxometry). These two properties are important to characterize a soil structure and to understand and model soil processes like water flow and colloidal particle transfer. We developed NMR methodologies that allow: 1- to obtain distributions of relaxation times associated to pore size repartition. 2- to measure water content profiles, distinguishing water contained into large pores from water contained into the whole porosity using two different imaging sequences. These methods were applied to about fifty samples of the same soil that was beforehand sieved down to aggregates of three different granulometry, then repacked at various apparent densities and equilibrated to various water contents. We found that relaxation time distributions presented essentially four peaks. The two shortest times were associated to intra-aggregate pores, and the two longest times were related to structural pores. We then compared water content profiles obtained with two imaging methods and showed how this comparison helped understanding water movements and water content variations between large and small pores.



S04.02-P -17

MAPPING SPATIO-TEMPORAL RELATIONSHIPS BETWEEN SOIL PROPERTIES AND REMOTE SENSING-DERIVED INFORMATION FOR SCOTLAND.

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Analysis and forecast of the spatial distribution and dynamics of soil properties is an important element of sustainable land management. Recent studies have noted that the most successful and promising approach to estimating soil properties continuously over time and space should include a combination of remote sensing and modelling. The aim of this paper was to investigate the spatial relationships between soil properties measured or observed at various soil profiles across Scotland and indices derived from remote sensing. The soil properties were measured or observed across the whole of Scotland following a regular grid at more than 1000 profiles. The data are derived from the Scottish Soil Survey Database. The remote sensing data were derived from Terra Moderate Resolution Imaging Spectroradiometer (MODIS) data. The indices considered were i) Enhanced vegetation Index, ii) Leaf Area Index, iii) Land Surface Temperature and iv) derived drought indices, such as the Normalised Difference Water Index, the Normalised Difference Drought Index and the Normalised Multi-band Drought Index. The preliminary results showed spatial and temporal patterns across Scotland, mainly following the morphological landscape, such as slope and river valleys and the soil types classification. The remote sensing data proved useful to predict various soil properties such as AWC and organic matter content. The remote sensing data are potentially very helpful for soil mapping in areas where soil data are not available. However a spatial calibration is often needed. The Scottish Soil Survey Database provides crucial data to validate remote sensing based soil mapping.



S04.02-P -18

OPERATIONAL MONITORING OF SOIL MOISTURE FROM SPACE: AN OVERVIEW OF THE TU WIEN PRODUCT SUITE

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Soil moisture plays an essential role within the hydrological cycle and affects all earth surface processes. Remote sensing was found to be a powerful instrument to observe soil characteristics and especially microwave remote sensing is recognized to be the most efficient tool for extracting meaningful soil moisture information. Various soil moisture products from active and passive microwave sensors are currently freely available. Among them are the products developed at Vienna University of Technology (TU Wien) of which an overview will be given in this presentation. The TU Wien products are based on the backscatter signal that is received by active microwave systems. Using a change detection approach an estimate of relative soil moisture information corrected by vegetation effects can be retrieved. The derived soil moisture data represents the relative content between totally dry conditions and maximum saturation in the surface soil layer. Independent from sun light and weather conditions a nearly daily coverage at a spatial resolution of 25 km is provided by the soil moisture product based on the Advanced Scatterometer (ASCAT). This operational global soil moisture service provides the basis for value-added products such as the Soil Water Index (SWI) which represents the profile soil moisture content. Soil moisture products at a spatial resolution of 1 km are the downscaled ASCAT surface soil moisture product over Europe and a research product based on the Advanced Synthetic Aperture Radar (ASAR). The products are being used to improve weather forecast skills, for flood and drought predictions, and for climate research.



S04.02-P -19

REMOTE SENSING APPLICATION IN EVALUATION OF SOIL CHARACTERISTICS IN DESERT AREAS

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Soil is one of the most important natural resources that cover much of the Earth's land surface. It supports plants that supply foods, fibers, drugs, and some other humans needs and because it filters water and recycles wastes. So, it is important to study this essential natural resource (especially in desert regions) and understand how it should be used and conserved properly. This paper investigate and review the remote sensing application in soil characteristics such as: mapping and diagnosis of color, mineral composition, soil salinity, drainage issues, potential and desert regions limitations using remote sensing. According to the result, remote sensing is an appropriate tool for studying soil and, but cognitive limitations help to the process of studies.



S04.02-P -20

REMOTE SENSING OBSERVATIONS AND GEOELECTRICAL SURVEYS IN A CRITICAL COASTAL AREA AFFECTED BY SOIL SALINITY

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Soil salinization heavily affects soil quality and productivity and is one of the most widespread soil degradation processes on the Earth. For monitoring soil salinization over large areas, we implemented an integrated approach based on remote sensing and geophysical techniques. In particular, multi-temporal remote sensing images (Landsat-TM/ETM, Spot, Corona) were analyzed to assess vegetation pattern evolution as indirect indicator of soil condition, and to evaluate shoreline changes jointly with field-GPS surveys and aerial laser scanner acquisitions. Critical areas identified at broad scale were investigated in situ by performing geoelectrical resistivity surveys with a multi-electrode acquisition system for characterizing soil salinity content and distribution. Such an integrated approach was adopted for monitoring the Ionian coast of Basilicata Region (Southern Italy) characterized by a narrow shore (10-30 m) of fine sandy formations. The integrated analysis of vegetation patch complexity variations, shoreline changes, and geophysical surveys highlighted that areas characterized by soil layers saturated by sea water limiting plant development are located along regression shorelines marked by fragmented patches, whereas the compacted patches are mainly present along progression areas where soil salinization is reduced. The obtained results suggest that the integration of remote sensing peculiarities (synoptic view, multi-temporal availability) as preliminary screening to minimize efforts and costs of field campaigns with those of geophysical techniques (local details, non-invasive soundings) can represent a suitable support tool for monitoring soil salinization processes along coastal areas and at the same time for identifying the most appropriated sites for restoration interventions.



S04.02-P -21

SOIL ORGANIC MATTER MONITORING ON LOCAL SCALE BY AIRBORNE IMAGING SPECTROSCOPY: A CASE STUDY ON APULIA LAND

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Soil organic carbon (SOC) plays an important rule in soil quality definition. Indeed, soil organic matter decline is one of the most relevant land degradation processes. Therefore, an innovative methodology able to monitoring this soil property, collecting data more rapidly and economically, is needed. In this regard, remote sensing technique can open new interesting scenarios of research. In particular, few studies have demonstrated the capability to accurately determine SOC contents from airborne-hyperspectral sensors (e.g. Ben-Dor et al., 2002; Selige et al., 2006; Stevens et al., 2006). The aim of this work is to experiment a remote sensing approach to monitor soil organic carbon on local scale, using airborne imaging spectroscopy. On detail, hyperspectral data have been acquired on an area of Apulia region, localized in Taranto province, by CASI and TABI airborne sensors. Soil samples have been collected on the survey area and investigated by laboratory analyses to determine organic content concentration, and also by portable radiometer to identify spectral signals of SOC. Preliminary results showed that an innovative new methodology, based on remote sensing technology, is efficient to monitor the SOC evolution continuously and with uniformity in topsoil on local scale. This methodology can also be a valid tool, which provides useful data for planning suitable agronomic practices in order to achieve a more sustainable management of soil resource.



S04.02-P -22

SUB-SURFACE IMAGING USING ELECTRICAL IMPEDANCE TOMOGRAPHY: A MODELLING APPROACH FOR ELECTRICAL IMPEDANCE DATA INTERPRETATION

Hayes Robert^[1], Newill Paul^[1], Podd Frank^[1], York Trevor^[1], Dorn Oliver^[3], Grieve Bruce^[1]

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In light of climatic change, rapid identification of new plant varieties that will thrive in future climates is increasingly important. The root system is critical to plant water uptake but this cannot easily be assessed without destroying the crop or disturbing the plant/soil matrix through extractive sampling. We are developing a new visualisation tool for seed breeders that will provide on-line data indicating how efficiently each plant in a screening programme utilises the water available in the surrounding soil. This will facilitate the early detection of desirable genetic traits. Visualisation of spatial water distribution takes the form of Electrical Impedance Tomography (EIT), a non-destructive and non-intrusive imaging technique. Measurements will allow water utilisation levels for each specimen to be inferred. An investigation into the relationship between soil moisture content and electrical properties has been carried out. A mixture model was implemented as a coupling mechanism between the Richards equation for describing fluid flow in an unsaturated soil and the electrostatics problem for predicting electric fields. This facilitates the estimation of electrical impedance measurement data for varying soil saturation levels. Experiments have shown that the finite element model (FEM) electrostatics simulation implemented in COMSOL Multiphysics exhibits an error of less than 9% and is able to predict capacitance measurements of soil at varying homogenous soil moisture levels within an average error of less than 6% based on the implementation of the mixture model. We present the inverse problem, discuss the inherent challenges and present the early experimental results.



S04.02-P -23

THERMAL AND SOLAR-REFLECTIVE REMOTE SENSING METHODS FOR MAPPING SUSTAINABLE FARMING RELEVANT SURFACE SOIL PARAMETERS

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Feeding humanity under the pressure of rapid population growth and global warming, attended by the depletion of fossil resources, the future of agriculture will depend on sustainable farming methods to avoid massive soil degradation. Thus, observation methods to quickly assess essential soil parameters are demanded to not lose sight of these upcoming ecological challenges. Soil spectroscopy within solar-reflective wavelengths (0.38-2.5 μ m) has already shown the potential of non-invasive methods to quantify soil parameters faster and much more economical than traditional laboratory soil analyses. Extending the spectral sensing range to thermal region (8.0–14 μ m) is experiencing growing acceptance, due to increasing surveying flexibilities and additional distinct spectral features. Attempts to apply spectroscopic experiences to airborne and space borne imaging spectroscopy, especially for the thermal region are rare, although such large scale observation methods would provide great support for an ecological or productive assessment of agricultural areas and more. In our research we are dealing with the possibilities of mapping organic and inorganic soil parameters using remote sensing techniques for the solar-reflective and the thermal wavelength regions. For this study soil samples were collected within an agricultural area in the WA-wheatbelt. The samples were spectrally measured in laboratory, both in the VNIR-SWIR and TIR wavelengths. Algorithms were created to derive soil parameters, such as texture and organic carbon content, based on models derived from the statistical relationship between the soil's spectral signatures and their physical and chemical constituents. The results show the ability of the method to derive these soil parameters from the soil's spectral signature.



S04.02-P -24

THERMOMAP – AREA MAPPING OF SUPERFICIAL GEOTHERMIC RESOURCES BY SOIL AND GROUNDWATER DATA

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The EU funded (ICT PSP) project ThermoMap aims to estimate very shallow geothermal potentials out of existing geoscientific datasets. 12 partners from industry and research in nine countries are involved in the project. ThermoMap will combine and analyse already existing data collections (pedological, climatological, topographical, geological, administrative and groundwater datasets) to calculate the geothermal potential in the first ten meters below surface on a large to medium scale. The project is divided into three phases: 1. Data collection 2. Setting up the model (processing, analysis and visualisation) 3. Testing. Variations of temperature and heat flow in depth up to 10m below earth surface are predominantly controlled by internal soil conditions like grain size, soil matter and mixture of soil substances. Especially the first three meters can be exploited in terms of geothermal power use with cost efficient, inexpensive methods with an amortization of the invested budget in a relatively short time period. The analysis of the geodata will be performed in a GIS-environment with standardised methods, valid for all participating EU countries. These methods will be intensely tested, verified and finally documented in a manual for geodata processing and analysis as future standards. The resulting geothermal potential as a georeferenced information value will be integrated into a WebGIS with a server side and a geo-visualisation, information front-end. The processing methods developed for the geoscientific datasets in different test areas across the partner countries and the analysis standards developed within the ThermoMap project may provide a significant value for energy saving.



S04.02-P -25

USE OF LANDSAT 7 IMAGE FOR THE DETERMINATION OF ABANDONED LAND IN BOSNIA AND HERZEGOVINA

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In a post war situation in BiH, one of the specific classes of LC/LU is abandoned agricultural/arable land . This class of land has been significant in some areas. This paper will show, on the basis of LANDSAT 7(15m) by using multispectral analysis, how the abandoned land have been determined within 10 municipalities in BIH. By having analysed them and field checks, the number of 12 LC/LU classes with abandoned land has been selected: 1. Abandoned land, 2. Abandoned/Arable 3. Arable/Abandoned, 4. Abandoned/Meadows; 5. Meadows/Abandoned; 6. Abandoned/Pastures, 7. Pastures/Abandoned; 8. Abandoned/Forest; 9. Abandoned/Shrubs; 10. Forest/Abandoned; 11. Abandoned/Forest. Depending on being within the fights during the war, and for how long some land was within the zone of fights, we got different results. For example, Tesanj municipality (continuously within the fights zone) 10,8 % land has been identified, and in Sipovo municipality (was not within the fights zone) 4,7 % of land LC/LU has been identified with predominant Abandoned land. In cooperation with municipal coordinators (trained for application of methodology in previous stages of the project) the reasons for not using abandoned land (displaced persons during the war, mine fields, abandone). Based on the results, the Municipal administration will make the plans for revitalisation of abandoned land and thus make priorities for demining areas.



S04.02-P -26

USING RADIOMETRIC TEMPERATURE FOR SOIL AND VEGETATION ENERGY FLUXES
ESTIMATION IN MEDITERRANEAN DRYLANDS

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In sparse vegetated drylands having reliable estimates of the partitioning of energy fluxes between soil and vegetation is crucial. Different thermal properties of soil and vegetation reflects this partitioning. Two source models have been applied to determine the partitioning of surface energy fluxes, heat flux (H) and latent heat (LE). Original two source model (TSM) formulation (Norman et al., 1995) relying on aggregated soil-vegetation surface temperature (TR), was evaluated in a semiarid Mediterranean grassland and compared with results using separate temperature measurements of soil (Ts) and vegetation (Tv). Eddy covariance data between January and June 2011 were used for validation. Model results showed a seasonal behaviour of the partitioning of H between soil (Hs) and vegetation (Hv). While during winter and spring $H_s \sim H_v$, from mid spring H_v increases reaching values twice of H_s . Total estimates of H were in the range of errors found in other semiarid areas using this approach (errors of 23% and $r^2 = 0.68$ for both) and similar results were found using TR and the original TSM formulation or measurements of Ts and Tv. However, total LE estimations using Ts and Tv measurements were significantly better ($r^2 = 0.48$ and errors of 48%) than using TR and the original TSM ($r^2 = 0.28$ and errors of 88%). General poor results for LE estimations are related with the low magnitude of this flux in the field site and the strong effect of H estimation errors over residual estimation of LE by surface energy balance.



S04.02-P -27

**USING SOIL LANDSCAPE RELATIONS AND REMOTELY SENSED INFORMATION FOR
DIGITAL SOIL MAPPING IN SOUTHERN BASILICATA**

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In the last decades Southern Basilicata underwent rapid changes in land use due to mechanization and the agro-economical/ -political situation. Moreover, long term fluctuations in climatic conditions and thus vegetation cover as well as human impact since prehistory influenced profoundly pedogenetic processes. In this study we present a digital soil mapping approach based on soil landscape relations as well as multispectral remote sensing analysis. We tested several methodologies to model and regionalize the soil characteristics such as mechanical statistics, classification and regression trees, random forest and stochastic gradient boosting. The models were trained in an area with an existing soil map that covers the main units of the Metapont marine terraces. The map was digitized and georeferenced and cross checked with own soil profile information. To validate the model an internal out of bag procedure was applied. The performance of all models is quite good however stochastic gradient boosting outperforms the other methods. Furthermore we show that including remotely sensed multispectral data the spatial differentiation between soil characteristics can be significantly enhanced especially in areas with different sediment substrates.



S04.02-P -28

USING THE WORLDVIEW2 SATELLITE DATA TO MAP SEVERAL PROPERTIES OF POST-GLACIAL SOILS

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The reflectance data derived from the WorldView2 satellite image, obtained on the 5th of May 2010 covering two 25 ha crop fields near Poznan, Poland was regressed with a number of soil properties using the Partial Least Squares regression, a multivariate regression method that allows robust modeling of multidimensional data by converting them into hidden variables. Eight spectral channels of the WorldView2 data build valid latent variables, among which one that minimized the validation error was chosen for a given soil property. The aim of this study was to assess to what extent is the WorldView2 data suitable to map physical and chemical properties of the surface horizons of post-glacial soils, such as Haplic Luvisols and Mollic Gleysols. The air-dried and sieved soil samples were also measured in the laboratory conditions using ASD FieldSpec3 Vis-NIR spectrometer to determine the optimal relationship between the analyzed soil properties with the reflectance data. To enhance the models, two signal pre-processing methods were tested, including the logarithmic linearization and the min-max normalization. The modeling results on both datasets improved substantially. For example, the RMSE of the SOC content (g kg⁻¹) measured by the ASD spectrometer and by the WorldView2 sensor respectively, improved from 3.3 and 4.5 to 3.1 and 3.6, when the soil reflectance was converted to absorbance, and to 2.9 and 3.1, when normalized by the min-max transformation. Yet, the spectral information brought by the satellite sensor is only a little less robust comparing to the laboratory spectroscopy in the same spectral range.



S04.03-P - SOIL MICRO-HETEROGENEITY: NOVEL MEASUREMENT TECHNIQUES, MODELLING AND MACROSCOPIC IMPACTS

Friday 06 July 2012 from 17:00 to 18:30. Room Poster Areas

S04.03-P -1

APPLYING X-RAY MICROTOMOGRAPHY AND FLUORESCENT LABELS TO TRACE NANOPARTICLE TRANSPORT AND FATE WITHIN MICROHETEROGENEOUS SOILS AND AGGREGATES

Jonathan Bridge, Sheffield - United Kingdom

S04.03-P -2

ASSUMPTIONS FOR A POLISH STANDARD OF THE PSD DETERMINATION OF SOILS WITH THE LASER DIFFRACTION METHOD

Andrzej Bieganski, Lublin - Poland

S04.03-P -3

EVALUATION OF SOIL GRANULOMETRY INFLUENCE ON CARBON AND HUMIFICATION DEGREE OF ORGANIC MATTER DETERMINATION

Edilene Cristina Ferreira, São Carlos - Brazil

S04.03-P -4

HIGH-RESOLUTION μ -CT AND NANO-CT FOR 3D ANALYSIS OF SOILS AND MINERALS

Gerhard Zacher, Wunstorf - Germany

S04.03-P -5

PHOTONIC TECHNIQUES FOR MEASURING SOIL ATTRIBUTES AIMING LOW CARBON AGRICULTURE

Debora Marcondes Bastos Pereira Milori, Sao Carlos - Brazil

S04.03-P -6

PROFILING TRACERS IN SOILS USING X-RAY COMPUTED TOMOGRAPHY

Kathryn Grayling, Nottingham - United Kingdom

S04.03-P -7

SEQUENTIAL MODELING OF SANDY/UNSTRUCTURED SOIL MICROSTRUCTURE

Roman Vasiliev, Vladimir - Russian Federation



S04.03-P -8

SOIL "PORE SPECTRUM" BY 3D MATHEMATICAL MORPHOLOGY: COMPARISON OF THREE DIFFERENT PROCEDURES.

Marcella Matrecano, Ercolano - Italy



S04.03-P -1

APPLYING X-RAY MICROTOMOGRAPHY AND FLUORESCENT LABELS TO TRACE NANOPARTICLE TRANSPORT AND FATE WITHIN MICROHETEROGENEOUS SOILS AND AGGREGATES

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Colloidal particles, including microbes, anthropogenic nanoparticles and a range of natural materials, constitute the basic structural unit of soil. Colloid mobility in soils therefore impacts on maintenance of soil structure, water retention characteristics, microbial ecology, nutrient dynamics, function as protective barriers for surface and ground waters, and other ecosystem services. However, while colloid transport and retention characteristics are easily quantified in laboratory systems (usually cleaned, packed sand beds analogous to water treatment filtration), in real soils the assumptions of colloid filtration theory break down. The micro-scale heterogeneity of pore networks, pore geochemistry, biofilms, water flow and saturation dominate colloid transport and fate. Conditions determining colloid transport and leaching in soils are empirically understood from column experiments, and correlated with the conditions for macropore flow and mass exchange from matrix to macropore networks. Less is known about the fate of particles retained within soils, where and how they are redistributed over cycles of infiltration, and how this impacts on the evolution of soil structure and function. We use silver and gold (nano)particles as tracers for X-ray microtomographic imaging of particle transport and fate in intact soils under a range of conditions. Coupled with this, we are prototyping robust fluorescent labels for particles in soils, allowing detection and analysis by confocal microscopy as a precursor to detailed microspectroscopic characterisation. Here, we present initial results and methodological constraints on this novel approach to particle fate in soils, and discuss potential application to a range of problems in soil and soil contaminant science.



S04.03-P -2

ASSUMPTIONS FOR A POLISH STANDARD OF THE PSD DETERMINATION OF SOILS WITH THE LASER DIFFRACTION METHOD

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Determination of soil particle size distribution (PSD) can be realised with a number of methods. Traditionally, combinations of the sieve method and one of the sedimentation methods have been applied. Those methods, however, are highly labour-consuming and, taking into account the whole procedure of soil sample preparation – relatively imprecise. Therefore, it is not surprising that there is an ongoing search for new methods of determination of PSD, one of the most important parameters characterising the soil. In the second half of the 20th century the method of laser diffraction was raising an increasing interest. It consisted in the measurement of laser light scattered on the soil particles studied. The smaller the particle the greater the angle of light scatter. Modern laser diffractometers have a measurement range permitting for the measurement of soil particles. The Technical Committee for Soil Physics And General Problems, Polish Committee for Standardization is planning to undertake a study aimed at developing a Polish Standard for the determination of particle size distribution of soils with the method of laser diffraction. The assumptions will concern the following: a) Validation of laser diffractometers and/or dispersion units b) Method of preparation of soil samples c) Amount of soil introduced into the measurement system d) Choice of theory (Fraunhofer or Mie) for the conversion of light intensity measured by the detectors into particle size distribution e) Utilisation of additional algorithms offered by the manufacturers f) Settings of elements of equipment of the measurement apparatus (stirrer speed, pump speed)



S04.03-P -3

**EVALUATION OF SOIL GRANULOMETRY INFLUENCE ON CARBON AND HUMIFICATION
DEGREE OF ORGANIC MATTER DETERMINATION**

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The determination of soil carbon content and its chemical formula is extremely important for studies related to carbon stocks and also to sustainability of management systems. Nowadays, the demand by this kind of studies has attracted interests by analytical techniques capable of providing fast, accurate and precise results. However, the scarcity of standard methodologies has made some researchers applying their own methodologies. In this sense, comparisons of results become quite complicated. Aiming to obtain data to support some kind of standardization, it was evaluated the performance of elemental analyzer (CHNS) for soil carbon determination and laser induced fluorescence spectroscopy (LIFS) for assessment of humification degree of soil organic matter. For this purpose three soil samples with different textures: clay, sandy clay loam and loamy sand were triturated to obtain subsamples of 2.0, 0.25 and 0.15 millimeters. The samples were analyzed using a CHNS and portable LIFS equipment. The results showed significant differences in the accuracy for different particle sizes with more precision for samples with granulometry of 0.15 millimeters. These results suggest the necessity of more sample homogenization and also highlight the importance of having standard methodologies for future comparisons among different investigations of soil carbon stocks.



S04.03-P -4

HIGH-RESOLUTION μ -CT AND NANO-CT FOR 3D ANALYSIS OF SOILS AND MINERALS

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High-resolution computed tomography (CT) with industrial CT-scanners has become a powerful evaluation tool for a wide range of scientific applications. Depending on sample size and material, it even allows a 3D look inside of soil and geological samples with submicron resolution. This allows sophisticated analysis of parameters like porosity and permeability or volumetric information about the spatial distribution and quantitative content of specific soils, roots and minerals. In recent years major steps in important components like open microfocus or even nanofocus X-ray tube technology allowed the development of very versatile and high resolution commercially available laboratory CT systems like the new phoenix nanotom® equipped with the first commercially available 180 kV / 15 W high power nanofocus X-ray tube. The so-called nanofocus mode can be used for highest resolution CT scans with voxel-resolutions down to <200 nm. On the other hand the high power mode (up to 15 Watts at the target) has enough penetration power to examine high-absorbing samples like core plugs up to 240 mm in diameter and weighing up to 3 kg. We will showcase several soil & geological applications which were performed with the phoenix nanotom. The possibility to visualize a whole plug volume in a non-destructive way and to use the same plug for further analysis is undoubtedly currently the most valuable feature of this new type of rock and soil analysis and will be a new area for routine application of X-ray CT in the near future.



S04.03-P -5

PHOTONIC TECHNIQUES FOR MEASURING SOIL ATTRIBUTES AIMING LOW CARBON AGRICULTURE

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Carbon (C) sequestration in plant and soil systems offers an opportunity for mitigating the greenhouse effect, but the relationship between soil carbon stocks (CS) and carbon fixation in natural and anthropic vegetation remains one of the least studied issues. As agriculture represents one of the major land use systems, there is a close relationship between soil carbon capture and emissions, and the allocation of land for agriculture. Nevertheless, to reliably assess the quantities sequestered, as well as, the chemical structure of the soil carbon, new methods and equipments are necessary. These methods and equipments must allow large scale measurements and so, the construction of dynamic maps. The present work intends to show results for soil carbon measurements using Laser-Induced Breakdown Spectroscopy (LIBS) and Laser-Induced Fluorescence Spectroscopy (LIFS). Methodology using LIBS was developed for C and nutrients quantification. LIFS equipment was developed to evaluate humification degree of organic matter, and thus C stability in soil. Each methodology has specific capabilities and their combined use along with other analytical tools will improve soil organic matter research. New opportunities arise with the development and application of portable equipments based on spectroscopic methods for in situ measurements in different ecosystems. These apparatus could provide faster and lower cost field analyses thus improving soil texture, carbon contents and quality databases. Improved databases are essential to model carbon balance and thus reducing the uncertainties generated through the extrapolation of limited data.



S04.03-P -6

PROFILING TRACERS IN SOILS USING X-RAY COMPUTED TOMOGRAPHY

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Chemical compounds are widely applied to soil to improve crop production and protection. Understanding their migration through the soil is essential for formulating sustainable application strategies. Leaching of the applied chemicals represents not only economic loss but also a threat to the environment. Understanding the migration of such compounds is often limited by the complex and heterogeneous nature of soil. Traditional methods of examining compound movement have often been limited by being destructive which can provide results that do not correctly represent the natural movement of compounds in soil. X-ray Computed Tomography (CT) can be used to rapidly visualise and characterise the 3D soil pore structure and crucially the applied tracer compound to better understand the mechanisms associated with the transport of such materials in soil. We tested a wide variety of materials and found that materials which have a high atomic number create favourable light scattering properties, leading to a higher X-ray absorption and a more accurate definition in images (Hainfeld, et al., 2006). The rapid scan times now available with the newest CT scanners although not permitting real time visualisation of solutes in soil, still enabled us to capture the dynamics of the flow process. Further, the ability to segment water from the tracer compound can be used to examine the distribution and residence of compounds in relation to a given plant root architecture, which will be crucial in understanding the interaction with compounds in the rhizosphere.



S04.03-P -7

SEQUENTIAL MODELING OF SANDY/UNSTRUCTURED SOIL MICROSTRUCTURE

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Different sphere packs were used by soil scientists and hydrologists to model structure and assess hydraulic properties. It is now quite clear that spheres alone can not account for soil complexity. However, modified sequential methods can be extremely useful for sandy/ unstructured soil structure reconstructions and different models verification (pore-network, correlation functions, modified Kozeny-Carman, etc.). Here we consider a couple of possible practical implications where 3D soil structure or hydraulic properties can not be assessed via conventional approaches due to sample size or shape, or imaging resolution limitations. Mainly, two types of sequential models are considered: 1) process-based (slow, but somewhat more realistic), and 2) discrete numerical model (fast with millions of particles). We show that both approaches can be successfully applied to yield structure reconstructions and hydraulic properties predictions based on grain size distribution data and/or high resolution 2D cut images.



S04.03-P -8

SOIL "PORE SPECTRUM" BY 3D MATHEMATICAL MORPHOLOGY: COMPARISON OF THREE DIFFERENT PROCEDURES.

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Current 3D imaging systems allow proper morphological characterization of internal architecture of undisturbed soil samples. Due to the soil multi-scale structure, the search of the best trade-off between the size of the samples to be scanned and the image resolution often leads to very large data sets with huge difficulties in being analyzed. The pore size distribution is one of the most useful properties to quantify complexity of the pore space and related soil processes. "Pore spectrum" analysis is a mathematical morphology approach very suitable to correlate results with water retention soil property. Its standard implementation is highly demanding in CPU time computation indeed different approximated versions of the procedure are available. Two cubic samples showing very different pore architectures were scanned by X-ray MicroCT at 5 μ m resolution and the so called "diamond", "octahedron" and "distance-dilation" approximated procedures were compared with the "successive opening" standard one. Results show that in both samples the "diamond" and "octagon" procedures underestimates and overestimates, respectively, the volume of smaller pores while saving of computing time is similar and increases exponentially for soil structures with pore size larger than 10% of cubic root of the sample volume. "Distance dilation" procedure was the fastest with the lowest loss in accuracy in the whole pore size range except when soil structure is very homogeneous with small pores. Overall results show that the choose of the best procedure for "pore spectrum" 3D image analysis should be preceded by a preliminary characterization of some general soil structure parameters.



S04.04-P - LANDSCAPE-SCALE MODELLING OF SOIL PROCESSES IN AGROECOSYSTEMS

Monday 02 July 2012 from 17:00 to 18:30. Room Poster Areas

S04.04-P -1

APPLICATION OF THE LANDSOIL MODEL TO SIMULATE WATER AND TILLAGE EROSION IN AN INTENSIVELY FARMED LANDSCAPE SUBMITTED TO LAND CONSOLIDATION WITH CONTRASTING SOIL TYPES

Sébastien Salvador-Blanes, Tours - France

S04.04-P -2

ASSESSMENT OF SOIL WATER REGIME IN THE PRESENT AND FUTURE CLIMATE: A CASE STUDY IN AN OLIVE-CULTIVATED AREA IN SOUTHERN ITALY

Silvia Maria Alfieri, Ercolano (NA) - Italy

S04.04-P -3

CLUSTERING OF TOP SOIL PROPERTIES FOR SOIL EROSION MODELING AT DETAILED SCALE

José A. Martínez-Casasnovas, Lleida - Spain

S04.04-P -4

CONTINUOUS DEPTH FUNCTION MAPPING OF SOIL PH VARIABILITY IN DENMARK

Kabindra Adhikari, Tjele - Denmark

S04.04-P -5

DATA MINING APPLIED TO DIGITAL SOIL MAPPING OF THE AREA OF SÃO PEDRO, BRAZIL

Célia Regina Paes Bueno, Jaboticabal - Brazil

S04.04-P -6

EFFECTS OF INCREASED CROP PRODUCTION FOR BIO-ENERGY USE ON SOIL EROSION RISK – EXAMPLES FROM THE STATE OF HESSE (GERMANY)

Björn Tetzlaff, Jülich - Germany

S04.04-P -7

ESTIMATION OF THE USLE/RUSLE R PARAMETER WITH SCARCE RAINFALL DATA

Miguel Azevedo Coutinho, Lisboa - Portugal



S04.04-P -8

FORECASTING SOIL AGROCHEMICAL PROPERTIES FROM ATR-MIR SPECTROSCOPY AND PARTIAL LEAST-SQUARES REGRESSION ANALYSIS

Lorena Recio-Vázquez, Madrid - Spain

S04.04-P -9

HIGH RESOLUTION 3D MODELING OF SOIL ORGANIC CARBON IN A COMPLEX AGRICULTURAL LANDSCAPE USING CONTINUOUS DEPTH FUNCTIONS

Marine Lacoste, Rennes - France

S04.04-P -10

HOW DOES AGROFORESTRY SYSTEM AFFECT SOIL QUALITY IN TEMPERATE AREAS?

Hongtao Hao, Rennes - France

S04.04-P -11

HYDROLOGICAL INSTRUMENTATION OF A PILOT CATCHMENT IN VIEW TO IMPROVE THE SOIL LOSS MODELING: FOCUS ON THE SPATIAL DISTRIBUTION OF EROSION AND DEPOSITION (LOAMY REGION, BELGIUM)

Nathalie Pineux, Gembloux - Belgium

S04.04-P -12

HYPER-SCALE DIGITAL TERRAIN ANALYSIS – THE CONMAP APPROACH FOR DIGITAL SOIL MAPPING

Thorsten Behrens, Tuebingen - Germany

S04.04-P -13

INITIAL SEDIMENT DISTRIBUTION AND SURFACE DEVELOPMENT OF AN ARTIFICIAL CATCHMENT

Horst H. Gerke, Muencheberg - Germany

S04.04-P -14

INTEGRATION OF A NATIONAL SPATIAL SOIL INFORMATION AND A MONITORING SYSTEM FOR THE IMPROVEMENT OF THEIR SPATIO-TEMPORAL CHARACTERISTICS

Pásztor László, Budapest - Hungary

S04.04-P -15

SOILS AS NATURAL LANDSCAPE COMPONENTS: MAPPING AND CLASSIFICATION

Alexandra Nikiforova, Moscow - Russian Federation



S04.04-P -16

SOLUTE DYNAMICS IN THE CRITERIA MODEL

Antonio Volta, Bologna - Italy

S04.04-P -17

SOME SOIL PHYSICAL PROPERTIES AS RELATED TO LANDSCAPE POSITION: A GEOSTATISTICAL STUDY

Askin Tayfun, Ordu - Turkey

S04.04-P -18

SPATIAL AND QUANTITATIVE IDENTIFICATION OF NITRATE LEACHING RISK ASSESMENT

Marjan Sinkovec, Ljubljana - Slovenia

S04.04-P -19

THE CROP ADAPTABILITY INFORMATION SYSTEM (CAIS)

Antonello Bonfante, Ercolano (NA) - Italy

S04.04-P -20

THE IMPLEMENTATION OF EMPIRICAL KNOWLEDGE IN DIGITAL SOIL MAPPING

Borut Vrščaj, Ljubljana - Slovenia

S04.04-P -21

WEB GIS BASED LANDSCAPE SCALE SIMULATION OF RUNOFF AND SOIL EROSION IN TWO STUDY AREAS IN GERMANY AND CHINA – DATA AVAILABILITY AND METHODOLOGIES

Ralph Meissner, Falkenberg - Germany



S04.04-P -1

APPLICATION OF THE LANDSOIL MODEL TO SIMULATE WATER AND TILLAGE EROSION IN AN INTENSIVELY FARMED LANDSCAPE SUBMITTED TO LAND CONSOLIDATION WITH CONTRASTING SOIL TYPES

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Among the various existing soil erosion models, the Landsoil model has recently been developed to spatially simulate both water and tillage erosion at the event scale. The aim is to apply this model to an intensively farmed area that has been submitted to an important land consolidation in the 1960s, in order to assess the evolution of past and still existing lynchets. The 240 ha study site is located in Seuilly, in the south western Parisian basin (France). The area is mostly under crop cultivation. Monthly calendars of soil surface characteristics have been established for each main crop, and are for the first time adapted to account for the major soil variations observed in the study area. A detailed DEM has been computed using LIDAR data. These data had to be carefully filtered to remove any non-perennial microtopographic feature. 6 mn rainfall data were used to characterize the rainfall events. As the site is not instrumented, the effect of infiltration capacity and suspended sediment load values is approximated. Results show a very contrasted soil redistribution in the study area, mainly due to the different soil types, thus leading to a contrasted morphological evolution of the landscape. The upper, predominantly flat part of the study site with silty soils is mainly under the influence of water erosion, whereas the lower, calcareous and clayey part of the site is mostly under the influence of tillage redistribution processes, leading a progressive flattening of the former lynchets, whereas current lynchets are still developing.



S04.04-P -2

ASSESSMENT OF SOIL WATER REGIME IN THE PRESENT AND FUTURE CLIMATE: A CASE STUDY IN AN OLIVE-CULTIVATED AREA IN SOUTHERN ITALY

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A study was carried out to assess spatio-temporal variations of soil water regime and estimate their effects on crops' yield. This study provided new insights as to how climate change will affect soil water budget and land suitability to present cultivated systems. The study area is Telesina Valley (20,000 hectares, Campania Region, Southern Italy) where olive groves over 3,300 hectares. A spatially distributed model (parallel stream-tube approach) of the soil-plant-atmosphere system was used to describe the soil water regime of 45 soil map units. Hydraulic properties were measured (Wind's method) in five representative soil profiles of the main landscape units. Pedo-Transfer-Functions were tested and the best ones were applied in the other 40 landscape units. Future climate scenarios were generated within the Italian Project AGROSCENARI. Scenarios include 50 realizations of daily minimum, maximum temperature and precipitation data, on a 35 km spatial resolution grid, for the 2021-2050 period. A climate data set of the 1961-1990, the WMO reference period, was also used. The model was run for the daily time series of the two climatic periods, taking into account the soil units and with generic parameters for olive species. Spatial pattern of soil water and evapotranspiration deficit was determined. A data base on climatic requirements of olive varieties was set up to evaluate cultivars' adaptation options and combined with the simulated water regime. Adaptability of each cultivar in the future climate scenario was assessed. The information system utilized in the approach has been described by Bonfante et al.



S04.04-P -3

CLUSTERING OF TOP SOIL PROPERTIES FOR SOIL EROSION MODELING AT DETAILED SCALE

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Although, traditional soil surveys provide information to serve a wide range of applications, from detailed to reconnaissance scales, in researches such as soil erosion at detailed scale precise information about top soil is needed. In these cases, a detailed map of top soil properties units can be more efficient than traditional soil maps. Thus, the objective of this research was to map major soil units on the basis of interpolation methods and cluster analysis of the most important soil properties determining soil erosion. Ten primary maps were created based on 40 soil samples using kriging and local polynomial interpolation. These included: bulk density, coarse and fine particle content (5 fractions), organic carbon and water retention capacity (3 components). After individual spatial interpolation of these properties, cluster analysis (Isodata algorithm) was applied using GIS. The result produced an unsupervised map of the top soil properties with 18 cartographic units. For soil erosion modeling at detailed scale this map groups in the cartographic units the spatial variation of the properties of interest, and it can be easily implemented in models such as the Soil and Water Assessment Tool (SWAT).



S04.04-P -4

CONTINUOUS DEPTH FUNCTION MAPPING OF SOIL PH VARIABILITY IN DENMARK

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Soil pH influences a wide range of functionalities in soil system controlling ions mobility, solubility and also microbial activities at extreme pH. So, a better land and crop-nutrient management plan needs detailed information on soil pH distribution especially in Denmark where 61% of total area is cultivated. Our research purpose is to investigate and visualize pH variability of Danish soils to 1m depth from the surface. Total 1950 profiles with pH data (1soil:5CaCl₂) gathered from different sources (nation-wide 7km grid and other sources) were analyzed. Equal area splines were fitted to harmonize the pH depth function, and averaged for 0-5, 5-10, 10-20, 20-30, 30-50, 50-70 and 70-100cm depths and later on aggregated to 0-30 and 30-100cm to know the top and subsoil pH status. Rule-based regression method was applied to build prediction models on 75% training profiles and validated on the remaining profiles. The predictors used were elevation, slope, aspect, TWI, overland flow distances etc. extracted from LiDAR DEM and existing soil, land use, geology and landscape maps. Residuals of prediction were calculated for all 7 depths, and added to the corresponding regression output to get final pH grids at 30m resolution for whole Denmark. Deeper layers where pH variability was found to be higher were associated with higher prediction errors (RMSE for 0-5cm: 0.58 and 70-100cm: 0.71). The mean top and subsoil pH were 5.7 and 5.5 respectively suggesting moderately acidic Danish soils where liming is necessary for a better agriculture. **Keywords:** Soil pH, Depth harmonization, Rule-based regression, Denmark



S04.04-P -5

DATA MINING APPLIED TO DIGITAL SOIL MAPPING OF THE AREA OF SÃO PEDRO, BRAZIL

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Limiting factors such as resource and time bring the need for novel methods to support soil surveys more efficiently. Digital soil mapping is an alternative to accomplish that. This research aimed at developing a digital soil mapping technique by using relief features, geologic data and existing soils databases scale 1:100.000 applying techniques of data mining and data descriptors relevant geological and pedological maps pre-existing. Based on such a database, a Digital Model of Elevation was generated to make possible the calculation of relief morphometrical parameters slope gradient, slope profile, contour profile, basin contribution area, and diagonal distance to the drainage of the two study areas of São Pedro, scale 1:50.000. These parameters along with the geological map were georeferenced, rasterized, and spatially associated to the existing soil maps, what allowed building a matrix of landscape parameters and soil mapping units. These matrices were used as the input of the software Weka, a collection of machine learning algorithms for solving data mining problems, to generate a prediction model by means of decision trees. Geology was the element with the greatest ability to predict soil mapping units, followed by slope, diagonal distance to the drainage, basin contribution, slope profile and contour profile, reaching a classification accuracy of 55% with the elimination of classes with zero probability of occurrence, a fact which showed the possibility of using this technique in the digital mapping of soils.



S04.04-P -6

EFFECTS OF INCREASED CROP PRODUCTION FOR BIO-ENERGY USE ON SOIL EROSION RISK – EXAMPLES FROM THE STATE OF HESSE (GERMANY)

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The increased demand for sustainable and „green“ energy sources has led to a boom of new bio gas plants in Germany. The plants require adequate and sufficient input matter without long-distance transport. To fulfil this requirement, the cropping area of silage maize is extended around these biogas plants leading to an increase in soil erosion. Looking into this problem was among the objectives of the project “Erosion atlas for the state of Hesse” conducted by the Research Centre Jülich and financed by the Hessian Agency for the Environment and Geology. For the erosion atlas for Hesse soil erosion at the plot scale in the actual state was modelled using the MEPhos model (Tetzlaff 2006), followed by sensitivity and scenario analyses to derive the consequences of changing crop production. Furthermore, a detailed study was conducted, focusing on separate bio gas plants and their 40 km radius to analyse concrete crop rotation changes in the years 2004-2010. Negotiations, how sustainable land use in the surrounding of bio gas plants can be implemented, using the model results are still going on. A poster presentation will give more details about the methodology and about the consequences of these model results for practical implementation, also with respect to soil and water conservation issues.



S04.04-P -7

ESTIMATION OF THE USLE/RUSLE R PARAMETER WITH SCARCE RAINFALL DATA

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To assess local or regional potential erosion, a good indicator is the rainfall erosivity parameter (R) of RUSLE. In most cases, there is no enough data available, but, other parameters, such the Modified Fournier Index, are not adequate “per se” for alternative use, to make detailed assessments. The Madeira’s island catastrophe of 20 February 2010, with intense debris flows was responsible for devastation and losses of lives; efforts have been made to analyze the event and evaluate the distributed erosion. The RUSLE methodology was adopted, however the key issue was obtaining the distributed values of R, both for the event and on a yearly basis. Funchal-Observatório is the only meteorological station available with long records and precipitation data with 10 minute discrimination (last 10 years), to enable the calculation of the erosivity, by event and on daily and monthly basis. This station has also hourly records for more than 20 years and daily records exist since the middle 1930’s. Recently, automatic meteorological stations were established in locations with higher altitudes, but the number of years of data with 10 minute discrimination doesn’t exceed 2-4 years. Due to the scarcity of data, correlations were established to estimate erosivity for larger periods and assess erosivity in other locations. The established methodology allowed calculation of RUSLE erosivity parameter on yearly and event basis, in Madeira. Comparisons were made with previously estimations obtained for Portugal. The procedure showed good robustness and a proposal to deal with cases of data scarcity is presented.



S04.04-P -8

FORECASTING SOIL AGROCHEMICAL PROPERTIES FROM ATR-MIR SPECTROSCOPY AND PARTIAL LEAST-SQUARES REGRESSION ANALYSIS

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A valid characterization of agroecosystems requires explaining different aspects of its functioning through the analysis of a large number of independent variables. Nowadays, the use of spectroscopic techniques lead to a rapid and efficient field monitoring of anthropogenic activities on soil; which enables environmental modelling and the development of precision agriculture. In general non-destructive techniques are faster and less expensive than conventional wet chemical analytical methods, requiring small amounts of sample and simple or no sample pre-processing. Nevertheless, quantitative spectral analyses require sophisticated statistical techniques, such as partial least-squares (PLS) regression, in order to calibrate the soils' response from spectral characteristics. With the aim to determine the extent to which spectral information may led to valid, soil-dependant predictions of a series of agrochemical properties, soil samples affected by human activities were analyzed by attenuated total reflectance (ATR) mid-infrared (MIR) spectroscopy (4000 to 400 cm⁻¹) and PLS regression. Routine soil physical and chemical variables, such as organic matter (OM), total N, amorphous materials, heavy metals or nematode biodiversity were determined. Preliminary results show that the intensity of the 2920 cm⁻¹ IR band shows high correlation with the total OM content, regardless of the OM quality. The application of this spectroscopic technique lead to valid forecasting of the amount of OM, amorphous oxides or the abundance of phytoparasitic nematodes in a short-time and cost-effective way. Such an approach is especially helpful to optimize field studies, and to decide previously the number of samples to be collected during the sampling campaigns.



S04.04-P -9

HIGH RESOLUTION 3D MODELING OF SOIL ORGANIC CARBON IN A COMPLEX AGRICULTURAL LANDSCAPE USING CONTINUOUS DEPTH FUNCTIONS

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Soil organic carbon (SOC) spatial variability and temporal dynamics are strongly affected by natural and anthropogenic processes occurring at the landscape scale. Spatiotemporal modeling is increasingly used to understand these dynamics, and the initialization of the SOC stocks prior to modeling is a key point. This study aims at modeling SOC distribution at high resolution, for an area of 10 km² in a complex agricultural landscape (NW France). 200 points were selected using conditioned Latin hypercube sampling in order to cover the whole range of ancillary variables (elevation, Modified Compound Topographic Index, K emissions and land use). This sampling strategy enables to select a limited number of sampling sites covering the study site heterogeneity. We used a data mining tool, Cubist, to build a rule-based predictive model and predict SOC at 8 different depths up to 105 cm. Predictive environmental data consisted in the data used in the conditioned Latin hypercube sampling, to which were added topographic attributes derived from the DEM and geological variables. Two independent datasets were used to evaluate our predictive maps at the landscape scale and at hedgerow proximity. The respective RMSE for these datasets were 7.47 and 4.77 g/kg. The best prediction levels were obtained for the 15-to-60-cm soil layers. The final maps show that the carbon stocks in the soil below 30 cm were not negligible. The SOC 3D map we obtained will be used as soil data input in a soil evolution model, coupling SOC dynamics and soil erosion fluxes.



S04.04-P -10

HOW DOES AGROFORESTRY SYSTEM AFFECT SOIL QUALITY IN TEMPERATE AREAS?

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Hedgerow system, among other agroforestry systems, is a balanced way to minimize soil degradation and maintain crop production. Besides, in the sense of soil carbon sequestration, it has great potential to benefit local farmers (through possible carbon market, and energy furniture) and the whole world. Compared to tropical areas, much fewer studies have been conducted on the effect of agroforestry on soil quality in temperate areas. At least in Europe, the farmers are still quite hesitating to adapt this system because of the uncertainties on crop productivity and soil conditions. Therefore, to design appropriate policies for landscape management and conservation of hedgerows, we must base on sound science and a precise definition of their role. Here we use a landscape modeling approach to consider under different combinations of soil and hydrology behaviors, the impact of agroforestry on soil quality. Due to their roots and canopies, the trees can create an influence-zone for the nearby soil and crops. The intensity of the impact on soil and hydraulic properties vary along the gradient of the influence-zone. We emphasize on soil organic matter (SOM) evolution linked to C inputs, local modifications of soil conditions and soil redistribution at landscape scale influenced by hedgerows. Subsequent effects on soil water budget and nitrogen cycles (nitrogen content, denitrification) are also assessed. Our results on the resolution of influence zone could help to improve the precision on spatially-distributed models for agroforestry systems.



S04.04-P -11

HYDROLOGICAL INSTRUMENTATION OF A PILOT CATCHMENT IN VIEW TO IMPROVE THE SOIL LOSS MODELING: FOCUS ON THE SPATIAL DISTRIBUTION OF EROSION AND DEPOSITION (LOAMY REGION, BELGIUM)

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^[1]Univ. Liège, GxABT ~ Hydrology and Agricultural Engineering ~ Gembloux ~ Belgium

Nowadays, lots of catchments are affected by inundations or mudflows which are the consequences of excessive runoff and accelerated erosion. That generates also a significant loss of arable land. Yet, the soil resource is not an unlimited commodity. Moreover, sediments' transfer to watercourses alters their physical and chemical quality. The watershed management should aim at both limiting erosion and enhancing deposition in appropriate zones. Therefore, the global objective of this work is to acquire hydropedological data in order to better quantify the erosion and deposition phenomenon in Belgium. The poster presents the field monitoring put in place in our experimental watershed. Indeed, observed quantitative data are essential but still limited. Particularly, we lack observations spatially distributed on the watershed. The watershed is a 124 ha agricultural zone in the loamy region. Its slopes range from 0% to 9%. Instrumentation includes a weather station with disdrometer, discharge measurement at the outlet coupled with water sampling. Fields observations are done to determine the texture redistribution and compared with a previous soil survey realised in 1958. Moreover, regular flights above the area will allow us to obtain a very accurate DEM using Lidar technology (5cm pixel) and observing the relief evolution. The CAESAR model will be tested on this watershed. It aims at representing both erosion and sedimentation and estimates the net erosive flows. This model is based on the Einstein-Brown equations and needs a initial digital elevation model, hourly rainfalls, soil texture, etc. It produces a digital elevation models' evolution through time.



S04.04-P -12

HYPER-SCALE DIGITAL TERRAIN ANALYSIS – THE CONMAP APPROACH FOR DIGITAL SOIL MAPPING

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In this talk, we present a new digital terrain analysis framework for digital soil mapping, referred to as the contextual hyper-scale elevation mapping (ConMap). In contrast to common terrain analysis, ConMap is based on elevation differences from the center pixel to each pixel in circular neighborhoods, allowing to account for effects of geomorphic arrangements in larger neighborhoods with low mathematical complexity. Such an integration of scales is partly essential for a holistic description of spatial soil property distributions since soil formation driven by landscape characteristics shows local, regional and supra-regional components. We applied and validated the framework by predicting topsoil silt content in a loess region of 1150 km² in Rhineland-Palatinate and Hesse, Germany based on 342 samples and a 20m resolution DEM. We compared ConMap with standard and multi-scale terrain analysis approaches as well as with ordinary Kriging interpolations. Cross-validation root mean square error (RMSE) decreased from 16.1 when the standard digital terrain analysis was used to 11.2 when ConMap was used. This corresponds to an increase in R² from 15 to 61%. Even though ordinary Kriging out-performed standard terrain analysis as well, the variance explained was 6% smaller compared with that using ConMap. The results show that the geomorphic settings in the study area must have influenced the spatial soil property distribution by interacting with other environmental covariates and that these effects can be accounted for by integrating over multiple scales in a single perdition approach. We conclude that ConMap shows great potential for digital soil mapping.



S04.04-P -13

INITIAL SEDIMENT DISTRIBUTION AND SURFACE DEVELOPMENT OF AN ARTIFICIAL CATCHMENT

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Artificial catchments are well suited as open-air laboratories for ecosystem research. Knowledge of their spatial heterogeneity is a prerequisite for the assessment of many aspects of ecosystem development (e.g. flow processes, erosion and deposition, soil formation, vegetation dynamics). In initial systems, processes of sediment relocation can cause rapid alterations in the primary sediment distribution, leading to spatial differentiation into regions with differing initial conditions and developmental ages. The examination of initial catchment development requires the quantification of the initial sediment distribution and a spatio-temporal analysis of structure-forming processes. Our objective is the description and quantification of i) the initial sediment distribution and the associated hydraulic properties, and ii) the initial surface development stages of an artificially constructed catchment. The initial sediment distribution is reconstructed using a process-based structure generator program, considering uncertainties in the parent material's origin and the internal dumping structures. Furthermore, different aspects of initial surface evolution are considered using a variety of approaches: i) the magnitude of wind erosion is simulated in a multi-scenario modeling study; ii) the development of surface types is assessed using supervised classification of aerial images; iii) the evolution of surface morphology (i.e. the drainage network of rills and gullies), is analyzed using multi-temporal digital elevation data from remote sensing and, iv) the internal structure of newly deposited areas is generated by simulating sediment redistribution using a landscape evolution model. The comprehensive analysis of these important aspects of initial catchment development gives a better understanding of early ecosystem interactions and structure-process interdependencies.



S04.04-P -14

**INTEGRATION OF A NATIONAL SPATIAL SOIL INFORMATION AND A MONITORING SYSTEM
FOR THE IMPROVEMENT OF THEIR SPATIO-TEMPORAL CHARACTERISTICS**

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The Hungarian Soil Information and Monitoring System (SIMS) is a national monitoring system, with about 1,200 observation sites. Thematically very wide range of soil characteristics are covered, thus providing a unique opportunity for detailed monitoring of the state of Hungarian soils and follow up of major trends in their conditions. Nevertheless SIMS locations were not selected to be spatially representative, the sampling was not designed for spatial extension of information collected at SIMS points. To provide reliable spatial inventories on the state of national soil resources as well as to produce soil maps, SIMS based information should be regionalized. We suggest that an adequate national spatial soil information system with appropriate data structure and spatial resolution provide inherent possibility for so called pedocentric spatial inferences. In Hungary Digital Kreybig Soil Information System is a suitable candidate being the most detailed nationwide spatial dataset which covers the whole area of the country. It simultaneously contains approximately 100,000 soil mapping units and detailed data on soil properties determined and measured in soil profiles. There is representative profile description in the database for about 22,000 sites, which is transferred for further locations, which sums up in approximately 250,000 plots. The fact that soil profile database contains hard and soft data simultaneously facilitates the spatial inference of any profile related variable. In our paper we present how the two different types of datasets were integrated for the spatial inference of some specific soil features producing more complex and more realistic digital soil maps.



S04.04-P -15

SOILS AS NATURAL LANDSCAPE COMPONENTS: MAPPING AND CLASSIFICATION

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Soil mapping and classification are closely interrelated. Classification schemes serve as a basis for the legends of maps; at the same time they draw on and are corrected in accordance with the results of mapping. However, not all maps help to elaborate classifications. For instance, only "system" soil maps, created using the systems approach, suit for verification of hierarchical soil classifications. Soils are unique landscape components because only they are formed through the interaction of all the other components. That is why soil maps must be unique also and display the relationships of soils with all the other components. The concept, methodology and GIS technologies of creation of multi-scaled system maps are worked out. All system maps (landscape, and of soil and the other component's properties) are different versions of one integrated polygon layer, which is created manually on the basis of expert analysis of maximum possible quantity of cartographic, and text sources and following improvement according to remotely sensed data. Legends of the system maps are based on one hierarchical landscape classification. Soil classification is developed as derived from the landscape classification. In order to provide connection with the integrated layer and simplify extracting information, the landscape classification is elaborated as interactive and placed in Internet. At present system maps of Saratovskaya oblast (100200 square km) are created. *Landscapes are natural geographical systems - elementary structural units of the Earth's landscape envelope, each component of which (rocks, air, natural water, vegetation, animals, and soils) possesses relatively homogeneous genetic properties.*



S04.04-P -16

SOLUTE DYNAMICS IN THE CRITERIA MODEL

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This work is based on a new modulus for the three dimensional version of the CRITERIA model which, besides the dynamics of water and heat enables to simulate the solute dynamics. The problem is set up with linear advection diffusion equations describing each solute and solved by means of the finite volume approach. In order to gain computational speed we decoupled the physical issues of dynamics from the chemical reactions. We take into account the liquid, gaseous and solid state of the substance by assuming equilibrium in between the three phases. What distinguishes this model from others is its agronomical footprint; in fact we took much care about the interactions between plant and soil (soil cover, roots activity, plant transpiration and nutrient consumption) in order to provide a helpful tool for agricultural soil management. Nevertheless the model can find further applications as for instance the dynamics of pollutants in soil.



S04.04-P -17

SOME SOIL PHYSICAL PROPERTIES AS RELATED TO LANDSCAPE POSITION: A GEOSTATISTICAL STUDY

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In present study, spatial variation of some soil physicochemical properties was evaluated in a small pasture taking 77 soil samples from 0-0,2 m depth by a systematic sampling scheme at the same line of three different landscape positions (summit, backslope and footslope) in 1,35 ha pasture field of Samsun-Karaköy State Farm. Soil bulk density (ρ_b) was the least variable property while the lime contents (LC) were the most variable. The greatest range of influence (440,1 m) occurred for saturated hydraulic conductivity (K_s) and the least range (26,4 m) for field capacity (FC). The properties on the summit and backslope positions were the most variable while those on the footslope position were the least variable.



S04.04-P -18

SPATIAL AND QUANTITATIVE IDENTIFICATION OF NITRATE LEACHING RISK ASSESMENT

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Agricultural production can, in terms of nitrogen inputs, have a major impact on groundwater quality. The nitrate leaching risk is especially high in agricultural areas on shallow soils formed on highly porous sand and gravel deposits. Holistic and spatial approach for nitrate leaching risk assessment can be an alternative for applicable identification of nitrate leaching hot spots followed by mitigation measures as a basis for agricultural production adaptation. Purpose of this study was to spatially and quantitatively identify areas under nitrate leaching risk, using available nitrogen input data from used manure and mineral fertilizers. Ljubljana field and Murska basin are primarily under intensive agricultural and animal husbandry land use. Consumption of mineral nitrogen fertilizers and manure was estimated to establish a spatial database of plant available nitrogen. These were implemented in spatial algorithms with factors that affect groundwater pollution (soil type, land use, precipitation, evaporation and soil depth) to identify nitrate leaching risk. For most agricultural land on both test sites small to mean total nitrogen input (42,5 - 85 kg/ha) was estimated. The allowed 170 kg/ha of nitrogen input was exceeded on 779 ha of Ljubljana field, representing 25% of agricultural area and on 4.108 ha of Murska basin, representing 13% of agricultural area. The highest risk for nitrate leaching into groundwater was identified for individual fields located on Eutric/Dystric Cambisols and Calcaric Fluvisols. Spatial data processing and possibility to link the results with national spatial databases has proven to be an effective approach for nitrate leaching risk assessment.



S04.04-P -19

THE CROP ADAPTABILITY INFORMATION SYSTEM (CAIS)

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The "Crop Adaptability Information System" (CAIS) is being developed within the Italian national project AGROSCENARI (MIPAAF, D.M. 8608/7303/2008) . One task of the project AGROSCENARI is to evaluate adaptation options of typical Italian cultivation systems to future climate change, in order to identify crops and varieties compatible with future scenario. The approach applied in the project integrates future climate scenarios, soil water regimes and crop yield response functions to water availability to determine the crop adaptability. In CAIS system the soil water regime is estimated through the use of hydrological model physically based (SWAP) at landscape scale on raster or shape support. The software allows to: (i) spatialize the model inputs (climatic variables and bottom boundary conditions), (ii) estimate the soil water and saline balance through the application of the SWAP model; (iii) define the spatial crop rotation; (iv) analyze the results and (v) evaluate the crop adaptability through the comparison of crop yield response functions with the soil water balance determined by simulation runs. The one-dimensional Richards equation is used to solve the soil water balance coupled with a simple crop growth model (which represents a green canopy that intercepts precipitation, transpires and shades the ground) that describes crop development, independent of external stress factors. The CAIS system works in Linux via web and multi-run can be realized



S04.04-P -20

THE IMPLEMENTATION OF EMPIRICAL KNOWLEDGE IN DIGITAL SOIL MAPPING

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Soil profiles are composed of individual horizons, each of them being a function of pedogenetic factors. Classical soil mapping is time and resource consuming process in general difficult to be implemented on detailed /needed scale. Pedogenesis is to a certain extent predictable process. During elaboration of a soil map the soil surveyor subjectively delineates soil mapping units on the basis of field observation and empirical knowledge on local functioning of soil forming factors. Recently earth observation and other data collection method yields much better digital information on main soil forming factors which can be in combination with GIS technologies used for spatial and semantic improvement of soil maps. In spite of geostatistical and other computing methods the empirical soil surveyor's knowledge on local paedogenesis remains indispensable for spatial soil inference models. In the study the surveyor's knowledge was used to elaborate soil type distribution prediction models. Two models for different lithological substrates and climatic conditions were designed and tested. The expert knowledge for predicting the occurrence (presence/thickness) of individual soil horizons was embedded in into GIS algorithms. The additional classification algorithm elaborates raster dataset on distribution of individual soil types. This two stage processing results data on individual soil horizons and the raster soil map of better resolution. The method can be used for spatial improvement of vector soil maps in a first stage and for prediction of soil properties data as covariates for other digital soil mapping methods in second stage.



S04.04-P -21

WEB GIS BASED LANDSCAPE SCALE SIMULATION OF RUNOFF AND SOIL EROSION IN TWO STUDY AREAS IN GERMANY AND CHINA – DATA AVAILABILITY AND METHODOLOGIES

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Environmental impact assessment is important in developed countries as well as in countries in transition. The simulation of runoff, sediment, and nutrient fluxes at landscape scale needs adequate modelling procedures, being adapted to data availability and regional specific processes. In this contribution, we compare our experiences in Saxony/Germany (18.000 km²) and North-China (study area of 16.000 km²), using our investigations to simulate runoff and soil erosion with a WebGIS based modelling approach. It is the common target of both projects to contribute to an applied and integrated water resources management, which is recently more common in Europe. The availability of geodata at the focused scale is rather satisfying for Mid-European landscapes, whereas we have to face strong limitations in the Chinese study area, mainly caused by political restrictions. For that we have to switch to free available geodata sources (ASTER, Landsat, HWSO). Due to semiarid monsoon climate in our Chinese study area, runoff generation is more episodically than in Saxony. To guarantee a sufficient resolution in time, we integrated daily surface runoff (CN) and daily FAO ETC into the modelling, whereas we can use a runoff approach in Saxony that has a one year resolution. The same applies to the soil erosion modelling, which is daily based in China (modified USLE-M), but a one year calculation in Saxony (USLE). In China we have to learn much more about the processes, using combined monitoring and modelling strategies. The results will be discussed and further needs for research will be shown.



S04.05-P - ASSESSING SOIL SYSTEMS AND FUNCTIONS BY MODELING INTERACTIVE PROCESSES

Wednesday 04 July 2012 from 17:00 to 18:30. Room Poster Areas

S04.05-P -1

A GIS-BASED LAND SUITABILITY ASSESSMENT FOR AGRICULTURAL PLANNING IN KILTE AWULAELO DISTRICT, ETHIOPIA.

Ahmed Harb Rabia, Damanhur - Elbehera - Egypt

S04.05-P -2

APPLYING MODFLOW MODEL AND GIS TOOLS TO ASSESS SOIL SALINITY HAZARD IN JEZRE'EL VALLEY, ISRAEL

Vladimir Mirlas, Emek-Hefer - Israel

S04.05-P -3

COMBINING LYSIMETER EXPERIMENTS AND MODELING TOOLS TO DELINEATE PARAMETER CONSTRAINTS FOR MODELS OF FLOW, TRANSPORT, AND BIODEGRADATION OF DEICING CHEMICALS

Heidi Lissner, Jena - Germany

S04.05-P -4

DETERMINATION OF LAND PRODUCTIVITY INDEX BASED ON PARAMETRIC APPROACH USING GIS TECHNIQUE

Orhan Dengiz, Samsun - Turkey

S04.05-P -5

FIELD MONITORING AND SAMPLING OF INFILTRATED SOIL WATER UNDER ON-SITE TREATMENT SYSTEMS: EVALUATION OF SOIL FUNCTIONS AND ENVIRONMENTAL RISK

Behzad Nasri, Paris - France

S04.05-P -6

GEOCHEMICAL MODELING OF 226RA TRANSPORT IN PHOSPHOGYPSUM PILES

Diederik Jacques, Mol - Belgium



S04.05-P -7

INTEGRATING SOIL QUALITY ASSESSMENT INTO ECONOMIC AND ECOLOGICAL VALUATION OF LAND-USE IN THE TROPICAL MOUNTAIN RAINFOREST REGION OF SOUTH ECUADOR

Ute Hamer, Dresden - Germany

S04.05-P -8

KINETIC STUDY OF PHOSPHORUS SORPTION IN PREFERENTIAL FLOW PATHS AND SOIL MATRIX OF A BOREAL FORESTED TILL SOIL SLOPE

Soile Backnäs, Kuopio - Finland

S04.05-P -9

MODELLING AND OPTIMIZATION OF THE INFLUENCE OF SOME TRACE ELEMENTS AND MINERAL COMPOSITION IN SOIL AND DIFFERENT PARTS OF THE ARGAN TREES

Rahma Bchitou, Rabat - Morocco

S04.05-P -10

MODELLING SOIL THERMAL DIFFUSIVITY RESPONSE TO CHANGES IN MOISTURE CONTENT FOR SOILS OF DIFFERENT TEXTURE CLASSES

Tatiana Arkhangelskaya, Moscow - Russian Federation

S04.05-P -11

MULTICOMPONENT TRANSPORT OF 226RA IN AGRICULTURAL SOILS FOLLOWING THE APPLICATION OF PHOSPHOGYPSUM

Jacques Diederik, Mol - Belgium

S04.05-P -12

MULTICOMPONENT VARIABLY-SATURATED TRANSPORT MODEL HP1 WITH ACTIVE NUTRIENT UPTAKE BY PLANT ROOTS.

Tom Groenveld, Boquer - Israel

S04.05-P -13

MULTI-ISOTOPIC APPROACH FOR TRACING VERTICAL MATTER TRANSFERS IN SOIL

Marianna Jagercikova, Aix en Provence - France

S04.05-P -14

NEW DEVELOPMENTS IN THE HP1 REACTIVE TRANSPORT CODE: EXTENSIONS TO TWO- AND THREE-DIMENSIONAL FLOW AND TRANSPORT PROBLEMS

Jacques Diederik, Mol - Belgium



S04.05-P -15

NONPARAMETRIC UNCERTAINTY ANALYSIS IN FIELD SCALE APPLICATION OF EXTENDED SORPTION ISOTHERMS

Levke Godbersen, Hannover - Germany

S04.05-P -16

PORE SPACE EXPLORATION OF NATURAL SOILS BY NUCLEAR MAGNETIC RESONANCE RELAXATION

Markus Duschl, Jülich - Germany

S04.05-P -17

SAGA LEM - A GIS MODEL TO PREDICT PARENT MATERIAL PROPERTIES OF SOIL

Michael Bock, Hamburg - Germany

S04.05-P -18

SOIL C CHANGE AND GHG EMISSIONS AFTER LAND USE CHANGE TO BIOENERGY CROPS

Marta Dondini, Aberdeen - United Kingdom

S04.05-P -19

STATISTICS IN THE CLOUD: ONLINE TOOLS FOR STANDARDIZED ANALYSIS OF GEOCHEMICAL AND SPECTROSCOPIC DATA OF ENVIRONMENTAL ARCHIVES.

Luis Rodriguez Lado, Santiago de Compostela - Spain

S04.05-P -20

THE INFLUENCE OF BIODIVERSITY ON NO₃-N CONCENTRATION IN SOIL SOLUTION: A BAYESIAN MODEL

Sophia Leimer, Bern - Switzerland

S04.05-P -21

VALIDATION OF APSIM'S ESTIMATES OF CARBON MINERALISATION UNDER DIFFERING LAND USES

Joanna Sharp, Christchurch - New Zealand

S04.05-P -22

WATER FLOW AND SOLUTE TRANSPORT MODELLING IN SOIL AT KOSNICA SITE

Stanko Ruzicic, Zagreb - Croatia



S04.05-P -1

A GIS-BASED LAND SUITABILITY ASSESSMENT FOR AGRICULTURAL PLANNING IN KILTE AWULAELO DISTRICT, ETHIOPIA.

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Land Suitability refers to the ability of a portion of land to tolerate the production of crops in a sustainable way. Such kind of analysis allows identifying the main limiting factors for the agricultural production and enables decision makers to develop crop managements able to increase the land productivity. Objectives of this study were to develop a GIS based approach for land use suitability assessment which will assist land managers and land use planners to identify areas with physical constraints for a range of nominated land uses. Also to help identify the management requirements that will ensure that a particular land use can be sustained without causing significant on-site or off-site degradation to land quality. Georeferenced Soil survey data and field work observations have been integrated in a GIS based land use suitability assessment for agricultural planning in Kilté Awulaelo District, Ethiopia. A suitability map for each land use was developed to illustrate these suitability degrees and display the spatial representation of soils suitable for agriculture, grazing and afforestation. Results showed that land units which have no limitations cover about 7% of the study area. Total area of land units that are suitable for rainfed, irrigated agriculture and open vegetation growth is around 67% of the study area. On the other hand, land units that are suitable for grazing or afforestation represent less than 29% of the total area. The study showed also that GIS based approach is a useful tool in land suitability assessment for agricultural planning.



S04.05-P -2

APPLYING MODFLOW MODEL AND GIS TOOLS TO ASSESS SOIL SALINITY HAZARD IN JEZRE'EL VALLEY, ISRAEL

Mirlas Vladimir*^[1]

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A high water table and soil-salinization processes are common in irrigated fields in the Jezre'el Valley, Israel. The Jezre'el Valley, located in the Lower Galilee in the northern part of Israel, covers nearly 300 km². Salinization accelerates whenever the field is underlain by a shallow, semi-confined aquifer exerting upward hydraulic pressure, which impedes drainage of the overlying soil layers. Owing to its hydrological setting, the valley has inherent drainage problems that were aggravated by the introduction of intensive irrigated farming. The water table rose, leading to soil salinization problems. By 1989, 1500 ha showed soil salinity problems and by 1991, an area of 3300 ha was affected by salinity. In this study, we used the MODFLOW groundwater flow model to simulate groundwater levels in Jezre'el Valley. Geo-database and ArcGIS techniques were used for model input for the required dates, spatial analysis of the model results and assessment of areas under soil salinity hazard. Assessment of soil salinization hazard was based on two hydro-geological criteria: 1) groundwater table depth from soil surface and 2) difference between groundwater levels in the upper soil layer and semi-confined aquifer. It was found that the total square of the areas with intensive soil salinization is 325 ha, and that of areas with potential soil salinization, 6275 ha. With the appropriate input, a spatially distributed groundwater flow model such as MODFLOW can provide more reliable information than different analytical solutions for the planning of an effective subsurface drainage system to prevent soil salinization.



S04.05-P -3

**COMBINING LYSIMETER EXPERIMENTS AND MODELING TOOLS TO DELINEATE
PARAMETER CONSTRAINTS FOR MODELS OF FLOW, TRANSPORT, AND
BIODEGRADATION OF DEICING CHEMICALS**

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The intensive use of the deicing chemicals (DIC) propylene glycol (PG) and formate at airports every winter requires thorough environmental management by stakeholders. We carried out lysimeter studies at Gardermoen airport (Norway) to be able to delineate appropriate experimental and modeling approaches for management practices. DIC together with bromide were applied to the lysimeters before snowmelt in March 2010 to determine their fate and transport. For flow and transport characterization we monitored the effluent composition and equipped the lysimeters with probes for water content and water tension measurements. The annual monitoring revealed remarkable differences in solute and water transport with serious consequences for modeling attempts. Whereas only marginal concentrations of formate were analyzed in all lysimeters up to 50 % PG left the upper, microbially most active, region of the soil. The biodegradation of remaining PG during summer resulted in the almost complete depletion of dissolved oxygen and the partially vast discharge of mobilized manganese in autumn. This qualitative complexity of the degradation process requires consideration in the model structure. For example, a Monod type kinetic was required to take account of a temporally variable effective degradation. The drawback of the flexibility of the Monod model is its susceptibility to equifinal parameter sets. This is in particular true in field experiments, where the data basis is often inappropriate for a rigorous parameter estimation. Consequently, environmental management of deicing chemicals has to take account of the complex dynamics of degradation processes, uncertainties of parameter estimation, and spatial heterogeneities.



S04.05-P -4

**DETERMINATION OF LAND PRODUCTIVITY INDEX BASED ON PARAMETRIC APPROACH
USING GIS TECHNIQUE**

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The land productive capacity can be evaluated directly or indirectly. Direct evaluations are carried out in the field, greenhouses or laboratory by means of some experiments under given climatic and management conditions. Indirect evaluations consist basically in developing and applying models of varying complexity, thereby attempting to estimate land productivity. The main objective of this research was to determine land productivity index based on parametric approach using GIS. This study was carried out in Çetinkaya district located on Bafra Delta Plain. The study area covers about 1762.4 ha. After analysing and evaluating topographic, soil physical and chemical properties, result map was generated for land productivity index (LPI) by means of GIS. After LPI taking into rating of soil and topographic parameters was calculated using square root formula, productivity classification was determined for each land mapping unit. According to results, while most of the study area's land productivity (45.4%-800.0 ha) consist of excellent and good classes (I and II) in terms of agricultural uses, it was found that 19.7% (346.6 ha) of study area has average (III), 25.1% (441.6) of it has poor (IV) and rest of it (9.8%) has extremely poor or nil (V).



S04.05-P -5

FIELD MONITORING AND SAMPLING OF INFILTRATED SOIL WATER UNDER ON-SITE TREATMENT SYSTEMS: EVALUATION OF SOIL FUNCTIONS AND ENVIRONMENTAL RISK

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The knowledge of the composition and fluxes of vadose zone water is essential for a wide range of scientific and practical fields. One of the main but less studied media is the soil under the Undrained On-Site Treatment Systems (UOSTS). In situ monitoring is necessary to interpret most physical and hydric properties of soil and to determine the chemical composition of seepage water as a key aspect in sustainable management of soils. The two main targets of this study are to obtain the information about: i) salute concentration in 3 stages of percolation process of domestic wastewater, in entry of the wastewater spreading field, at 70 cm depth and finally at 120 cm depth; ii) mass balance in a period of 12 months. For interpreting this difference and determining the degraded or accumulated substance, the soil samples in low quantity are also collected each 4 months. At the same time the processes of soil moisture and weather monitoring are continued in the spreading field. Additionally, the physical properties, specially soil texture and surface specific of particles, and the hydraulic conductivity of concerned soil are measured by in situ and laboratory tests. We present a compilation of different instruments including the soil water suction plates, tensiometers, the profile probes, weather mini-station and water table variations monitoring in a rural house in centre of France. The relations between the different physical and hydrological properties of soil and solute concentrations enhance the realism of risk assessment in the case of UOSTS.



S04.05-P -6

GEOCHEMICAL MODELING OF ^{226}Ra TRANSPORT IN PHOSPHOGYPSUM PILES

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In this study we analyzed the fate and multicomponent transport of radioactive contaminants contained in phosphogypsum piles (byproducts of the fertilizer industry) located in two different parts of Brazil (Unit A in Sao Paulo state and Unit B in Minas Gerais). A major objective was to understand and evaluate the transport of the radionuclide ^{226}Ra , which tends to concentrate in phosphogypsum during the fertilizer production process. Our modeling study considered transient fluid flow through the phosphogypsum stacks, as well as a range of geochemical processes, including sorption/desorption and interactions between anions and cations in the system. First a relatively traditional modeling approach was used to estimate water flow rates using the HYDRUS-1D software package. Next, simulations were carried out using the multicomponent HP1 module. Results were obtained for long-term transient one-dimensional variably-saturated fluid flow conditions. A sensitivity analysis was further performed to show the effect of different initial and boundary conditions (including precipitation rates) of the phosphogypsum piles on the transport of ^{226}Ra . The speciation and mobility of ^{226}Ra in the form of RaCl^+ , RaOH^+ and RaSO_4 (undersaturated) was different depending upon the affinity of strong and weak sorption sites for these species. Because of contrasting hydrologic and geochemical conditions, simulated results showed four times more mobility of ^{226}Ra in the phosphogypsum pile of Unit A as compared to Unit B.



S04.05-P -7

INTEGRATING SOIL QUALITY ASSESSMENT INTO ECONOMIC AND ECOLOGICAL VALUATION OF LAND-USE IN THE TROPICAL MOUNTAIN RAINFOREST REGION OF SOUTH ECUADOR

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The tropical mountain rainforest region of South Ecuador is one of the hotspots of biodiversity. This unique ecosystem is threatened by deforestation. Large areas have been converted by slash-and-burn practice into pasture land. Due to the invasion of the tropical bracken fern pastures become unproductive and are abandoned. One important land-use option in the area is to take abandoned pasture land either back into agricultural or silvicultural production. To identify the most suitable land-use option for the rehabilitation of these degraded areas from the ecological as well as socio-economical point of view different indicators are applied. Indicator development is based on data obtained during about 10 years of research in the study area (www.tropicalmountainforest.org). One important ecological indicator is soil quality. The assessment of soil quality strongly depends on the management goal for specific sites. In the present study two probably conflicting management goals exist: plant productivity and re-establishment of the function of soils as habitat and gene reservoir as it is provided by the tropical mountain rainforest. Therefore, two different soil quality assessment schemes are developed. The results show different rankings for soil quality depending on the management goal. Combining the two approaches is a good alternative to meet the biased challenges of land-use systems on soil quality. Links between ecological indicators, especially soil quality, and the economic valuation of the different land-use systems will be presented.



S04.05-P -8

KINETIC STUDY OF PHOSPHORUS SORPTION IN PREFERENTIAL FLOW PATHS AND SOIL MATRIX OF A BOREAL FORESTED TILL SOIL SLOPE

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Phosphorus (P) sorption in the preferential flow paths (PFPs) and in the soil matrix was studied in a boreal, forested till soil slope in Eastern Finland. PFPs were visualized sprinkling Acid Blue 9 tracer on study plots of 0.5 m² near the top and the bottom of the slope and on a plot of 1 m² in the midslope area, and samples were taken from the dye-stained PFPs and the undyed matrix. Ammonium oxalate-extractions and batch-type sorption experiments were carried out with varying reaction times and temperatures. In the upper and lower slope, PFPs occurred throughout the profile and had lower oxalate-extracted P (Pox) and P sorption capacity than the matrix in all horizons. In the midslope PFPs reached the B/BC-horizon and the Pox and P sorption capacity were lower in the PFPs of the E-horizon than the matrix and similar in the B-horizon. Sorption reaction was faster and capacity higher in 13 °C than in 3 °C. However, there was no difference between 13 and 21 °C. Kinetic studies showed that the sorption followed a pseudo-second order reaction. Also Bangham and Elovich equations were able to describe the kinetic sorption reaction. The study revealed that the pore and intra-particle diffusion played an important role in the sorption mechanism. The results indicate that during seasons with low temperature and high soil humidity, P transport through PFPs is possible due to slow sorption kinetics. The study offers new knowledge for parameterization of a dual-permeability model for P transport in forested hillslope.



S04.05-P -9

MODELLING AND OPTIMIZATION OF THE INFLUENCE OF SOME TRACE ELEMENTS AND MINERAL COMPOSITION IN SOIL AND DIFFERENT PARTS OF THE ARGAN TREES

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Argan oil is traditionally used for skin, nail and hair care, cooking, massaging and healing. Its chemical composition highlights interest of many laboratories to use it in their best-selling products. Recently, various studies were realized to characterise specific antioxidants and polyunsaturated fatty acids in Argan oil. Nevertheless, there is a lack of information concerning the trace elements content. This work deals with the presence of trace elements and some minerals in soil collected from an Argan field in Essaouira and the distribution of Cd, Cr, Cu, Pb and Zn in different parts of Argan trees. A methodology based on inductively coupled plasma optical emission spectroscopy (ICP-AES) has been developed to determine the content of microelement concentrations. Samples of soil, wood, leaves, almonds and oils were taken for the determination of metals and micronutrients. Only adult trees were considered. Most of the trees studied were characterized by a high lead and calcium content. The multidimensional analysis of data, performed on all analytical results obtained, showed significant relationships between different heavy metals and micronutrients considering all groups as a whole. The regression coefficients obtained on variables determined in wood, leaves, almonds and oil are relatively higher. On the contrary, the soil group is poorly related to the other four groups. Significant differences are mainly due to the partial-spatial variations in these contents. The nature of soils explained most of the elements' distribution pattern in Argan tree.



S04.05-P -10

MODELLING SOIL THERMAL DIFFUSIVITY RESPONSE TO CHANGES IN MOISTURE CONTENT FOR SOILS OF DIFFERENT TEXTURE CLASSES

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Pedotransfer functions (PTFs) for modelling soil thermal diffusivity (k) vs. moisture content (w) dependences were developed using data for 49 soil samples. Bulk density of studied soils varied from 0.9 to 1.8 g cm⁻³, organic carbon content from 0.1 to 6.5 %, sand content from 1 to 97 %. Soil thermal diffusivity varied from 0.0009 cm²s⁻¹ for dry silty clay to 0.0097 cm²s⁻¹ for sandy loam at 0.21 g cm⁻³ moisture content. The highest determination coefficients between thermal diffusivity and basic soil properties were obtained for soil texture characteristics. Experimental $k(w)$ curves were parameterized with a 4-parameter approximating function, which fits well with different shapes of $k(w)$ dependences: from peak curves typical for sandy soils to sigmoid curves typical for loamy and especially for compacted soils. Regression analysis of 49 parameter sets vs. 49 sets of basic soil properties resulted in constructing PTFs for calculating parameters of $k(w)$ curves from data on soil texture, bulk density and organic carbon content. Regression tree approach gave better results than analysing the entire array of experimental data. Suggested PTFs were used to simulate soil temperature for paleocryogenic soil complexes of the East European Plain. Simulated and experimental patterns of lateral temperature distribution were similar: the coolest were soils with lowest bulk density and highest carbon content located within now completely buried paleomicrodepressions. These areas formerly were cooler due to ancient microtopography, but now the lateral temperature differences are explained rather by regular variability of soil properties than by smoothed agrogenic microrelief.



S04.05-P -11

MULTICOMPONENT TRANSPORT OF ^{226}Ra IN AGRICULTURAL SOILS FOLLOWING THE APPLICATION OF PHOSPHOGYPSUM

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This study analyzes the environmental fate and multicomponent transport of contaminants present in phosphogypsum (PG) when used as a fertilizer or amendment in agricultural operations. PG (dihydrated calcium sulfate) is a by-product of the production of phosphoric acid as used by the phosphate fertilizer industry. PG can contain relatively high amounts of impurities from the host rock, including heavy metals and radionuclides such as ^{238}U and especially ^{226}Ra . It is important to assess the risks and advantages related to the long-term use of PG in agriculture. Our study focused on the transport of ^{226}Ra when PG is applied to a typical soil profile in the Brazilian Cerrado. Expected water flow and solute transport processes were estimated first using the HYDRUS-1D software package, followed by similar simulations using the HP1 multicomponent transport module. Analysis with HP1 considered a range of geochemical and physical parameters affecting the transport of ^{226}Ra species in the vadose zone between the soil surface and the groundwater table. We looked especially at the effects of varying calcium concentrations on ^{226}Ra transport since Ca competes for sorption. Several aspects related to the modeling approach, such as the use of daily rainfall data and the effect of invoking different flow regimes in the vadose zone (e.g., transient flow versus long-term steady-state flow) are also discussed.



S04.05-P -12

MULTICOMPONENT VARIABLY-SATURATED TRANSPORT MODEL HP1 WITH ACTIVE NUTRIENT UPTAKE BY PLANT ROOTS.

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Active uptake of nutrients is described by means of Michaelis-Menten kinetics. In this study, uptake rate parameters include the effect of specific ion concentrations. The objective is to include nutrient uptake deficiency stress in a generic multicomponent transport model HP1 (geochemical code PHREEQC coupled to the transient water and solute transport model HYDRUS-1D). The dataset used to validate this model was composed of laboratory and field experiments with lysimeters. The controlled upper boundary conditions consisted of different salinity treatments. The bottom boundary conditions were measured to account for a complete water and macro-nutrient balance. Transpiration, growth, and nutrient uptake of bell-pepper as a function of irrigation water amount, nutrient concentration and salinity were measured over time, and compared well with calculated data. The transport of N, P, K, Ca, Mg, Na and Cl, was modeled and the nutrients considered in uptake were Ca and N. What is ground-breaking in this model is the separation of the nutrient deficiency stress due to certain ions (e.g., Na or Cl) from the osmotic stress they pose. This will allow the functions describing water uptake reduction due to salinity (Maas and Hoffman, 1977; van Genuchten and Hoffman, 1984) to be strictly used to model osmotic stress (Ben-Gal et al., 2009), so that the additional stress due to reduction in nutrient uptake and specific ion toxicity may then be quantified separately.



S04.05-P -13

MULTI-ISOTOPIC APPROACH FOR TRACING VERTICAL MATTER TRANSFERS IN SOIL

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Clay translocation is one of the major soil forming processes in many soil types. It is however poorly quantified and modelled. We propose to quantify this process, as well as bioturbation, combining different isotopic systems. The chosen isotopes are mainly brought to the soil through its surface (^{14}C , ^{13}C , ^{210}Pb in excess, ^{10}Be atmospheric, ^{137}Cs , $^{206/207}\text{Pb}$). As they are either constitutive of the soil component or are strongly sorbed to the surface of organic matter and/or clay, the evolution of their concentrations with depth depends on the particle transfer and on chemical processes occurring in the soil. The multi-isotope approach benefits (i) from the different chemical properties of the different isotopes to differentiate the solute transport that fractionates them from physical transport that acts simultaneously on them; (ii) and from their different half-lives and input history to assess the kinetics of the processes. Bioturbation and lessivage is quantified by an equation including a term of radioactive decay and a diffusion-convection equation. The convection term represents the downward shifting due to both lessivage and solute transfer while the diffusion term represents the dispersion due to bioturbation. This method is applied on studying soil sequences of Luvisols in North-Western France differing by land use (cropping versus grassland or forest) and agricultural practices (reduced tillage and manure input). Preliminary results show that the vertical isotopic distribution between cultivated soils and their natural equivalents varies along the upper 40 cm of the soil profiles.



S04.05-P -14

NEW DEVELOPMENTS IN THE HP1 REACTIVE TRANSPORT CODE: EXTENSIONS TO TWO- AND THREE-DIMENSIONAL FLOW AND TRANSPORT PROBLEMS

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A multiple of interacting physical, chemical, and biological processes determines the fate of major cations and anions, contaminants (e.g., heavy metals, pesticides), and colloids in soil systems. Also, modeling of soil CO₂ sequestration requires consideration of water flow, heat transport, gas diffusion, and microbiological soil respiration processes. The HP1 simulator (Jacques et al., 2008) is a state-of-the-art model, specifically developed to evaluate unsaturated zone processes, that couples the one-dimensional variably-saturated flow and transport model HYDRUS-1D (Šimunek et al., 2008) with the generic geochemical model PHREEQC (Parkhurst and Appelo, 1999). Although HP1 is a versatile code for implementing different geochemical and transport conceptual models in variably-saturated porous media, one of its main limitations is that flow and transport is restricted to one dimension. Therefore, PHREEQC has recently been coupled with HYDRUS 2D/3D (Šimunek et al., 2011) to handle flow and transport problems, which require a higher dimensionality (HP2/3). Typical examples are flow and transport in soil systems with tiled drains, or with drip and furrow irrigation, or in sloped layered or heterogeneous systems. A typical two-dimensional flow and transport problem illustrating the capability of the HP2 simulator will be presented. The HP2/3 code uses the graphical user interface of HYDRUS 2D/3D for input and output processing, enabling definitions and finite element discretization of very complex flow domains.



S04.05-P -15

NONPARAMETRIC UNCERTAINTY ANALYSIS IN FIELD SCALE APPLICATION OF EXTENDED SORPTION ISOTHERMS

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The risk of groundwater contamination by trace elements is usually assessed at field scale and quantified using spatially aggregated values. The fate of trace elements in the soil- groundwater pathway is predominantly governed by the sorption characteristics of the soil. Semi empirical pedotransfer functions (PTF) based on extended Freundlich equations can be applied to estimate the sorption behaviour from common soil properties such as pH, Corg and cation exchange capacity. Such PTF have been derived for Cd, Cr, Cu, Ni, Pb and Zn by multiple regression analysis on a national scale for soils used as arable or grass land PTFA (Utermann et al. 2005) and forest PTFF (Heidkamp 2005). Altfelder et al. (2007) splitted the residual variance between modelled and measured trace element concentrations sorbed to the soil into on-site and between-site variance and calculated a ratio of approximately 70% to 30%, respectively. Possible sources of variance are the model error resulting from the ignorance of sorption relevant soil properties; the variability resulting from the heterogeneity of soil properties and uncertainty resulting from imperfect knowledge. In this study the PTFs performance will be evaluated under conditions with background level trace element concentrations on sites not used in the PTF training dataset. We focus on how the field scale uncertainty and variability in sorption relevant soil properties and trace element concentrations affect the PTF results in three case studies. Thereby we hypothesize given the PTF is valid spatial variability of soil properties to be the predominant source of variance.



S04.05-P -16

PORE SPACE EXPLORATION OF NATURAL SOILS BY NUCLEAR MAGNETIC RESONANCE RELAXATION

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The pore space structure is a crucial factor for many soil physical properties like water retention and hydraulic conductivity. Therefore, many possibilities for the determination of the pore space exist such as multistep outflow or gas and Hg adsorption isotherms. A fast and furthermore non-destructive opportunity to characterize the pore space is nuclear magnetic resonance (NMR) relaxation which is a well-known tool in particular for the characterization of rocks in petroleum exploration [1]. The physical principle is the relaxation of water molecules in an external magnetic field after excitation. In porous media, water near the surface of pores relaxes faster than in the middle of pores. Thus, the characteristic relaxation time is a measure for the surface to volume ratio, and one can deduce pore size and grain size distributions from the relaxation times [2]. In this work, we show the characterization of a set of natural soil materials covering a wide range of textural classes by NMR relaxation. T2 relaxation times were monitored by the Carr-Purcell-Meiboom-Gill sequence and further analyzed by inverse Laplace transformation yielding relaxation time distribution functions. These are further correlated with soil texture and van Genuchten parameters. Generally, slow processes ($T_2 > 200\text{ms}$) are due to macropore structure and show little correlation with the texture. The fast processes ($0.5\text{ms} < T_2 < 200\text{ms}$) correlate best with the silt content and the a-parameter. 1. Hedberg S. et al., Water Resources Research, 29, 1163-1170 (1993) 2. Stingaciu L. R. et al., Water Resources Research, 46, W11510 (2010)



S04.05-P -17

SAGA LEM - A GIS MODEL TO PREDICT PARENT MATERIAL PROPERTIES OF SOIL

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We propose a GIS implementation of a landscape evolution model (LEM) for the spatial prediction of parent material of soil formation. In particular, the process-oriented modeling of regolith formation during the Late Pleistocene in the periglacial areas of Central Europe is the goal of the development. According to Scott & Pain (2008) the term "regolith" refers to "everything between fresh rock and fresh air". It therefore includes both in situ weathered material and mixtures of allochthonous, transported material. The model is intended to improve the data situation contributing to regolith, because commonly only fragmentary data on its properties and distribution is available: between spatial data on soils (as analogous or digital soil type maps) and those on geology of the hard rock (as analogous or digital geological map), a data gap exists. In contrast to the poor data situation, the importance of regolith with respect to terrestrial material conversion processes is recently highly emphasized. The initial conditions for regolith formation modeling with SAGA LEM are specified by a digital terrain model and a simplified geological structural model. Along a time line in varying degrees of time slices, the weathering, erosion and accumulation processes of allochthonous material are simulated. Physical and chemical weathering processes are described by weathering formulas which are calibrated using paleo-climatic datasets. The involved processes on regolith formation are modeled both index-based and process-oriented. The lithologically differentiated representation of the weathering and transport processes using engineering-geological parameters is one of the major developments of SAGA LEM.



S04.05-P -18

SOIL C CHANGE AND GHG EMISSIONS AFTER LAND USE CHANGE TO BIOENERGY CROPS

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Current process-based models of bioenergy crop growth have only recently begun to include descriptions of soil C change and GHG emissions. These models can be used to explore the interactions between bioenergy crop type, soil type, climate and crop management, to determine likely soil C change and GHG emissions under present and future climate. While such models have been developed and improved against a range of soil C and GHG experimental datasets, few of these originate from the second generation bioenergy crop. In this study, the soil process-based model ECOSSE has been used to simulate soil C change and GHG emissions arising from bioenergy crop land use change. The model has been run using the driving data collected at several sites in UK and Ireland, and soil C change and GHG emissions have been tested against measurements. The implications of previous land use and the time since the energy crops were established have been simulated. The model has been then run for a transition matrix of previous land uses, assuming the following previous land uses: cropland, semi-natural grassland, improved grassland and woodland. Finally, the soil C change and GHG budget of each potential transition at each site have been addressed. The use of detailed driving variables at these well characterized sites form a sound basis for a further application of the model at larger spatial scales.



S04.05-P -19

STATISTICS IN THE CLOUD: ONLINE TOOLS FOR STANDARDIZED ANALYSIS OF GEOCHEMICAL AND SPECTROSCOPIC DATA OF ENVIRONMENTAL ARCHIVES.

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Understanding the geochemistry of environmental archives is challenging due to the temporal information they store. The increasing availability of data from different techniques makes necessary the application of data reduction techniques for a proper interpretation of the variance structure and understanding the underlying, controlling processes. Partial Least Squares (PLS) is a multivariate technique, commonly used in Chemometrics but less known in geochemical research, for the generalization of data of different nature. It is especially useful to determine statistical relationships with relatively small number of samples and a large set of explanatory variables. Although this technique has been implemented in some statistical packages such as R, its availability is already limited due to the programming skills it requires. In this work we present an online application for the automatic processing of geochemical data from environmental archives. As an example we present the analysis of a dataset from a peat core using FTIR spectra as input and some physico-chemical parameters as response variables, to establish the ability of FTIR to model peat properties. Cloud computing technology is rapidly growing in many disciplines and it probably will be an essential tool for environmental assessment in the near future. The implementation of statistical tests based in web-technologies can constitute a solution to standardize and run complicated analyses while minimizing potential analytical errors. Acknowledgements. The research was supported by projects CGL2010-20672 (Spanish Ministry of Science and Innovation) and 10PXIB200182PR (Xunta de Galicia). LR-L is supported by the Parga-Pondal Programme of Xunta de Galicia.



S04.05-P -20

THE INFLUENCE OF BIODIVERSITY ON NO₃-N CONCENTRATION IN SOIL SOLUTION: A BAYESIAN MODEL

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The Jena Experiment is an experimental grassland to study the biodiversity-ecosystem functioning relationship since 2002. We present a Bayesian model to simulate the effect of plant community composition on NO₃-N concentration in soil solution using species and functional group richness and identity, meteorological data, time since establishment of the grassland, and interaction terms between the variables. For development and analysis of the complex Bayesian model, the software OpenBUGS, in which Markov Chain Monte Carlo-methods are implemented, was used. Nitrate-N concentrations in soil solution were available from 62 plots of the Jena Experiment between 2003 and 2006 in fortnightly resolution. The plots included 1, 2, 4, 8, 16 and 60 plant-species mixtures from the Arrhenatherion grasslands and are categorized into 1-4 functional groups (legumes, grasses, non-leguminous small herbs and non-leguminous tall herbs). The variables influencing NO₃-N concentration in soil solution were chosen by deviance information criterion-based model selection. The model simulates NO₃-N concentration in soil solution well (mean error = 1 mg l⁻¹, root mean square error = 2.71 mg l⁻¹ and R² = 0.48). The quality of simulated values on plots with low species number (monocultures with R² between 0.00 and 0.70) varies more than on plots with high species number (60 species plots with R² between 0.31 and 0.72). The model shows that NO₃-N concentration in soil solution decreases with increasing species richness and that this effect becomes stronger with time. The presence of legumes increases and the presence of grasses decreases NO₃-N concentration in soil solution.



S04.05-P -21

VALIDATION OF APSIM'S ESTIMATES OF CARBON MINERALISATION UNDER DIFFERING LAND USES

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A wide variety of models enable simulation of soil carbon dynamics, however few incorporate the complexities of a typical set of soil – plant – management interactions. There is a growing need for agricultural systems models to address the implications of management decisions on carbon storage and loss. As a result, greater emphasis and scrutiny is placed upon the soil components within these models. Agricultural Production Systems Simulator (APSIM) is a systems model which, through a suite of modules, enables the simulation of systems that cover a range of plant, animal, soil, climate and management interactions. While there has been extensive testing of the plant modules within APSIM, the soil organic matter module, SoilN, has received less validation. This paper will validate APSIM's estimates of carbon mineralisation by comparing them with results from incubated soil taken from a long-term land use experiment. The field experiment, established in 2000 at Lincoln, Canterbury, New Zealand, on a silt loam that had been under permanent sheep-grazed pasture, has several treatments including a permanent grazed pasture, no-till cropping and chemical fallow. Soil was sampled 11 years after establishment and sub samples were incubated at 5, 15 and 25°C (-30 kPa water potential), with CO₂ evolution measured at regular intervals. This paper will report on the relationship between measured and modelled results for different land uses over a range of different soil temperatures, and what changes to the model parameterisation are most effective at improving the fit between measured and modelled results.



S04.05-P -22

WATER FLOW AND SOLUTE TRANSPORT MODELLING IN SOIL AT KOSNICA SITE

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The subject of this study is the soil zone above Zagreb unconfined Quaternary aquifer in which high concentration of several toxic metals were observed probably caused by industry, traffic, agriculture and urbanization. The goal of the study is land use impact assessment on groundwater quality, by 1D modelling of water flow and solute transport using Hydrus software. Investigated site is situated about 800 m from right bank of Sava River at Kosnica water capture site where Fluvisol type of soil is developed. The following soil horizons were recognized: O; A; AC; C; 2C/Cl; 3 C1; 4Cl/Cr; 5Cl/Cr and 6Cr. Soil is silty to sandy in texture. Soil pH increases while electrical conductivity generally decreases with depth. Air capacity is higher in the upper part of soil profile, while bulk density has opposite trend. All soil horizons are porous and have medium water retention capacity. One year monitoring of water content, electrical conductivity, soil water tension and concentration of metals in percolating water is in progress. The monitoring takes place at two different depths of the profile. The parameters stated are necessary for calibration of models. Results of electrical conductivity monitoring show no significant changes along profile. Soil water tension is higher in the upper part of the profile. Water content depends on weather conditions (varies from 17% to 35%). The results of this study will contribute to better understanding of metals migration through the soil zone and allow risk assessment of possible groundwater pollution.



S04.06-P - CURRENT ISSUES AND APPLICATIONS OF SOIL MONITORING

Wednesday 04 July 2012 from 17:00 to 18:30. Room Poster Areas

S04.06-P -1

DISTRIBUTED SOIL MOISTURE PROFILES IN A LYSIMETER BY ACTIVELY HEATED FIBER OPTICS

Francesco Ciocca, Lausanne - Switzerland

S04.06-P -2

A QUICK, EASY AND LOW-COST METHOD FOR SAMPLING CO₂ IN SOIL GAS

Eleanor Hobley, Newcastle - Australia

S04.06-P -3

A SOIL INDEX FOR FARMER-BASED MONITORING

Karoline D'haene, Merelbeke - Belgium

S04.06-P -4

AN INTEGRATED SOIL MONITORING FRAMEWORK COMBINING REPEATED SAMPLING AND MODELLING OF ELEMENT CONCENTRATIONS

Raniero Della Peruta, Zurich - Switzerland

S04.06-P -5

APPLICATION OF A ROTATIONAL SAMPLING DESIGN TO ADDRESS THE SPATIAL MEAN TEMPORAL TREND IN SOIL SATURATED HYDRAULIC CONDUCTIVITY

Sibylle Hassler, Potsdam - Germany

S04.06-P -6

DELINEATION OF MANAGEMENT ZONES IN A VINEYARD FOR SITE-SPECIFIC NITROGEN FERTILIZATION

Gilberto Bragato, Gorizia - Italy

S04.06-P -7

EDAPHOLOG®: AN AUTOMATIZED SYSTEM FOR MONITORING NUMERICAL ABUNDANCE AND BODY SIZE DISTRIBUTION OF SOIL MESOFAUNA

Csongor Gedeon, Budapest - Hungary



S04.06-P -8

ELABORATION OF THE SOIL DEGRADATION SUBSYSTEM OF THE HUNGARIAN ENVIRONMENTAL INFORMATION SYSTEM

József Szabó, Budapest - Hungary

S04.06-P -9

ESTIMATING SOURCES OF UNCERTAINTIES OF SOIL ORGANIC CARBON STOCK ASSESSMENTS WITHIN A SOIL MONITORING NETWORK

Manuel Martin, Orléans - France

S04.06-P -10

EVALUATION OF METHODS TO ESTIMATE HUMUS EROSION AFTER COARSE-SCALE DISTURBANCES ON A MONTANE MIXED FOREST SITE IN THE NORTHERN LIMESTONE ALPS

Anna R. Hollaus, Vienna - Austria

S04.06-P -11

EVOLUTION OF SOIL ORGANIC CARBON IN THE SWISS MONITORING NETWORK (NABO) OVER THE LAST 25 YEARS, 1985-2009

Reto Giulio Meuli, Zurich - Switzerland

S04.06-P -12

FIRST EVALUATION OF THE DISTRIBUTION AND ORIGIN OF BORON CONCENTRATIONS IN FRENCH SOILS ISSUED FROM THE FRENCH SOIL MONITORING NETWORK (RMQS)

Claudy Jolivet, Orléans - France

S04.06-P -13

FOREST SOIL MONITORING OF ORGANIC POLLUTANTS IN GERMANY

Bernd M Bussian, Dessau - Germany

S04.06-P -14

FUNDAMENTALS FOR THE USE OF SOIL MICROBIOLOGICAL METHODS IN LONG TERM MONITORING

Hans-Rudolf Oberholzer, Zürich - Switzerland

S04.06-P -15

HOW TO HARMONIZE THE DATA COLLECTED FROM DIFFERENT SOIL MONITORING NETWORKS: A CASE STUDY IN FRANCE

Saby Nicolas, Pa, Orléans - France



S04.06-P -16

LEGACY DATA, A HELP OR A HINDRANCE TO SOIL CLASSIFICATION AND MAPPING?

Brian J Reidy, Wexford - Ireland

S04.06-P -17

MAKING USE OF THE WORLD REFERENCE BASE DIAGNOSTIC HORIZONS FOR THE SYSTEMATIC DESCRIPTION OF THE SOIL CONTINUUM

Mareike Ließ, Bayreuth - Germany

S04.06-P -18

MAPPING ORGANIC CARBON POOLS OF SWISS FOREST SOILS

Madlene Nussbaum, Zurich - Switzerland

S04.06-P -19

MEASURING BULK DENSITY IN LARGE SCALE SOIL INVENTORIES TO ESTIMATE SOIL ORGANIC CARBON STOCKS - REGRESSION EQUATIONS FOR CORRECTING THE RESULTS FROM DRIVING HAMMER EQUIPMENT AND SOIL SAMPLE RINGS

Michaela Bach, Braunschweig - Germany

S04.06-P -20

MIXED MODEL METHODOLOGY IS SUITABLE FOR ANALYSING SOIL MONITORING DATA

Elsa Suuster, Tartu - Estonia

S04.06-P -21

MONITORING AND INTERPRETING THE PHYSICAL QUALITY OF ARABLE SOILS

Karoline D'haene, Merelbeke - Belgium

S04.06-P -22

MONITORING LAND USE INDUCED CHANGES OF CARBON STOCKS IN GRASSLAND AND FOREST SOILS – LESSONS LEARNED FROM REGIONAL CARBON INVENTORIES

Ingo Schöning, Jena - Germany

S04.06-P -23

MONITORING SOIL QUALITY IN THE NETHERLANDS: KEY CHALLENGES

Esther Wattel-Koekkoek, Bilthoven - Netherlands



S04.06-P -24

NEW TAXONOMIC FRAMEWORK FOR ENHANCING A HORIZON LOWERCASE SUFFIXES TO ENABLE DETAILED MONITORING OF SOIL CHANGE IN TOPSOILS

Gabriele Broll, Osnabrück, - Germany

S04.06-P -25

SPATIAL DISTRIBUTION OF ORGANIC MATTER RESERVES IN THE FOREST SOILS OF KARKONOSZE MOUNTAINS NATIONAL PARK (SOUTH-WEST POLAND)

Katarzyna Szopka, Wroclaw - Poland

S04.06-P -26

THE INTERNATIONAL SOIL MOISTURE NETWORK: A GLOBAL SOIL MOISTURE MONITORING PLATFORM

Angelika Xaver, Vienna - Austria

S04.06-P -27

THE TOTAL PHOSPHORUS CONTENT OF SOILS AND ITS SPATIAL DISTRIBUTION IN FRANCE

Magalie Delmas, Orléans - France

S04.06-P -28

TWO DIFFERENT ANALYTICAL APPROACHES IN LASER INDUCED BREAKDOWN SPECTROSCOPY (LIBS) TECHNIQUE TO DETERMINE ELEMENTAL CONCENTRATIONS IN SOILS

Giorgio S. Senesi, Bari - Italy

S04.06-P -29

USE OF LEGACY DATA FOR BROAD SCALE SOIL MONITORING

Ben Marchant, Harpenden - United Kingdom



S04.06-P -1

DISTRIBUTED SOIL MOISTURE PROFILES IN A LYSIMETER BY ACTIVELY HEATED FIBER OPTICS

Ciocca Francesco^{*[1]}, Lunati Ivan^[2], Van De Giesen Nick^[3], Parlange Marc B.^[1]

^[1]EPFL ~ EFLUM ~ Lausanne ~ Switzerland ^[2]UNIL ~ GEOPHYSICS ~ Lausanne ~ Switzerland ^[3]TU DELFT ~ CIVIL ENGINEERING ~ Delft ~ Netherlands

Despite recent improvements of the techniques based on the measure of dielectric properties like Time/Frequency Domain Reflectometry (TDR and FDR) and of capacitance-based probes, estimate Volumetric Water Content (VWC) within big amounts of soil and over long distances still remains a challenging topic cause of the limited spatial extension. A potential alternative is offered by optical fibers, accounting on their reliability for soil temperature measurements over distances of kilometers. Heating the metal sheath of the fiber buried in the soil, a distributed heat pulse is sent. From both the increasing (heating) and decreasing (cooling) temperatures, values of VWC are obtained. Test the effectiveness of this technique is the aim. A weighable lysimeter is homogeneously filled with loamy soil and a double coil rigid structure of optical fiber (15 loops for a total length of 52 meters) is placed in the upper 80 centimeters. A thick series of capacity-based sensors provides crosschecks of VWC at the same depths of the fiber. Possible effects of the nylon jacket that surrounds the metal sheath are investigated through thermocouples wrapped around the fiber cable. Heat pulses of different duration and power are applied in different moments during the day. Several soil moisture regimes are generated gradually lowering the water table inside the lysimeter. Analysis of both heating and cooling phase with different approaches are realized and presented. VWC inferred through the fiber and those by the capacitance-based probes are matched. Limits to the applicability of this technique are finally discussed.



S04.06-P -2

A QUICK, EASY AND LOW-COST METHOD FOR SAMPLING CO₂ IN SOIL GAS

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^[1]University of Newcastle ~ Environmental Engineering ~ Newcastle ~ Australia ^[2]University of Newcastle ~ Geology ~ Newcastle ~ Australia

In soils, stable isotopes and radiocarbon are utilised as naturally occurring tracers to infer retention times and turnover of SOM, which has lead to the identification of stable carbon pools – such as charcoal - in soils. Research into SOM dynamics has focussed on chemically or physically separated carbon fractions in soil, and to a lesser extent on dissolved organic matter (DOM) in soils. The general assumption is that during SOM humification and biodegradation, the vast majority of carbon is transformed into CO₂ and lost to the atmosphere. Using ¹³C and ¹⁴C in the CO₂ of soil gas as natural tracers of these turnover processes provides the potential of better quantifying and validating our current understanding of the soil carbon cycle, for example in modelling the turnover of carbon from different stabilisation pools of SOM. Here we present a simple, reliable and cost effective method of sampling soil gas with a manual apparatus that is easy to assemble and use. A gas-tight syringe is mounted to a series of stopcocks, which are attached to the soil gas probe tubing and a gas tight sampling bag for radiocarbon, or a needle and exetainer for d¹³C analysis. Laboratory tests using IRMS to detect d¹³C in CO₂ showed atmospheric contamination in the vials to be below the detection limit. The advantage of the method is that the dead-volume of the apparatus can be flushed from the system to the atmosphere prior to sampling, minimising atmospheric contamination.



S04.06-P -3

A SOIL INDEX FOR FARMER-BASED MONITORING

D'haene Karoline^{*[1]}, Wustenberghs Hilde^[1], Marchand Fleur^[1], Zendeheh Kamran^[1]

^[1]ILVO ~ Social Sciences Unit ~ Merelbeke ~ Belgium

The development of a soil index starts with identifying its goal and end-user. The definition of sustainable soil management 'preserve as many soil functions as possible for different types of land use' makes it clear that soil indices have to comprise the soil functions 'crop production' and 'environmental protection'. Achievability -i.e. costs- and relevance -i.e. the critical limits- are important 'SMART' criteria for indicators aiding farmers' management decisions. The soil index was developed in three steps: 1) choosing a minimum data set of soil properties; 2) transformation of values between the critical limits into common unitless scores and 3) selection of weights for the integration of indicator scores into an index. Soil researchers, advisors, extension agents and environmental experts were involved in each step as stakeholder involvement is commonly presumed to be a beneficial bridge between research and practice. Laboratory measurements of soil organic carbon (SOC), nitrogen, phosphorus and magnesium were selected as indicators because they apply well to the 'SMART' criteria. Since laboratory measurements of physical and biological soil properties are found to be too expensive for farmers, visual field methods were analyzed critically. The parameters size and form of aggregates, surface ponding, surface crusting, porosity, potential rooting depth and earthworm holes from the field methods were selected as indicators. Despite the fact that chemical, physical and biological soil quality indicators were selected, the high weight of SOC within the soil index indicates that the experts mainly advice farmers to improve their soil quality through SOC management.



S04.06-P -4

AN INTEGRATED SOIL MONITORING FRAMEWORK COMBINING REPEATED SAMPLING AND MODELLING OF ELEMENT CONCENTRATIONS

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^[1]Agroscope Reckenholz-Taenikon Research Station (ART) ~ Swiss Soil Monitoring Network (NABO) ~ Zurich ~ Switzerland ^[2]Swiss Federal Institute of Technology (ETH) ~ Institute of Terrestrial Ecosystems (ITES) ~ Zurich ~ Switzerland

A primary objective in soil monitoring is the detection of temporal changes of soil element concentrations. Two of the possible approaches for this task are: (i) direct monitoring (repeated soil sampling); (ii) indirect monitoring (balances of element inputs and outputs or dynamic modelling). Each one has its benefits and pitfalls. However, in combination they may complement each other. Within the Swiss Soil Monitoring Network (NABO) the direct and indirect approaches are applied since 1985 at 46 agricultural soil monitoring sites, where field management records are gathered from the farmers annually and soil sampling is repeated every five years. Recently, the soil element concentrations have been modelled with the dynamic model EPIC (Environmental Policy Integrated Climate) in order to better account for soil processes. Sensitivity and uncertainty analyses have been carried out in order to map the model behavior and improve the understanding of the system. In this presentation, the measured changes of soil nutrients concentration in the top soil over five repeated samplings (1985-2009) and the predictions of the EPIC model are compared at 9 arable and 9 grassland sites. While at most of these monitoring sites the pattern of temporal changes are in agreement for both approaches, substantial differences were found at specific sites. The reasons are investigated and possible modifications of the EPIC model are discussed. Conclusions about the confidence in the indirect approach are drawn and recommendations for its optimal design provided.



S04.06-P -5

APPLICATION OF A ROTATIONAL SAMPLING DESIGN TO ADDRESS THE SPATIAL MEAN TEMPORAL TREND IN SOIL SATURATED HYDRAULIC CONDUCTIVITY

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In the humid tropics, vast tracts of former agricultural areas are being reclaimed by forests, either by secondary succession or by afforestation. These reforestations are likely to affect infiltration and permeability of the soil, influencing water flow paths and erosion processes. A suitable parameter to assess these changes in the soil is the saturated hydraulic conductivity (Ks). In order to estimate the temporal changes in mean Ks after catchment-scale reforestation of former pastures in central Panama, we employed a rotational sampling design for three reforestation trials: a teak plantation, a plantation with native tree species and natural forest succession. After a baseline survey we started an annual monitoring programme; to date, we completed three sampling campaigns. We will present details of the sampling design and associated methods of data analysis in order to discuss challenges in the development of monitoring networks for soil properties.



S04.06-P -6

DELINEATION OF MANAGEMENT ZONES IN A VINEYARD FOR SITE-SPECIFIC NITROGEN FERTILIZATION

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Vine canopy variability is strongly affected by heavy dug hillslope environments. As a consequence, soil fertility becomes one important factor affecting vine vigour, yield and wine quality. Soil nitrate content is a simple, easy-to-handle indicator of soil fertility related to vine vigour. The objective was to delineate homogenous zones suitable for fertilization practices in the framework of precision farming. The surveys were conducted in a 20ha-vineyard farm located in north-eastern Italy in 2009-2011 using a combined approach of detailed soil survey and radiometric inspection of vegetation. The variables considered for this study were: the main physical-chemical soil parameters (texture, om, pH, nitrate content), apparent electrical conductivity (ECa) in two polarizations, elevation and vegetation index (NDVI). An approach of uni- and multi-variate geostatistics was applied to collected data to model spatial variability and to interpolate data. The estimated values were treated using the analysis of geographic clustering based on the calculation of non parametric probability density function to obtain statistically significant clusters. The spatial pattern of nitrates in soil was preserved over the 2009-vine growing season and the successive vintages, showing it could be used to direct site-specific fertilization. The clusters identify homogeneous classes depending on soil properties and plant radiometric responses. The vineyard partition shows some positive correlation between nitrates in soil and vine vigour (measured as NDVI). The advantage to integrate a multivariate dataset by using a combined approach (geostatistics + clustering), consists in disclosing some permanent spatial structures which will be effectively used in variable rate fertilization.



S04.06-P -7

EDAPHOLOG®: AN AUTOMATIZED SYSTEM FOR MONITORING NUMERICAL ABUNDANCE AND BODY SIZE DISTRIBUTION OF SOIL MESOFAUNA

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Organic matter breakdown is carried out by decomposing soil biota. Soil mesofauna controls populations of soil micro biota by feeding and predating them. Consequently, their abundance and diversity are crucial for good quality soil. Measuring abundance and biomass of mesofauna taxa is a difficult task. If we need these data in large quantities for large ecological surveys, it appears almost impossible. On condition that we are able to assess body size distribution and numerical abundance of mesofauna we can monitor soil mesofaunal communities on a standardized way. If these variables are measured continuously, in-situ, automatically and as long as necessary without strong human interaction then we may have a solution for measuring soil biological activity with temporal-spatial considerations. In the frame of a LIFE+ project we developed EDAPHOLOG® System, a novel, monitoring system of soil biological activity and degradation, which is composed of an innovative, optical-electric sensing tool designed to continuously monitor biological activity in field, an own logging system for GSM remote data-transmitting storage and a data evaluation procedure. First of all, we will show how EDAPHOLOG® System operates, and how it provides data on body size distribution and numerical abundance of mesofauna. Moreover, we will present the results of testing of precision of body size estimation and counting success of trapped invertebrates within laboratory conditions. We would like to demonstrate that EDAPHOLOG® System is able to measure the numerical abundance of mesofauna in the 0 - 2 mm size range and to estimate their body size distribution reliably.



S04.06-P -8

ELABORATION OF THE SOIL DEGRADATION SUBSYSTEM OF THE HUNGARIAN ENVIRONMENTAL INFORMATION SYSTEM

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Regular data collection on the state of agricultural soils has not been in operation in Hungary for more than two decades. The soil fertility monitoring system (AIIR), which was started in 1978 stopped before completing the third phase in the late '80s. In the meantime, mainly thanks to the Hungarian Soil Strategy and the planned Soil Framework Directive, the demand for the information on state of Hungarian soils and the follow up of the harmful changes in their conditions and functioning has greatly increased. In 2010 the establishment of a new national soil monitoring system was supported by the Environment and Energy Operational Programme for Informatics Development. The aim of the project is to collect, manage, analyse and publish soil data related to the state of soils and the environmental stresses attributed to the pressures due to agriculture; setting up an appropriate information system in order to fulfil the directives of the Thematic Strategy for Soil Protection. Further objective is the web-based publication of soil data as well as information to support the related public service mission and to inform publicity. The developed information system will operate as the Soil Degradation Subsystem of the National Environmental Information System being compatible with its other elements. A suitable representative sampling method was elaborated. The representativity is meant for soil associations, landuse, agricultural practices and typical degradation processes. Soil data are collected on county levels led by regional representatives but altogether will be representative for the whole territory of Hungary.



S04.06-P -9

ESTIMATING SOURCES OF UNCERTAINTIES OF SOIL ORGANIC CARBON STOCK ASSESSMENTS WITHIN A SOIL MONITORING NETWORK

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^[1]INRA ~ INFOSOL ~ Orléans ~ France

The Kyoto Protocol, Bonn and Marrakesh agreements, provide that certain voluntary activities for an additional storage of organic carbon in soils can be accounted for under Articles 3.3 and 3.4 of this protocol. Soil monitoring networks are helpful for reporting sources or sinks at the national scale and the performance of such networks in that perspective must be addressed. Estimating the error associated with soil organic carbon (SOC) stock measurements, on each monitoring site, is required in order to assess SOC stock changes or stability. Here, we estimate the error related to SOC stocks (0-30cm) measurements on sites of the French Soil Monitoring Network. The error is modelled as a function of errors related to SOC content, bulk density and rock fragments measurements. To estimate the relative magnitude of the sources of errors of these variables, we undertook a nested analysis of data from 10 duplicate sites. The results show that the extreme values of SOC stock are not correctly estimated, especially for extremely low values of the stocks where the measurements of carbon contents appear as the main source of error. Altogether, the average measurement error is 11.2% and the bulk density and rock fragment percentage are the most contributing variables to errors in SOC stocks measurements. This estimated stock measurement error at site level appears however to be negligible compared to the SOC spatial variability when taken into account for computing SOC stocks at the national scale.



S04.06-P -10

EVALUATION OF METHODS TO ESTIMATE HUMUS EROSION AFTER COARSE-SCALE DISTURBANCES ON A MONTANE MIXED FOREST SITE IN THE NORTHERN LIMESTONE ALPS

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Mountain forests preserve soils and their humus layers from erosion and degradation. Coarse-scale disturbances, such as windthrow events frequently impair the integrity of these forest ecosystems. Humus disintegration and erosion after disturbances may lead to severe losses of forest functions and services. Therefore, methods to estimate the extent of soil degradation are urgently needed for adaptive and proactive management. Especially the Northern Limestone Alps, a hydrogeological karst system, hardly accessible, with steep topography and high spatial heterogeneity pose a formidable challenge. This study explores erosion and relocation dynamics after disturbances on shallow Follic Histosols and Rendzic Leptosols in an intact south exposed forest and two large adjacent windthrow areas of different age in the Höllengebirge mountain range (Austrian Northern Limestone Alps). Following methods for investigating soil degradation were applied: Aerial photo interpretation was used to detect area-wide land cover developments. Orthofotos from 2009 and 2010 were compared, documenting an on-going increase of bare rock on the site surface. The photographs were taken from an aircraft in 2009 and from a remotely controlled helicopter in 2010. Additionally humus gauges were installed in a geostatistical design to study and estimate soil loss or accumulation with respect to extreme climatic events, such as heavy rainfall. And finally, the particular soils at the same sampling plots were analysed to describe the impact of site dynamics on physical and chemical soil properties.



S04.06-P -11

EVOLUTION OF SOIL ORGANIC CARBON IN THE SWISS MONITORING NETWORK (NABO) OVER THE LAST 25 YEARS, 1985-2009

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The potential of carbon sequestration in adaption strategies underpins the importance of establishing a reliable soil monitoring system. However, assessments of long-term trends in soil organic carbon (SOC) content based on repeated measurements over large areas are very few because most existing national soil monitoring systems have undertaken a single sampling only and bulk density is estimated by PTF's instead of being determined. Until today, often rates of changes are approximated via modeling with high uncertainties and consequently, direct measurements by repeated soil monitoring programs are needed to further constrain these estimates. Here we present the results of measured SOC data and carbon pools from the NABO network 1985-2009. Detailed studies at monitoring sites showed that short-term temporal variation of soil properties can result from different site conditions at the sampling date. The majority of the measured temporal variation for all sites is interpreted as natural variation and not as real SOC changes. Moreover, the variation of soil bulk density was in the same order of magnitude as the measured changes in the SOC content. In this respect, the NABO strongly support the conclusion that within the Swiss monitoring network no carbon decline occurred over the last 25 years which in turn is not in line with other European countries.



S04.06-P -12

FIRST EVALUATION OF THE DISTRIBUTION AND ORIGIN OF BORON CONCENTRATIONS IN FRENCH SOILS ISSUED FROM THE FRENCH SOIL MONITORING NETWORK (RMQS)

Jolivet Claudy^{*[2]}, Nicolas Saby^[2], Line Boulonne^[2], Céline Ratié^[2], Dominique Arrouays^[2], Marion Bardy^[2]

^[1]INRA ~ US 1106 InfoSol ~ Orléans ~ France ^[2]INRA ~ US 1106 InfoSol ~ Orléans ~ France

A survey on water soluble boron concentrations in soils was performed in France using the French soil monitoring network. Boron concentrations in soils vary over disparate spatial scales because of the effect of factors such as parent materials, depositions from atmospheric sources through marine aerosols, point source pollution or varying soil properties affecting boron behaviour in soil. Robust geostatistical methods have been used to understand the underlying variations of boron concentration in soils and to detect the presence of natural or anthropogenic outliers in the data set. The median concentration of boron in French surface soil (0-30 cm) was 0.21 mg.kg⁻¹, with 95% of the data less than 0.49 mg.kg⁻¹. The pedogeological background in boron varied over the territory. The highest concentrations (1 to 5 mg.kg⁻¹) were measured in coastal soils issued from marine sediments. Soils developed in clayey or chalky materials exhibited concentrations higher than the median value with 0.36 and 0.33 mg.kg⁻¹ respectively, whereas soils developed in hard limestone, volcanic or sandy materials showed the lowest concentrations with median values of 0.17, 0.13 and 0.12 mg.kg⁻¹ respectively. The spatial analysis revealed also a gradient of boron covering a large area along the north-west coast, originating from atmospheric deposition coming from the sea. Few numbers of outliers were related to point source pollution. The RMQS gives the first evaluation of the distribution and origin of water soluble boron concentrations in soil over the French territory with major concerns in soil boron deficiency or toxicity for plant growth.



S04.06-P -13

FOREST SOIL MONITORING OF ORGANIC POLLUTANTS IN GERMANY

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PAHs, PCBs, and DDx are ubiquitously found in the environment. To make use of the forest filtering effect the environmental agencies in Germany launched a monitoring study of POPs in German forests within the framework of ICP Forests, namely for 16 priority PAHs (EPA PAHs), indicator PCBs, and DDT with five of its metabolites. The content of these organic pollutants was determined in the O-horizon and the mineral top soil at 470 sampling plots distributed in a 16 km x 16 km grid. The following results refer to the O-horizon. The concentration of 16 PAHs shows a median of 1,500 µg/kg d.w. where the PAH pattern reflects local emission situations and (historical) industrial impact. The concentration of PCB6 shows a median of 13 µg/kg d.w.. All samples exhibit similar PCB patterns with highly-chlorinated congeners as dominating compounds (PCB153>138>180). Generally, there is a trend towards higher concentrations in the north-western part of Germany compared to the south-east. Peak concentrations occur close to industrialized urban areas. DDT and its metabolites with a median of 31 µg/kg d.w. show higher concentrations in eastern Germany where it was used until the early nineties. We interpret these results as ubiquitous background contamination at most sites. Samples with enhanced concentrations indicate sites with industrial activities (PAHs, PCBs) and application of pesticides in agriculture or forestry (DDT). The study proves the need for further monitoring of organic pollutants in view of long range distribution effects as well of local and regional applications in a European wide scale.



S04.06-P -14

FUNDAMENTALS FOR THE USE OF SOIL MICROBIOLOGICAL METHODS IN LONG TERM MONITORING

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Soil microbiological parameters are important indicators for soil quality. Therefore the use of these parameters in long-term soil monitoring programs is essential. Microbial biomass (BM), determined with substrate-induced respiration (SIR) or chloroform fumigation extraction (FE) method as well as soil respiration are the most commonly used parameters in monitoring programs. However, the quality assurance of such data is not well established. Whereas the precision of determination with standardized microbiological methods is in a similar range as that of chemical methods, long term repeatability between years of microbiological methods over several years remains a major problem. This is mainly due to the lack of stable reference samples as well as to difficulties with the absolute calibration of these methods. For controlling long term repeatability of microbiological methods in long term monitoring we use a procedure with frozen reference samples. From a well homogenized sample a large quantity of subsamples is frozen. Within every series of determination of microbiological parameters one of these subsamples is analysed together with the real samples during several years. Results of this procedure are presented and its feasibility is discussed in the context of quality assurance.



S04.06-P -15

HOW TO HARMONIZE THE DATA COLLECTED FROM DIFFERENT SOIL MONITORING NETWORKS: A CASE STUDY IN FRANCE

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Regulations about soil quality become more and more international while monitoring networks are rather national or even local . Since these networks use different sampling strategies, there is a strong need to harmonize a posteriori the collected data from the local networks in order to answer questions raised by the global regulations. Studies about data harmonization methodologies, such as the ENVironmental ASsessment of Soil for mOnitoring project (ENVASSO), have underlined the need to set up calibration sites where different sampling strategies have been carried out in order to construct pedotransfert functions between soil indicators measurements from different the sampling protocols. However, how to define the number and the position of these calibration sites remains a key issue. A case study is available for French forest soils as they have been sampled twice on the same sampling grid but with different sampling and analytical strategies. This was done in the frameworks of the French soil quality monitoring network (RMQS) and the European forest soil monitoring network (BioSoil). In this work, we compared both RMQS and BioSoil strategies using a set of measured variables (e.g. carbon content, potassium content, lead content and pH). We investigate the questions about the number and localization of the sites by testing the stability of pedotransfert functions on the selected soil indicators in terms of the power of prediction. Several resampling procedures with different number of sites have been tested such as random sampling or stratified random sampling.



S04.06-P -16

LEGACY DATA, A HELP OR A HINDRANCE TO SOIL CLASSIFICATION AND MAPPING?

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Harmonised soil information within a 1:250,000 geo-referenced soil database will allow exchange of data across member states and provide the information needed by the European Commission and European Environment Agency for reporting on issues relating to soil quality under the forthcoming Soil Framework Directive(s). National soil survey programmes have generated vast amounts of vital information in relation to soil classification/associated properties, through the wealth of analyses completed over the last 50yrs. However, it is vitally important that the application of legacy data to inform production of new maps/databases takes into account the changing methodology and equipment over that 50 year period. Changes in soil property methodology require comparison to more modern methods due to changes in detection limits and inclusion of standard reference materials, as well as changes to the methodology itself. In addition there is the legacy of the storage method for soils re-analysed from archives. Soils can degrade if not properly sealed from gaseous exchange with the atmosphere or from chemical interaction with the storage container. The ISIS project will provide a new classification for Ireland that (a) reappraises, rationalises and updates data capture for surveyed areas; (b) predicts maps of unsurveyed areas, based on soil-landscape models and data from surveyed areas, including additional capture of new data for soils not previously encountered, using traditional soil survey techniques; (c) construction of a soil information system for Ireland (SIS) that will provide a data infrastructure for organising, managing and disseminating soil information at national and international level.



S04.06-P -17

MAKING USE OF THE WORLD REFERENCE BASE DIAGNOSTIC HORIZONS FOR THE SYSTEMATIC DESCRIPTION OF THE SOIL CONTINUUM

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The World Reference Base for Soil Resources (WRB) (FAO, IUSS Working Group WRB, 2007) at present does not acknowledge the soil continuum, but provides a sound basis to do so. The soil profile until a depth of 100 cm is systematically described by the relative parts of the diagnostic horizons it is composed of. Typical diagnostic horizon thickness and occurrence probability was predicted from terrain parameters by classification and regression trees (CART), throughout the research area in southern Ecuador. The two disadvantages of CART, abrupt prediction class boundaries and dependence on the dataset, were addressed by hundredfold model runs of different data subsets, Jackknife partitions, leading to a range of possible predictions. Prediction uncertainty was included in the digital soil maps by calculating these predictions' means and standard deviations and by horizon occurrence probability prediction. Model performance was evaluated by means of hundredfold external cross validation. Terrain parameters were found to have a strong influence on topsoil properties. However, no influence on the vertical profile differentiation was observed. Hence predicting horizon thickness and subsoil properties was difficult. Whether the first mineral soil horizon displays stagnic properties or not, might depend on physical soil properties in addition to terrain parameters. The systematic description of the soil continuum of this particular soil-landscape resulted in histic and stagnic soil parts dominating the first 100 cm of the soil column for most of the area.



S04.06-P -18

MAPPING ORGANIC CARBON POOLS OF SWISS FOREST SOILS

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Quantifying carbon (C) pools and fluxes in forest ecosystem is of interest because C sequestration into forest sinks offsets greenhouse gas emissions under the Kyoto protocol. In Switzerland, the National Forest Inventory offers comprehensive data to quantify the aboveground forest biomass. Estimating pools of soil organic C (SOC) in forests is more difficult because of its high spatial variability. Based on data from 1033 sites, we modelled topsoil (0-30 cm) SOC pools for the Swiss forest area below 2'000 m a.s.l. We used a novel robust restricted maximum likelihood method to fit a linear regression model with spatially correlated errors to the C pool data. For the regression analysis we used covariates derived from climate data, two elevation models (resolutions 25 and 2 m), spectral variables representing vegetation and a soil map. Precipitation, reflectance of the vegetation in the near infrared range of the spectrum, a topographic position index and aggregated soil map information were the only significant covariates. The residual autocorrelation was weak but significant. Testing the predictive power of the fitted model with independent test data showed acceptable precision of the predictions (coefficient of determination 0.46). The fitted model was used to map the carbon pool in forest topsoils on a 1-ha grid over Switzerland. The mean SOC storage (without organic surface layers) was 79.5 Mg/ha (standard error, SE 1.4 Mg/ha). Organic surface layers stored another 12.4 Mg/ha (SE 0.9 Mg/ha), hence we estimated a total mass of carbon of 114.4 Tg stored in Swiss forest topsoils.



S04.06-P -19

MEASURING BULK DENSITY IN LARGE SCALE SOIL INVENTORIES TO ESTIMATE SOIL ORGANIC CARBON STOCKS - REGRESSION EQUATIONS FOR CORRECTING THE RESULTS FROM DRIVING HAMMER EQUIPMENT AND SOIL SAMPLE RINGS

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As soils can play a vital role in mitigating climate change, calculating and international reporting of emission and sequestration of greenhouse gases, due to the UN Framework Convention on Climate Change, are present standard. To enhance this reporting, especially for agricultural land use, a consistent dataset on SOC stocks in arable soils is strongly required in Germany. The SOC stock of an individual site is the product of SOC concentration and bulk density. Uncertainty of SOC stock accelerates with bulk density estimation versus measurement. But it is beyond question, that evaluating bulk density in the field is a time-consuming and expensive procedure. Soil sample rings are the standard method to define soils` bulk density in lab-analysis (ISO 11272:1998). But in line with large-scale soil monitoring time and cost-efficient sampling strategies are of great interest. Therefore driving hammer equipment provides an interesting alternative for volumetric soil sampling. As pointed out by Parfitt et al. (2010), bulk density from driving hammer cores will be underestimated by 5% versus the soil sample ring method. Hence correction is needed, because it is critical to entitle a change in SOC stock which might only depend on sampling methodology. Three driving hammer equipments and three soil sample rings with varying diameters will be compared within a systematic field experiment on four sites with negligible stone content. The authors evaluate the repeatability of bulk density within and across different sampling devices and obtain regression equations for data correction, using depth increments, texture, and soil moisture as covariates.



S04.06-P -20

MIXED MODEL METHODOLOGY IS SUITABLE FOR ANALYSING SOIL MONITORING DATA

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Soil monitoring networks provide valuable data for understanding soil properties and their spatio-temporal changes. However, for respectable results appropriate data analysing methods in combination with experience from soil science have to be used. In Estonia a soil monitoring network of arable land was started in 1983. 79 sites with cereal-based crop rotation were selected for monitoring and re-sampled after 4 years. The monitoring scheme was hierarchical as ten plots were established within transect and four transects within site. The monitoring ended in 1994 due to political changes and was resumed in 2002. We used data collected from 1983 to 2008 to predict soil organic carbon concentration and soil bulk density of mineral soils in the humus horizon. The dataset consists of 90 different sites all over Estonia holding 17,294 unique soil bulk density and 8,697 unique soil organic carbon concentration values. We used different statistical approaches (median approach, analysis of variance, and mixed model) in order to find out which method gives results with the smallest prediction error. This also indicates which method enables to capture the variation imposed by the monitoring scheme. For both soil parameters we report mixed model-based methodology to predict with the smallest mean square error. Mixed model enables to capture the random variation introduced by the monitoring scheme with the random effects opposed to e.g., analysis of covariance or median approach. Therefore we recommend using mixed model-based method to analyse soil monitoring data if the sampling scheme is nested.



S04.06-P -21

MONITORING AND INTERPRETING THE PHYSICAL QUALITY OF ARABLE SOILS

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Modern agriculture focusing on intensive crop production often causes physical soil degradation. Since a decline of physical soil quality takes considerable time and costs to correct, farmers should be able to regularly monitor and interpret their soils and if necessary adapt their soil management. The objective of this research was to 1) critically review the existing monitoring methods and 2) develop a matrix -based on an evaluation of the impact of field management on the physical soil properties- which can help farmers to improve their soils. A literature review showed a wide range of monitoring methods. Quantitative (i.e. laboratory measurement), semi-quantitative (i.e. field measurement) and qualitative (i.e. visual assessment) methods vary in reliability, clearness, sensitivity and costs. Independent of the method the results can only be interpreted by farmers if reference values or critical limits are available. Therefore, reference values and critical limits of physical soil properties from literature were evaluated by soil experts for the specific soil and climate conditions of Western Europe. If the interpretation of the results from the monitoring methods signals that action is needed, farmers can look into the developed matrix for the best option for their farm. Based on a literature review and an expert consultation the cells in the matrix indicate which types of tillage, crop rotation, green manure and fertilization have a positive, negative or neutral effect on physical soil properties. The impact of the field management is nuanced by using seven classes between 'very positive' (+++) to 'very negative' (---).



S04.06-P -22

MONITORING LAND USE INDUCED CHANGES OF CARBON STOCKS IN GRASSLAND AND FOREST SOILS – LESSONS LEARNED FROM REGIONAL CARBON INVENTORIES

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Fertilization, grazing, and mowing of grasslands and harvesting of forests can potentially result in changes of soil organic carbon (OC) stocks. Here we present data from three large scale soil carbon inventories in Germany. In each of our study areas (Schorfheide-Chorin, Hainich-Dün and Schwäbische Alb) which have a size of 1300, 1561 and 423 km² we sampled 500 grassland and 500 forest soils. Organic C stocks in different soil horizons (O, A, B, E horizons) and depth increments (0-10 cm, 10-30 cm, 30-50 cm, etc.) were determined. Our results show that it is difficult to extract management related changes in OC stocks. The largest management related effect was due to fertilization in grasslands and this was still relatively small (+0.8 kg OC m⁻²) considering the high total carbon stocks of >10 kg OC m⁻² in many grassland soils. Spatial variation hampers the identification of management related changes in soil OC. On the regional scale, the coefficient of variation for soil OC stocks was similar in grasslands and forests and increased from 20% in topsoils to 80% in subsoils. Due to the high variability of soil horizon thickness it was easier to detect OC stock changes in depth increments than in soil horizons. Significant parts of the regional spatial variation in our data set could be explained by soil type, slope, slope aspect, and soil texture. These co-variables need to be considered when land use related carbon stocks are monitored.



S04.06-P -23

MONITORING SOIL QUALITY IN THE NETHERLANDS: KEY CHALLENGES

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Since the early 1990s the Dutch National Institute for Public Health and the Environment (RIVM) has been developing the National Soil Quality Monitoring Network (LMB). The LMB monitors the composition of the soil in the Netherlands for ten combinations (categories) of soil type and land use, mainly agricultural. The objectives of the network are: (1) to analyse trends in soil quality and (2) to analyse and where possible explain differences in soil quality between categories. The network is used to report on soil quality to the national government. The network consists of 20 sites for each category, 200 monitoring sites in total. Over a 5-year cycle, each year two of the ten categories are sampled (40 sites). Key challenges in this monitoring program are: (1) changes in land use in time, making it difficult to determine trends in soil quality; (2) changes in laboratory methods, resulting in difficulties to compare results over the years; and (3) a lower power to detect trends than expected at the start up of the program, owing to the limited statistical knowledge available at that time. It is recommended to focus on analyzing differences in soil quality between categories using data on farm management. In addition, it is recommended to harmonize LMB with other monitoring programmes, such as the Biological Indicator of Soil Quality (BoBI) and the Minerals Policy Monitoring Program (LMM). By implementing these steps, the LMB would be keeping in line with new policy developments, such as the concept European Soil Framework Directive.



S04.06-P -24

NEW TAXONOMIC FRAMEWORK FOR ENHANCING A HORIZON LOWERCASE SUFFIXES TO ENABLE DETAILED MONITORING OF SOIL CHANGE IN TOPSOILS.

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The A horizon is one of the most important soil layers subject to environmental and anthropogenic impacts. Current taxonomic protocols for A horizon designations in most soil classification systems is centered on identifying the soil process. This reliance on process designators (i.e., Ap, Ah etc,) does not provide sufficient differentiation within the A horizon designation for detailed topsoil characterizations. For example, in assessing agricultural fields, despite implementing beneficial management and remediation practices, all of the A horizons affected would still be designated as an Ap horizon; for forest soils as Ah horizons. It was recognized that additional taxonomic protocols were essential to enable tracking specific subtle soil changes when applying new management practices or evaluating impacts from environmental and anthropogenic stressors such as climate change and urbanization. Information was needed about soil properties subject to dynamic change to assess the kind and extent of impact on the soil. Intensive field workshops carried out in Canada and Germany has led to the development of enhanced four-level protocols for A horizon lower case suffixes. These new taxonomic protocols define designators for soil processes, soil structure, organic carbon and pH. By applying the new four-level designators, for example, an enhanced Ah horizon designator is "Ah[gr](h){n}" where h – humus accumulation, gr – granular structure, h – high organic carbon and n – neutral pH. The new A horizon framework and its potential for enhanced topsoil characterization and soil monitoring will be discussed.



S04.06-P -25

SPATIAL DISTRIBUTION OF ORGANIC MATTER RESERVES IN THE FOREST SOILS OF KARKONOSZE MOUNTAINS NATIONAL PARK (SOUTH-WEST POLAND)

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In the 1970s and 1980s the industrial emissions caused rapid decay of dense spruce forests and transformation of natural ecosystems in Karkonosze Mountains. This situation initiate expansion of grasses which influanced on soil cover and organic matter reservoir. To observe ongoing changes in forest habitats, system of forest environment monitoring was established. The system of forest environment monitoring in the Karkonosze Mountain National Park consists 630 spherical areas located in forest zone and 230 areas in subalpine zone, arranged in a regular grid 200x300m. Samples for analyses was prepared by mixing at least four primary soil samples taken with a pedological sampler from circular monitoring areas. From each of spherical surfaces, samples of forest litter and from 0-10 cm and 10-20 cm depth were taken. The following analyses were made on all samples: loss on ignition (in organic samples) and organic carbon by Turin method (in mineral and mineral-organic materials) recalculated to organic matter content. The average content of organic matter grows in all high-altitude levels most poorly in forest litter (20%), stronger in 0-10 cm layer (130%) and most strongly in 10-20 cm (300%). It mean that with depth the thickness of organic and organic-mineral horizons are increasing and it's conected with altitude arrangement of soil units. Thickness of ectohumus is increasing with altitude but averages are doesn't different statistically.



S04.06-P -26

THE INTERNATIONAL SOIL MOISTURE NETWORK: A GLOBAL SOIL MOISTURE MONITORING PLATFORM

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The important role of soil moisture for the hydrological cycle is a well-known truth; therefore monitoring soil moisture conditions is of major interest. Although meteorological networks measuring soil moisture exist all over the globe, their observations are not easily accessible and are not provided in common technical standards. The collected data differ in units, measurement depths, sampling rates and measurement techniques. Thus, handling and especially comparing these datasets is a demanding issue. To overcome these limitations the International Soil Moisture Network (ISMN; <http://www.ipf.tuwien.ac.at/insitu/>) has been initiated to act as a centralized data hosting facility. Available in situ soil moisture measurements from various networks over the whole globe are collected, harmonized and after a quality check stored in a database. In addition, meteorological variables such as soil temperature, air temperature and precipitation are inserted into the ISMN as well as wilting point, field capacity, saturation and plant available water. Through a web interface users can easily access and download the data. Currently, data from 27 networks covering more than 800 stations in Europe, Asia, Australia, North America and Africa is hosted by the ISMN. With historical measurements from 1952 on up to near-real time available measurements and a growing spatial coverage the ISMN is becoming a valuable foundation for soil monitoring and a variety of validation products. In this contribution the automated workflow from harmonization and quality control to the implementation will be introduced and an overview of the contents will be given.



S04.06-P -27

THE TOTAL PHOSPHORUS CONTENT OF SOILS AND ITS SPATIAL DISTRIBUTION IN FRANCE

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The spatial distribution of phosphorus content in soils is essential to better know the stock of phosphorus in agricultural areas, but also to have indices on the phosphorus stock that can be transferred to water bodies. Most soil analyses relying on soil content in phosphorus are based on the extractable P with different methodologies (Dyer, Olsen or Menlich most often), but P total content is less measured, because of the cost of analyses. In this context, we want to estimate the P total content in French soils. An estimate of total phosphorus stored in French soils was made using data from geo-referenced databases. For this statistics on carbon stocks in soils were produced according to different land uses and soil types and properties. Then, using a combination of maps of soil and land use we were able to estimate regional and national phosphorus stocks. This soil phosphorus map of France allowed us to identify the main controlling factors of the phosphorus distribution.



S04.06-P -28

TWO DIFFERENT ANALYTICAL APPROACHES IN LASER INDUCED BREAKDOWN SPECTROSCOPY (LIBS) TECHNIQUE TO DETERMINE ELEMENTAL CONCENTRATIONS IN SOILS

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Laser Induced Breakdown Spectroscopy (LIBS) is an analytical technique based on the optical emission spectroscopy of the plasma generated by high energy laser pulse and solid sample. LIBS allows to perform stand-off and in situ analysis with immediate response and a limit of detection (in the range of mgkg⁻¹), and for these peculiarities is particularly suitable for analysis in the environmental field. In this work is presented a case of study where the elemental analysis of some polluted soils are obtained either with the classical calibration curve (CC) method or with a Local Thermodynamic Equilibrium (LTE)-based Calibration-Free (CF) method, in order to demonstrate the capability of this technique. It is important to underline that the latter methodology does not require the use of preliminary experiments with standard samples and so it does not have any limitation due to the matrix effect. Several polluted soil samples were analyzed by drawing calibration lines to determine the concentration of some trace metals (e.g., Cr, Pb, Cu, Zn, Sr, Ni), as well as those of some major elements (e.g., Fe, Mn, Mg). The elemental concentration (normalized by Fe concentration) was measured with ICP-OES and LIBS techniques respectively. For what concern LIBS measurements, a comparison was done between two different data treatment: the LTE-CF based method and the classical CC method. For some elements a comparison was tried between calibration lines and calibration-free data, in order to validate the latter techniques also for complex matrices such as soils.



S04.06-P -29

USE OF LEGACY DATA FOR BROAD SCALE SOIL MONITORING

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Soil monitoring networks (SMNs) are required globally to identify threats to soil function and to confirm that current land management practices are sustainable. The intensity of sampling required for the SMN to achieve the desired accuracy will depend upon how both the status and rate of change of key soil indicators vary in space. This information is not known exactly prior to the establishment of the SMN but it might be inferred from available soil legacy information. For example within Victoria, Australia there exists a database of over 70,000 results of soil nutrient tests requested by farmers since the mid-1970s. These tests broadly cover all of the agricultural land in the state and include a wide range of farming systems. The soils were sampled according to the farmers' concerns which include investigating poor performance, optimising fertiliser use or a desire to monitor soil functionality, there is a risk that the survey might not be fully representative. In this talk we will discuss the extent to which this soil legacy information can be used to monitor soil functionality and/or to design SMNs. We will test whether significant temporal trends can be identified in the soil nutrient concentrations and the significance of these trends for sustainable farming in Victoria. Finally we will demonstrate the impact of the inferred soil trends upon optimized designs of a state-wide SMN and quantify the benefits of implementing such an SMN rather than continuing to analyse the results of the farmers' survey.



S04.07-P - SYNCHROTRON RADIATION IN SOIL SCIENCE: APPLICATIONS AND METHOD DEVELOPMENT

Thursday 05 July 2012 from 17:00 to 18:30. Room Poster Areas

S04.07-P -1

EVAPORATION INDUCED ORDER IN AQUEOUS SOFT SOLID PHASES OF CLAYS

Elisabeth Lindbo Hansen, Trondheim - Norway

S04.07-P -2

EXAFS STUDIES OF SOIL IRON IN RELATION TO BIOLOGICAL PARAMETERS

Edith Hammer, Roskilde - Denmark

S04.07-P -3

EXPLORATION OF SYNCHROTRON RADIATION TO VISUALIZE WATER/AIR MENISCI IN SMALL SOIL SAMPLES AT DIFFERENT WATER POTENTIALS

Valerie Pot, Thiverval-Grignon - France

S04.07-P -4

HIGH RESOLUTION X-RAY COMPUTED TOMOGRAPHY (XCT) OF SOIL AND ROOT STRUCTURES

Samuel Keyes, Southampton - United Kingdom

S04.07-P -5

REDUCTION OF MANGANESE OXIDES BY SULFIDE STUDIED BY IN SITU XAFS MEASUREMENTS

Thilo Behrends, Utrecht - Netherlands

S04.07-P -6

SPATIALLY RESOLVED QUANTITATIVE DETERMINATION OF IRON (FE) IN PLANTS BY MEANS OF SYNCHROTRON MICRO X-RAY FLUORESCENCE

Roberto Terzano, Bari - Italy

S04.07-P -7

SPECIATION OF COPPER AND ARSENIC ENRICHED IN AGRICULTURAL LIME

Michael Kersten, Mainz - Germany



S04.07-P -8

SYNCHROTRON X-RAY SCATTERING STUDIES OF SOFT NANOSTRUCTURES IN FLUOROHECTORITE CLAY

Jon Otto Fossum, Trondheim - Norway

S04.07-P -9

X-RAY ABSORPTION STUDY OF AS(V) SPECIATION IN IRON RICH SOILS

Juan Antelo, Santiago de Compostela - Spain



S04.07-P -1

EVAPORATION INDUCED ORDER IN AQUEOUS SOFT SOLID PHASES OF CLAYS

Hansen Elisabeth Lindbo^{*[1]}, Hemmen Henrik^[1], Dommersnes Paul^[2], Fossum Jon Otto^[1], Fossum Jon Otto^[1]

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The present study concerns ordering in soft solid suspensions of Na-fluorohectorite and Laponite RD clays in water, and the investigation of these systems by x-ray scattering, x-ray absorption and birefringence imaging. We demonstrate the possibility for promoting orientational order in initially isotropic dispersions of Na-fluorohectorite and Laponite RD by a slow evaporation of the dispersion water. From the anisotropy of the x-ray scattering from the ordered phases, it is possible to obtain quantitative measures for the order [2]. From x-ray absorption, knowing the composition of the solvent and of the dispersed phase, it is possible to calculate the clay volume fraction [3,4]. It is evident that the development of orientational order is not counterindicated by the viscoelastic nature of the samples, and that although the translational and likely also rotational diffusion of the particles is restricted in the soft solid state, the orientational degree of freedom can undergo a transition from a collectively random to an ordered state. [1] L. Onsager, Annals of the New York Academy of Sciences 51, 627 (1949). [2] Y. Méheust, K. D. Knudsen, and J. O. Fossum, J. Appl. Cryst. 39, 661 (2006). [3] F. M. van der Kooij and H. N. W. Lekkerkerker, J. Phys. Chem. B 102, 7829 (1998). [4] D. M. Fonseca, Y. Meheust, J. O. Fossum, K. D. Knudsen, and K. P. S. Parmar, Phys. Rev. E 79, 021402 (2009).



S04.07-P -2

EXAFS STUDIES OF SOIL IRON IN RELATION TO BIOLOGICAL PARAMETERS

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We examined fourteen different soils from across the world with EXAFS for their Fe minerals, and their proportion of organically to inorganically bound Fe fractions. We are relating the Fe speciation to other soil properties as pH, organic matter fraction, microbial parameters and soil aggregation, in which Fe plays a role. Preliminary results indicate that the greatest differences could be found according to climate zones, as tropical soils grouped at other mineral forms than temperate or arctic soils. In a comparison of soils grown with or without arbuscular mycorrhizal fungi, we could find strong differences in soil aggregate formation. We hypothesized that an enhanced fraction of organically bound Fe could serve as a stabilizer between organic matter and minerals in the soil aggregates. This biological effect on soil aggregation was however not measurable in the Fe-EXAFS-spectrum. The future use of imaging synchrotron light techniques can be a more powerful tool to detect such small-scale effects at biological interfaces.



S04.07-P -3

EXPLORATION OF SYNCHROTRON RADIATION TO VISUALIZE WATER/AIR MENISCI IN SMALL SOIL SAMPLES AT DIFFERENT WATER POTENTIALS

Pot Valerie^{*[1]}, Peth Stephan^[2], Vogel Laure^[1], Garnier Patricia^[1], Pinheiro Marc^[1], Vieubl -Gonod Laure^[3], Ogurreck M^[4], Beckmann Felix^[4]

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Description of the hydration status of soils is essential to properly understand and quantify the diffusion pathways of nutrients and pollutants in soils. With the recent developments of pore-scale models that describe the biological functioning of soils and non-invasive experimental techniques to describe soil structure in 3D, explicit description of the spatial distribution of water and air in soil pore space is now needed. Pore network models, lattice-Boltzmann methods and pore morphology models are approaches that give access to the location of water/air menisci in the complex 3D geometry of soil pore space. However, these models lack of experimental evidence of the spatial distribution of water and air. Indeed, because of the different drying and wetting cycles occurring in a given soil sample, a complex distribution can be found. We present Synchrotron-based X-ray CT images of the water menisci in a complex 3D porous media. Small soil samples (6x6x6 mm³) were carefully sliced with a razor blade from a repacked column made of calibrated aggregates (2-3 mm) packed at a given bulk density of 1.2 g/cm³. The soil cubes were equilibrated at 3 fixed water potentials (-20, -10 and -5 hPa) using a miniaturized suction design. The design was specifically adapted to carry out measurements at the SR- CT facility operated by the GKSS research centre at HASYLAB (Hamburger Synchrotron Strahlungslabor) belonging to the DESY (Deutsches Elektronen Synchrotron) in Hamburg, Germany. The quality of the images allowed to visualise the water/air interface in the pores, without using dopant for water.



S04.07-P -4

HIGH RESOLUTION X-RAY COMPUTED TOMOGRAPHY (XCT) OF SOIL AND ROOT STRUCTURES

Keyes Samuel^[1], Grinev Dmitry^[4], Boardman Richard^[4], Mavrogordato Mark^[4], Marchant Alan^[2], Sinclair Ian^[1], Roose Tiina^[3], Smyth Kevin^[2]

^[1]University of Southampton ~ Engineering Materials & Surface Technology Group, Faculty of Engineering and Environment ~ Southampton ~ United Kingdom ^[2]University of Southampton ~ Centre for Biological Sciences ~ Southampton ~ United Kingdom ^[3]University of Southampton ~ Bioengineering Sciences Research Group ~ Southampton ~ United Kingdom ^[4]University of Southampton ~ μ -VIS Centre, Faculty of Engineering and Environment ~ Southampton ~ United Kingdom

There is a significant need to increase our understanding of the structural parameters related to soils and root development. Interactions between root structures and soil systems have been shown to be significant in governing many plant characteristics and processes, including phosphate uptake, water absorption and drought tolerance. Despite this, attempts to accurately model root behaviour have been hampered by a lack of robust validation with respect to the latest generation of non-destructive imaging techniques. In recent years, use of high-resolution X-ray Computed Tomography (XCT) has increased greatly in the fields of soil physics and root biology, being used to provide new insight into root development and numerous structural characteristics of soils. Few direct comparisons have however been made between different measurements, tools and approaches, and most previous work consists of stand-alone studies. Translation of findings into valuable and robust outputs for use in complementary disciplines requires cross-validation and development of repeatable methodology. The primary focus in this study is the investigation of reasonably robust approaches to feature extraction from images of soils, facilitating the extraction of significant structural parameters (such as porosity levels). Direct comparisons should thus be possible between XCT methods and established approaches to determining such parameters. A variety of complementary XCT tools are available for this work, including bench-top scanners, a bespoke high-energy 'hutch' system, and synchrotron light sources, allowing multi-scale investigation (lengths from <5mm to >1.5m), at resolutions down to <1 μ m.



S04.07-P -5

REDUCTION OF MANGANESE OXIDES BY SULFIDE STUDIED BY IN SITU XAFS MEASUREMENTS

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Redox cycling of manganese(Mn) is a characteristic phenomenon at oxic/euxinic water column redoxclines. When Mn oxides enter euxinic waters by sedimentation they become reduced by dissolved sulfide. The cycle is closed when reduced Mn in the form of dissolved Mn(II) returns into oxic waters by diffusion and reacts with oxygen to Mn oxides. A mechanism for the reaction between sulfide and Mn oxides has been proposed by Herszage and Afonso (2003) but uncertainties remain regarding the mechanism of the reaction. Here, we investigated the reaction of Mn oxide with sulfide between pH 7.5 and pH 9.5 in a batch reactor. During the reaction, the suspension was pumped through a capillary which was located in a X-ray beam for collecting X-ray absorption spectra in transmission mode. No indications for the formation of Mn(III) intermediates during the reaction were obtained from analyzing the XAFS spectra. The change in XAFS spectra can be explained by a transformation of Mn oxide into MnS. The reaction proceeded in two phases: a fast initial reaction which consumed about half of the added Mn oxide was followed by a slower second reaction phase. The rates and extent of the second reaction phase decreased with increasing pH. The consistency of these observation with the proposed reaction mechanism by Herszage and Afonso (2003) will be discussed. Reference: HERSZAGE, J. and AFONSO, M.D.S., 2003. Mechanism of Hydrogen Sulfide Oxidation by Manganese(IV) Oxide in Aqueous Solutions. *Langmuir*, 19(23), pp. 9684-9692.



S04.07-P -6

SPATIALLY RESOLVED QUANTITATIVE DETERMINATION OF IRON (FE) IN PLANTS BY MEANS OF SYNCHROTRON MICRO X-RAY FLUORESCENCE

Terzano Roberto^{*[1]}, Alfeld Matthias^[2], Janssens Koen^[2], Vekemans Bart^[3], Schoonjans Tom^[3], Vincze Laszlo^[3], Tomasi Nicola^[4], Pinton Roberto^[4], Cesco Stefano^[5]

^[1]University of Bari ~ Department of Agroforestry and Environmental Biology and Chemistry ~ Bari ~ Italy ^[2]University of Antwerp ~ Department of Chemistry ~ Antwerp ~ Belgium ^[3]Ghent University ~ Department of Analytical Chemistry ~ Ghent ~ Belgium ^[4]University of Udine ~ Department of Agricultural and Environmental Sciences ~ Udine ~ Italy ^[5]Free University of Bozen ~ Faculty of Science and Technology ~ Bozen ~ Italy

Iron is an essential element in plant nutrition and the determination of its concentration, location and chemical form is of paramount relevance to study Fe homeostasis in plants. Assessing the mechanisms of Fe uptake, transport and storage by plants is critical to overcome nutrition deficiencies for cultivated plants and to improve the nutritional value of food crops. For such studies, researchers need to visualize where iron is located at the level of the whole plant, the individual cell and the organelle. This requires a μm or sub- μm spatial resolution and a ppm or sub ppm detection sensitivity. Fe is not easy to analyze in plant materials because of its highly heterogeneous distribution with large differences in concentration, ranging from sub ppm to %, depending to its location. Especially the lower concentrations are hardly detectable with normal laboratory equipments (e.g., Electron Probe Micro Analysis, Proton Induced X-ray Emission). In this study, intact freeze dried leaves and roots of model plants such as tomato and cucumber have been studied for Fe distribution by scanning SXRF and confocal SXRF, without the need of sectioning. Quantification has been reached by using Fundamental Parameter algorithms coupled with standards analysis. With such an approach Fe distribution maps could be obtained with concentrations ranging from 100 ppb to 0,1%, with an accuracy of 2%. Such accurate distribution maps can be extremely useful to compare Fe allocation and concentration between plants altered with respect to the genes they express and/or the environmental conditions under which they are grown.



S04.07-P -7

SPECIATION OF COPPER AND ARSENIC ENRICHED IN AGRICULTURAL LIME

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Agricultural liming materials are used to correct soil acidity and to improve microbial functionality and plant growth. A brownish colored agricultural lime was found to contain up to 180 mg/kg copper and 125 mg/kg arsenic which is well above any fertilizing materials code threshold. The dark color of the milled material is due to ample black and brown dendrites. Electron microprobe analyses confirm that the dendrites rather than the carbonate matrix are responsible for elevated Cu and As concentrations in the limestone, where the Cu is bound by the black Mn oxide and the As by the brown Fe oxide dendrites. X-ray absorption spectroscopy (μ -XAS) at all relevant element K-edges (Fe and Mn as the matrix elements, As and Cu as trace pollutants) was used for a solid-state micro-spectroscopic speciation analysis approach. The μ -XAS spectra measured at the ANKA SUL beamline indicated the octahedrally coordinated Jahn-Teller cation of Cu(II) to be bound predominantly into lattice sites of the tectomanganate phase by substitution of Mn(III) tunnel edge sites. The μ -XAS results at the As K-edge revealed the pentavalent As species arsenate to predominate, with As-Fe distance and coordination indicating binding as strong inner-spheric adsorbate complex onto goethite. Both the Cu and As are therefore not likely to be mobilized and bioavailable under ambient physicochemical conditions, and the lime may therefore pose little threat to soils.



S04.07-P -8

SYNCHROTRON X-RAY SCATTERING STUDIES OF SOFT NANOSTRUCTURES IN FLUOROHECTORITE CLAY

Fossum Jon Otto*^[1], Hemmen Henrik^[1], Lindbo Hansen Elisabeth^[1], Rozynek Zbigniew^[1], De Miranda Fonseca Davi^[1], D. Knudsen Kenneth^[2], Meheust Yves^[3]

^[1]Norwegian University of Science and technology ~ Department of Physics ~ Trondheim ~ Norway ^[2]Institute for Energy Technology ~ Physics Department ~ Kjeller ~ Norway ^[3]Universite Rennes 1 ~ Geosciences ~ Rennes ~ France

Clays are everywhere, and they play very important roles in various areas like soil-, geo-, petroleum-, materials-, bio- sciences etc. In our research group, we have for several years studied interconnected physical phenomena in clays, using the clay fluorohectorite as a general model system for soft and complex matter with relevance to all the scientific areas mentioned above. Within this general context, we have studied phenomena such as: (i) spontaneous gravitationally induced phase separation and self-organization in systems of anisotropic clay nanoparticles in suspension, including isotropic to nematic transitions. (ii) transitions in magnetic field from biaxial to uniaxial nematics of anisotropic (diamagnetic) nanoparticle systems. (iii) guided self-organization into dipolar chain-structures of anisotropic clay nanoparticles in suspension when subjected to external electrical fields. (iv) stability of soft self-organized clay nanoparticle structures subjected to external mechanical stress. (v) role of structured water in the context of (i)-(iv). (vi) diffusion and spontaneous imbibition of fluids in nanoporous materials. In this presentation we focus on our most recent synchrotron X-ray scattering experiments studying fluorohectorite in various situations thus mapping out structures responsible for the behaviors (i) - (vi). Acknowledgments: Collaborators, postdocs and students at NTNU-Norway, University of Oslo-Norway, Institute for Energy Technology-IFE-Norway, Brookhaven National Lab.-USA, LNLS-Brazil, UFPE-Recife-Brazil, UnB-Brasilia-Brazil, UFABC-Brazil, Univ. Rennes1-France, and other places. The various studies have over the years mainly been supported by the Research Council of Norway (RCN), through the NANOMAT, SUP, FRINAT and CLIMIT Programs.



S04.07-P -9

X-RAY ABSORPTION STUDY OF AS(V) SPECIATION IN IRON RICH SOILS

Pérez Claudio^[1], Antelo Juan^{*[2]}, Fiol Sarah^[1], López Rocio^[1], Gondar Dora^[1], Arce Florencio^[1]

^[1]University of Santiago de Compostela ~ Physical Chemistry ~ Santiago de Compostela ~ Spain ^[2]University of Santiago de Compostela ~ Soil Science and Agricultural Chemistry ~ Santiago de Compostela ~ Spain

Information on the chemical speciation is essential for the application of surface complexation models to predict mobility and bioavailability of contaminants in natural systems. Synchrotron-based techniques have proven to be very powerful methods for measuring elemental distribution and speciation in soil minerals although their application to heterogeneous systems has been so far scarce. The goal of the present study was to analyze, by means of X-ray absorption spectroscopy (XAS), the surface speciation of As(V) on iron rich soil samples. EXAFS spectroscopy has been applied to infer the speciation and structure of As(V) complexes in these soils. Additionally some reference materials, such as goethite or ferrihydrite, have been also analyzed in order to assess the major role that natural iron oxides have in the adsorption of oxyanions in soil systems. Both the Fe and As K-edge X-ray absorption spectra were collected for the soil samples and the reference materials. The results indicate that despite the presence of other reactive fractions, such as aluminum oxides, natural iron oxides control the adsorption of As(V) in these heterogeneous samples. Based on the distances between As, O and Fe atoms, two different types of complexes can be identified on the surface of the soil iron oxides, which are analogous to those found in the literature for synthetic iron oxides.



S05.01-P - SOIL ORGANIC MATTER AMENDMENTS: IMPACTS, BENEFITS, AND RISKS

Tuesday 03 July 2012 from 17:00 to 18:30. Room Poster Areas

S05.01-P -1

ADSORPTION OF MICRONUTRIENTS BY TROPICAL PEAT FOR AGRICULTURAL APPLICATIONS

Rosa André Henrique, Sao Paolo - Brazil

S05.01-P -2

AGRONOMICAL VALORIZATION OF BIOSOLIDS FROM MUNICIPAL SEWAGE SLUDGE

Luigi Sciubba, Bologna - Italy

S05.01-P -3

AMELIORATIVE EFFECT OF COMPOST AND SULFUR IN THE PRESENCE OF DIFFERENT SOURCES OF PHOSPHORUS ON THE IMPROVEMENT OF GROWTH AND NUTRIENT UPTAKE OF LETTUCE

Hanan Siam, Cairo - Egypt

S05.01-P -4

AN EVALUATION OF POTENTIALLY MINERALIZABLE NITROGEN OF ALTERNATIVE ORGANIC AMENDMENTS DURING A LONG-TERM INCUBATION

Alexander Woodley, Guelph - Canada

S05.01-P -5

ANALYTICAL CHARACTERIZATION OF SEVERAL ALKALINE COMPOST EXTRACTS

Waed Tarraf, Valenzano - Italy

S05.01-P -6

ANTIOXIDANT CAPACITY AND RATE OF DECOMPOSITION OF ORGANIC AMENDMENTS IN A VERTISOL

David Rimmer, Newcastle - United Kingdom

S05.01-P -7

APPLICATION OF "TERRA PRETA MATERIAL" IN AGRICULTURE AND RECLAMATION ON POOR SANDY SOILS OF NORTHEASTERN GERMANY

Haubold-Rosar Michael, Finsterwalde - Germany



S05.01-P -8

APPLICATION OF COMPOST ON DEGRADED SOILS: EVALUATION OF SOIL-PLANT SYSTEM

Anna De Marco, Napoli - Italy

S05.01-P -9

APPLICATION OF DGT FOR A FASTER ASSESSMENT OF P PLANT AVAILABILITY FROM AGRICULTURAL WASTE DERIVED SOIL AMENDMENTS

Christel Wibke, Frederiksberg C - Denmark

S05.01-P -10

BENEFITS FROM COMPOST USE IN THE PREPARATION OF PLANT GROWING SUBSTRATES: INHIBITION OF THE PHYTOPATHOGEN FUSARIUM OXYSPORUM AND PLANT GROWTH STIMULATION

Elisabetta Loffredo, Bari - Italy

S05.01-P -11

BIOCHAR REDUCES NITROGEN LEACHING IN AN APPLE ORCHARD

Maurizio Ventura, Bolzano - Italy

S05.01-P -12

BIOMASS CARBONIZED BY DIFFERENT TECHNIQUES VARY WIDELY IN CARBON SEQUESTRATION POTENTIAL

Saadatullah Malghani, Jena - Germany

S05.01-P -13

BIOTIC RESPONSES MEDIATING CARBON SEQUESTRATION IN AGRICULTURAL SOIL UNDER FERTILISATION

Ee Ling Ng, Melbourne - Australia

S05.01-P -14

CARBON MINERALIZATION AND N₂O EMISSIONS IN AMENDED SOIL AS AFFECTED BY TEMPERATURE, SOIL WATER CONTENT AND DOSE OF APPLICATION

Claudio Mondini, Gorizia - Italy

S05.01-P -15

CHANGES IN SOIL CHEMICAL PROPERTIES AFTER THE SECOND APPLICATION OF COMPOSTED SEWAGE SLUDGE

Attila Tomócsik, Nyíregyháza - Hungary



S05.01-P -16

COFFEE BYPRODUCTS UNTREATED AND COMPOSTED AS SOIL AMENDMENTS SUITABLE FOR ORGANIC PRODUCTION.

F.g. Ceglie, Valenzano (BA) - Italy

S05.01-P -17

COMPARISON OF DIFFERENT CHEMICAL AND BIOLOGICAL INDEXES TO EVALUATE COMPOST MATURITY

Donato Mondelli, Bari - Italy

S05.01-P -18

COMPOSTED BIOCHAR AND PURE COMPOST EFFECTS ON PLANT GROWTH FACTORS AS REPORTED FOR OAT (AVENA SATIVA L.) IN A GREENHOUSE TRIAL

Hardy Schulz, Halle/ Saale - Germany

S05.01-P -19

DETERMINATION OF NITROGEN MOVEMENT IN AGRICULTURAL SOILS WITH PIG SLURRY APPLICATION IN CENTRAL CHILE

Osvaldo Salazar, Santiago - Chile

S05.01-P -20

DIRECT CHARACTERIZATION OF PEAT HUMIC SUBSTANCES BY POTENTIOMETRIC TITRATION.

Bruno Szpoganicz, Florianopolis - Brazil

S05.01-P -21

DYNAMICS OF SOIL ORGANIC CARBON AND NUTRITIONALLY RELEVANT ELEMENTS WITH COMPOST APPLICATIONS ON ARABLE LAND

Heide Spiegel, Vienna - Austria

S05.01-P -22

EFFECT OF COMPOSTING ON PLANT RESIDUES MINERALISATION IN SOIL: A ¹³C/¹⁵N LABELLING APPROACH

Thomas Lerch, Paris - France

S05.01-P -23

EFFECT OF LIGNITE COAL-DERIVED AMENDMENTS ON GERMINATION AND VEGETATIVE GROWTH OF PASTURE SPECIES AND CARBON SEQUESTRATION IN ACIDIC SOILS.

Karen Little, Clayton - Australia



S05.01-P -24

EFFECT OF PRIMARY TREATED SEWAGE SLUDGE ON CLAY SOIL FETILITY AND CROP PRODUCTIVITY IN MAIZE-MAIZE ROTATION SYISTEM IN CROATIA

Milan Poljak, Zagreb - Croatia

S05.01-P -25

EFFECT OF TREE VEGETATION AND WASTE AMENDMENT ON MINE SOILS ORGANIC CARBON CONTENT

Verónica Asensio, Vigo - Spain

S05.01-P -26

EFFECTS OF MUNICIPAL SOLID WASTE COMPOST ON STAMNAGATHI (CICHORIUM SPINOSUM) GROWTH IN CLAYEY AND IN SANDY SOILS.

Androniki Papafilippaki, Chania - Greece

S05.01-P -27

EFFECTS OF ORGANIC WASTES ON SOIL MOISTURE CONSTANTS AND RELATIVE SATURATION OF A CLAY FIELD

Coskun Gülser, Samsun - Turkey

S05.01-P -28

ENRICHMENT OF SOME ORGANIC WASTES (RESIDUES) WITH MINERAL FERTILIZERS IN RELATION TO GROWTH, YIELD AND NUTRIENT UPTAKE OF LETTUCE GROWN ON A SANDY SOIL

Hanan Siam, Cairo - Egypt

S05.01-P -29

ENVIRONMENTAL EFFECTS OF DIGESTATE AND BENTONITE APPLICATION IN CASE OF SANDY SOILS

Marianna Makádi, Nyíregyháza - Hungary

S05.01-P -30

EVALUATION OF ALTERNATIVE ORGANIC AMENDMENTS ON CEREAL CROP PRODUCTION AND NITROGEN DYNAMICS IN THE SOIL.

Alexander Woodley, Guelph - Canada



S05.01-P -31

EVALUATION OF PIG SLURRY ANION EXCHANGE MEMBRANE EXTRACTABLE PHOSPHORUS THROUGH DIFFERENT PROCEDURES

Marta Roboredo, Vila Real - Portugal

S05.01-P -32

FERTILIZING EFFECTS OF "TERRA PRETA MATERIALS" ON POOR SANDY SOILS OF NORTHEASTERN GERMANY – RESULTS OF POT EXPERIMENTS

Michael Haubold-Rosar, Finsterwalde - Germany

S05.01-P -33

FINGERPRINTING OF SOLUBLE ORGANIC MATTER IN IRON MINE TAILING AFTER SEWAGE SLUDGE-BASED RECLAMATION

Maria C. Hernandez-Soriano, Raleigh - United States

S05.01-P -34

GROWTH OF EUCALIPTUS GRANDIS AND TABEBUIA ROSEA BY THE USE OF ARACHIS PINTOI (LEGUMINOUS) AS MULCHING

Esperanza Huerta, Villahermosa - Mexico

S05.01-P -35

IMPACT OF MUNICIPAL COMPOST ON MINERAL PHOSPHORUS FRACTIONS IN SOME CALCAREOUS SOILS

Alireza Hosseinpur, Shahrekord - Iran, Islamic Republic of

S05.01-P -36

IMPACT OF SPATIAL DISTRIBUTION OF EXOGENEOUS ORGANIC MATTER ON ISOPROTURON FATE IN SOIL

Laure Vieubl  Gonod, Thiverval Grignon - France

S05.01-P -37

LABILE SOIL ORGANIC CARBON FRACTIONATION AND CHARACTERIZATION DURING TRANSITION TO ORGANIC FARMING

Hamada Abdelrahman, Bari - Italy

S05.01-P -38

LINKING SPATIAL DISTRIBUTION OF MANURE AMENDMENT WITH SOIL O₂ DISTRIBUTION AND N₂O, CH₄, AND CO₂ EMISSIONS

Kun Zhu, Copenhagen - Denmark



S05.01-P -39

LOW OXYGEN VERSUS ANAEROBIC COMPOSTING FOR THE TREATMENT OF SEPTIC TANK BIOSOLIDS IN RURAL AREAS OF VIET NAM

Marco Contin, Udine - Italy

S05.01-P -40

MULCHING WITH CHOPPED PINE RESIDUES IN SOIL RESTORATION PROJECTS: PROS AND CONS IN A MEDITERRANEAN SEMIARID EXPERIMENT.

Albert Solé-Benet, Almeria - Spain

S05.01-P -41

N STABILIZATION IN SOIL AMENDED WITH 15N-LABELED PLANT RESIDUES

Claudio Marzadori, Bologna - Italy

S05.01-P -42

NATIVE AND INVASIVE PRAIRIE PLANTS DIFFER IN THEIR RESPONSE TO BIOCHAR

Kevin Gibson, West Lafayette - United States

S05.01-P -43

NITROGEN AND PHOSPHORUS USE EFFICIENCY FROM POULTRY MANURE APPLICATION TO FORAGE GRASSLAND

Karamat Sistani, Bowling Green - United States

S05.01-P -44

NITROGEN KINETICS AND MINERALISATION IN A COMPOST-SEWAGE EFFLUENT AMENDED SOIL

Grivin Chipula, Bedford - United Kingdom

S05.01-P -45

ORGANIC AMENDMENTS ENRICHED WITH SCRAPS OF POPLAR PRUNING: SLOW DEGRADATION BIOMASS TO IMPROVE SOIL ORGANIC MATTER CONTENT OVER TIME

Maria A. Rao, Portici - Italy

S05.01-P -46

ORGANIC CARBON ALLOCATION IN POOLS OF DIFFERENT STABILITY IN A MEDITERRANEAN AGRICULTURAL SOIL AFTER FOUR YEARS OF COMPOST AMENDMENTS

Paola Iovieno, Fisciano (SA) - Italy



S05.01-P -47

PHOSPHORUS AVAILABILITY IN BIOCHAR AMENDED SOILS

Mohammed Masud Parvage, Uppsala - Sweden

S05.01-P -48

PHYTOEXTRACTION OF CHROMIUM CONTAMINATED SOIL BY THREE BRASSICA SPECIES: EFFECTS OF MICROORGANISM AND COMPOST AS SOIL AMENDMENTS.

Karam Farrag, Bari - Italy

S05.01-P -49

POTASSIUM HUMATES AND PLANT GROWTH – SEEKING UNDERSTANDING FOR OBSERVED EFFECTS

Antonio Patti, Clayton - Australia

S05.01-P -50

POTENTIAL USE OF RESIDUES FROM ANAEROBIC DIGESTION FOR BIOGAS PRODUCTION TO IMPROVE SOIL FERTILITY: AN HOLISTIC APPROACH

Alessandra Lagomarsino, Firenze - Italy

S05.01-P -51

PREDICTING THE PH BUFFERING CAPACITY OF COMPOST VIA TITRATION WITH DILUTE SULFURIC ACID

Dan M. Sullivan, Corvallis, Oregon - United States

S05.01-P -52

RE-INVENTING ANTHROSOLS: AN ANCIENT ANSWER FOR MODERN-DAY PROBLEMS CONCERNING CLIMATE CHANGE, SOIL DEGRADATION, NATURE CONSERVATION AND AGRICULTURAL YIELD DECLINE?

Karen Vancampenhout, Leuven - Belgium

S05.01-P -53

SOIL AMENDMENT WITH DIFFERENTLY TREATED PINE BARKS AND WOOD IN THE RESTORATION OF A MINE SITE

Patrizia Zaccheo, Milano - Italy

S05.01-P -54

SOIL AND PLANT RESPONSES IN THREE CONTRASTING SOILS AFTER AMENDMENT WITH ORANGE WASTE COMPOST AS BY A MESOCOSM EXPERIMENT

Antonio Gelsomino, Reggio Calabria - Italy



S05.01-P -55

SOLUTE TRANSFER FROM RUNOFF UNDER SIMULATED RAINFALL IN AN AMENDED IRON-MINE TAILING WITH SEWAGE SLUDGE COMPOST

Ana Sevilla Perea, Armilla - Spain

S05.01-P -56

STEROLS IN SOIL SOLUTION AS BIOMARKERS IN POULTRY MANURE AMENDED SOIL

Giovanni Gigliotti, Perugia - Italy

S05.01-P -57

THE EFFECT OF AGED BIOCHAR ON THE GROWTH OF NATIVE AND INVASIVE PRAIRIE PLANTS.

Erica Gibson, West Lafayette - United States

S05.01-P -58

THE EFFECT OF ASPEN PULP SLUDGE MIXTURE WITH CLINKER DUST ON SOIL PROPERTIES

Helis Rossner, Tartu - Estonia

S05.01-P -59

THE EFFECTS OF BIOCHAR APPLICATION ON WATER RELATION AND SOIL QUALITY IN VITIS VINIFERA

Silvia Baronti, Florence - Italy

S05.01-P -60

THE EFFECTS OF DIFFERENT ORGANIC AMENDMENTS ON THE EVOLUTION OF SOIL STRUCTURE AND FERTILITY

Manolis Kotronakis, Chania - Greece

S05.01-P -61

USE OF FOOD BY-PRODUCTS AND WHITE ROT FUNGI IN THE PRODUCTION OF BROWN COAL-BASED COMPOSTS

Lidia Sas Paszt, Skierniewice - Poland



S05.01-P -1

ADSORPTION OF MICRONUTRIENTS BY TROPICAL PEAT FOR AGRICULTURAL APPLICATIONS

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The aim of this work was to investigate the capacity of peat to adsorb essential plant micronutrients (Cu(II), Co(II), Fe(II), Mn(II), Ni(II), and Zn(II)), for potential use in agriculture. Peat samples collected at two locations in Sergipe State, Brazil, were characterized using granulometric and elemental analyses. The structures of the materials were investigated using ¹³C NMR. Batch adsorption experiments were conducted using different micronutrient concentrations and pH conditions. For both peats, adsorption affinities were in the order: Cu(II) > Fe(II) > Ni(II) > Zn(II) > Co(II) > Mn(II). The adsorption processes could be described by pseudo-second order kinetic models, and differences between the peats were observed using the Langmuir and Freundlich isotherms. Comparison of the results with those of previous studies using peat from temperate regions revealed similarities in the order of affinity of the micronutrients, and differences in the maximum adsorption capacities. The use of peats enriched with micronutrients offers an interesting alternative for the production of agricultural fertilizers. Keywords: Peat; micronutrients; adsorption; agriculture.



S05.01-P -2

AGRONOMICAL VALORIZATION OF BIOSOLIDS FROM MUNICIPAL SEWAGE SLUDGE

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In this work a new mixture of municipal sewage sludge composted with rice husk, has been characterized and studied for its effects on some soil chemical and biological properties usually correlated with soil fertility. Indeed, municipal sewage sludge are rich in organic carbon, nitrogen and other elements for plant growth [Laturnus et al., 2007]; however they could contain contaminants such as heavy metals, human pathogens and organic compounds and should be treated by composting or chemical stabilization before use [Pavan Fernandes et al., 2005]. So the employing of composted sludge in agriculture is an interesting way to achieve both the disposal of this waste and the supply of organic matter and elements for plant to the soils [Laturnus et al., 2007]. The biosolids employed in this study derived from composting of anaerobic and aerobic sludge, in presence of rice husk, and were compared with a common compost produced without sludge. We carried out, on a laboratory scale, an incubation of a sandy loam soil treated with the mentioned products at the concentration of 150 mg N/ kg ss, for 14 weeks, at 25°C and 66% WHC; at scheduled times, samplings were made in order to determine nitrogen mineralization, microbial biomass carbon, soil microbial biomass activity, basal respiration, other enzymatic activities and heavy metals concentration. The first results showed that the stabilized biosolids employed in this work did not have a negative impact on soil fertility if compared with the traditional compost and with the unamended control.



S05.01-P -3

AMELIORATIVE EFFECT OF COMPOST AND SULFUR IN THE PRESENCE OF DIFFERENT SOURCES OF PHOSPHORUS ON THE IMPROVEMENT OF GROWTH AND NUTRIENT UPTAKE OF LETTUCE

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Pot experiment was carried out at the National Research Centre, Cairo, Egypt and designed to study the impact of different sources of phosphatic fertilizers namely (Superphosphate, Rock-phosphate and triple phosphate), and addition rate of compost and elemental sulfur on productivity and nutrients uptake by lettuce plant. Data revealed that phosphatic fertilizers positively affected the fresh and dry weight of leaves and roots of lettuce plant grown on Sandy loam soil. The response depended on the type of p-fertilizes, application rate of compost and elemental sulphur.

The results indicated that the highest values for dry weight of roots and leaves N, P and K uptake by lettuce plant were obtained when organic matter was applied at higher rate with superphosphate, while the lowest values of plant growth and nutrients uptake were found with rock phosphate alone. Furthermore, data representing the growth and nutrients uptake of lettuce plant as affected by different applications of P and elemental sulfur showed that positive response in comparison with sources of P fertilizer alone. Key words: Nutrients uptake, sulfur, superphosphate, rock-phosphate, compost, dry weight.



S05.01-P -4

AN EVALUATION OF POTENTIALLY MINERALIZABLE NITROGEN OF ALTERNATIVE ORGANIC AMENDMENTS DURING A LONG-TERM INCUBATION

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Application rate and timing of organic amendment used as major plant nutrient sources is based on its N release characteristics following soil incorporation. A soil incubation study was conducted to determine the potentially mineralizable N of 7 organic amendments used on organic agricultural systems in Ontario, Canada. Field equivalent rates (200 kg N ha⁻¹) of composted turkey litter, fresh turkey litter, composted dairy manure, raw dairy manure, fresh broiler manure, a bacterial by-product and red clover were added to a surface soil obtained from an organic farm. Microbial respiration was measured over a 120-day incubation period, and repeated samples were taken for measurements of total mineral N. The net rate of N mineralization allowed development of refined organic amendment release curves. This information will be used to better estimate N contributions in time and quantity for producers using the organic amendments as the main N fertilizer source.



S05.01-P -5

ANALYTICAL CHARACTERIZATION OF SEVERAL ALKALINE COMPOST EXTRACTS

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The synchronization between nutrients release and plant demands even in organic agriculture is a major challenge to supply plant with necessary nutrients at critical stages. Since compost shows a slow release of nutrients, organic farmers can overcome a possible nutrients starvation preparing on farm compost extracts to feed plants by fertigation in correspondence to specific growing stages. An experiment was carried out to develop a procedure to extract more organic carbon (OC) and total nitrogen(TN) from composts by alkaline solutions in order to get compost extract richer in nutrients. Two composts were used; the first was a commercial one while the second was made on farm. Both were extracted using several KOH and KHCO₃ solutions at different concentrations, compost/extraent ratios and extraction times. The amount of OC and TN in the alkaline extracts depended mainly on the quality of raw materials rather than quantity of OC and TN of the composts. The best results in terms of OC and TN contents were obtained by using 1 normal extraent solutions, 1:10 compost/extraent ratio and longer time of extractions. Obviously, longer time helps to extract higher amount of OC and TN, even if the quality of raw materials and the evolution of organic matter (OM) influenced the extraction. It could be possible that more humified and complex OM needs more time to be extracted so that the extraction time should be scaled up according to the compost maturity. Finally, according to the results, the best extraent solutions were the KOH based ones.



S05.01-P -6

ANTIOXIDANT CAPACITY AND RATE OF DECOMPOSITION OF ORGANIC AMENDMENTS IN A VERTISOL

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We hypothesised that antioxidants in organic material would control the rate of its decomposition in soil; with materials with more antioxidant capacity (AOC) having slower rates of decomposition. This has been tested in an incubation experiment using a Vertisol amended with green waste compost, wheat straw, sugarcane trash and mineral fibre. Decomposition was monitored by measuring cumulative CO₂ emissions. Using replicates, the experiment was terminated after 7, 14, 28, 40, 53 and 84 d. NaOH extracts of soil material from all six time periods were analysed for their AOC by the Trolox equivalent method. The same method was used to characterise the organic amendments and the unamended soil. AOCs of the amendments were much greater than that of the soil and therefore we expected that the AOC of amended soils would be greater than the unamended control. However, a comparison of the AOC of amended soil measured after 7 d with that calculated from the components showed that the measured values of incubated amended soils were less than the calculated ones. This suggests that the extractable antioxidants in the amendments were lost or transformed during the first 7 d of incubation. There was a general increase in AOC with time in 4 M NaOH extracts of the amended soils. There was also some evidence that amendments with larger AOCs had slower rates of decomposition, especially during the first 7 d of the incubation; but other factors, such as C:N ratio, could have been responsible.



S05.01-P -7

APPLICATION OF “TERRA PRETA MATERIAL” IN AGRICULTURE AND RECLAMATION ON POOR SANDY SOILS OF NORTHEASTERN GERMANY

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“Terra preta” or “Indian black earth” is a very fertile soil in Amazonia that contains high amounts of stable organic matter and nutrients and has a favorable structure and microbial activity. Its development has decisively been influenced by man who added manifold municipal waste materials including charcoal to the tropical soils undergoing decomposition, fermentation and humification processes. The joint project “LaTerra” takes up a new technology for the production of “Terra preta material” in a pilot plant to test its application for soil improvement, reclamation and remediation purposes. Processing organic waste materials or residues and biomass and the creation of high quality organic soil improving materials will close material cycles and contribute to the value added in the regions. This should be an essential part of a sustainable material flow management. The paper presentation will focus on the application of different “Terra preta materials” in agriculture and reclamation on poor sandy soils of Northeastern Germany. In the model region, topsoils used for agriculture usually have low humus contents. Lignite mining activities leave raw soils without humus on dumps and tips. The rapid formation and maintenance of a balanced humus and nutrient budget is of great importance. Field experiments are part of the research program in order to find out the impact of “Terra preta material” application on soils and plants and to derive quality criteria and recommendations for practice. First results will be presented.



S05.01-P -8

APPLICATION OF COMPOST ON DEGRADED SOILS: EVALUATION OF SOIL-PLANT SYSTEM

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*This work studies the recovery of degraded soils by means of compost addition . Soils at 0 and 20 cm depth, were characterized by pH of 7.8 and 8.1, organic matter of 3% and 8%, N content of 0.4% and 0.3., C/N of 8.5 and 6,8, respectively. The soil quality was assessed by physical-chemical and biological indicators monitored along the profile (up to 20 cm). The plant functionality was assessed by means of leaf functional traits and maximal photochemical efficiency (Fv/Fm) measurements on spontaneous species *Malva sylvestris* L. and on trasplanted species, *Quercus ilex* L. and *Phillyrea angustifolia* L. The study was conducted on 12 mesocosms: 8 amended (2 kg m⁻²) with compost (4 with *M. sylvestris* and 4 with *M. sylvestris*, *Q. ilex* and *Ph. angustifolia*) and 4 left without amendment (with *M. sylvestris*). The compost addition did not determine changes in soil physical-chemical parameters, but an increase in microbial biomass and activity. Particularly evident was the increase of active fungal biomass. As regards plants, *M. sylvestris* on mesocosms with compost showed higher Fv/Fm, leaf area and leaf water content than those on soils without compost. No difference was observed for *Q. ilex* and *Ph. angustifolia* in these parameters.*



S05.01-P -9

APPLICATION OF DGT FOR A FASTER ASSESSMENT OF P PLANT AVAILABILITY FROM AGRICULTURAL WASTE DERIVED SOIL AMENDMENTS

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Solid-liquid-separation of agricultural wastes is a means to handle the large surplus of animal manure in areas of intensive livestock farming. The vast majority of phosphorous (P), is to be found in the solid fraction, which can be easily transported. Further processing by composting, combustion or pyrolysis enriches the solids even more with P and improves its stability during storage and long-distance transport to P deficient regions. However, additional processing also alters P speciation and hence plant availability. To assess it, conducting growth experiments is time-consuming, while chemical extraction methods are less laborious, but correlate only poorly with actual plant availability. A faster alternative method to predict the nutrient release capability of a soil amendment is the application of the “diffusive gradient in thin films” (DGT) technique. The DGT mimics the processes in the root zone, where it acts as an ‘infinite’ sink for the nutrient and transport to the sink is limited by diffusion through a well-defined gel. This method has recently been successfully used to assess the P status of different agricultural soils. In this study, we investigate the applicability of the DGT to predict the plant availability of P from different amendments, derived from manure solids, including biochar and ash. For validation, growth experiments and chemical extraction methods are performed simultaneously. Depending on the results, the DGT method could provide a faster way to estimate the nutrient release capability of agricultural waste as an organic fertilizer. Experimentation is on-going, and results will be reported at the conference.



S05.01-P -10

BENEFITS FROM COMPOST USE IN THE PREPARATION OF PLANT GROWING SUBSTRATES: INHIBITION OF THE PHYTOPATHOGEN FUSARIUM OXYSPORUM AND PLANT GROWTH STIMULATION

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*Compost utilization in the preparation of plant growing substrates represents a recent sustainable technology which achieves environmental and agricultural benefits in comparison with the use of conventional matrices, such as peat. In the last years, a number of investigations have demonstrated the effectiveness of composts and their humic fractions in suppressing soil-borne plant pathogens, and their application to soil has been proposed as an environmentally safe alternative to pesticides. The aim of this work was to test the effects of: (i) humic acids (HA) isolated from a green compost (C) and mixtures of C with peat (P) at 20, 40 and 60% (v/v), at concentrations of 50 and 300 mg L⁻¹, on the growth in vitro of *Fusarium oxysporum* f. sp. *callistephi* (Foc); and (ii) the bulk substrates on the growth and health of the ornamental plant China aster (*Callistephus chinensis* L. Nees) repeatedly infected with Foc. Any HA sample at both concentrations significantly inhibited the mycelial growth of Foc during the 13 days of experiments, with an almost total fungal suppression by HA at the highest dose from the mixture at 40% of C and P after 18 h from inoculation. The mixtures at 40 and 60% of C resulted highly effective in the protection of China aster from Foc producing a relevant increase of the number of leaves per plant, plant height, and the average length of the main vein, with respect to P alone, whereas C alone resulted lethal for plants even before the first fungal inoculation.*



S05.01-P -11

BIOCHAR REDUCES NITROGEN LEACHING IN AN APPLE ORCHARD

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*Nitrogen leaching in croplands is a worldwide problem with both human health and environment pollution implications. Efforts should be taken in order to increase nutrient use efficiency and minimize N losses from terrestrial to water ecosystems. Soil-applied biochar has been reported to increase soil fertility, improve nutrient retention and decrease nutrient leaching in tropical soils and lab conditions. The aim of the present experiment was to evaluate the effect of biochar soil addition on N leaching in a mature apple (*Malus domestica* Borkh.) orchard located in the Po Valley (Italy). In spring 2009, 10 Mg of biochar per hectare were incorporated into the first 20-cm soil layer by surface soil ploughing. A similar soil perturbation was applied to control plots. Cumulative nitrate and ammonium leaching was measured during a 4 months period after biochar addition and in the following year, using ion-exchange resin lysimeters installed below the ploughed soil layer. Cumulative nitrate leaching was not affected by biochar 4 months after application, while a significant reduction of nitrate leaching was observed during the following year in biochar treated soil. Conversely, ammonium leaching was very low and unaffected by the treatment. We speculated that the higher efficacy of biochar observed in the second year of the experiment might be due to a change in biochar properties with time.*



S05.01-P -12

BIOMASS CARBONIZED BY DIFFERENT TECHNIQUES VARY WIDELY IN CARBON SEQUESTRATION POTENTIAL

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Biochar, biomass that has been deliberately charred with the idea of slowing its rate of decomposition, has been proposed as amendment that can potential sequester carbon and improve certain soil properties. Chars made from hydro thermal carbonizations(HTC) and slow pyrolysis(PC) differ in physical appearance, chemical properties and their decomposition behaviors. We incubated HTC and PC amendments in three different soils and compared their impact on carbon sequestration and net greenhouse gases emissions. Trace gases (CO₂,N₂O&CH₄) fluxes were monitored in two forest soils; silty clay (pH~6.26) and sandy loam (pH~4.7), and one agricultural soil (silty loam,pH~6.68). Soils were amended with HTC (C~51.63%) or PC (C~77.88%) produced from same initial corn plant material. Amended and control soils were incubated under controlled temperature (20°C) and moisture (70%WHC) conditions using an automated chamber measurement system equipped with continuous measurement of CO₂ fluxes and a flask sampling system. HTC addition resulted into significant increase in CO₂ emissions in all soils ($p<0.001$), whereas PC showed almost no impact on forest soils and resulted in a decrease ($p<0.05$), in CO₂ emission rate from the agricultural soil. The variations in $\delta^{13}C$ signatures of respired CO₂ among treatments indicated that HTC decomposition was major contributor to the increased CO₂ fluxes. In addition, both chars resulted into lower fluxes of N₂O than control but HTC treatment resulted in increased CH₄ emissions in all soils. These results demonstrate that chars produced by different techniques even though from same feedstock, strongly vary in their potential for carbon sequestration.



S05.01-P -13

BIOTIC RESPONSES MEDIATING CARBON SEQUESTRATION IN AGRICULTURAL SOIL UNDER FERTILISATION

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Soil contains most of the terrestrial carbon stock and soil biotic interactions play an important role in regulating carbon dynamics in the terrestrial ecosystem. Soil respiration accounts for more carbon fluxes to the atmosphere than emissions of carbon dioxide through anthropogenic sources and soil microbes contribute significantly to these fluxes. Soil microbes are particularly responsible for decomposition and they are affected by agricultural practices. Agricultural soils are commonly fertilised and there has been increasing interest in the use of organic amendments (OA) not only for fertilisation but also for carbon sequestration. In order to examine carbon transformation and microbial responses, we conducted a soil incubation experiment, adding plant- derived organic amendments, stabilised via composting and pyrolysis, to two soil types (clayey and sandy) from temperate southeast Australia. We used a combination of molecular (phospholipid fatty acid biomarkers and ¹³C-NMR) and protein (enzyme assays) analysis to examine carbon forms and corresponding soil microbial community structure and activity. This experiment determined the effects of the source of organic material and treatment process on the potential for soil carbon sequestration which will likely occur through the carbon forms present, organic matter stabilisation and shift in bacterial- fungal food web channels. Results are discussed in terms of the potential for OA to be used to sequester carbon in agricultural soils.



S05.01-P -14

CARBON MINERALIZATION AND N₂O EMISSIONS IN AMENDED SOIL AS AFFECTED BY TEMPERATURE, SOIL WATER CONTENT AND DOSE OF APPLICATION

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Amendment of soil with organic residues may have a significant impact on climate change by generating GHG emissions and/or promoting C sequestration. Therefore, it is important to assess the factors that reduce the adverse environmental effects and increase the C sequestration of the exogenous OM. The aim of this work was to investigate the effect of temperature, soil water content and dose of application on C mineralization and N₂O emissions dynamics of an amended soil. An Inceptisol was brought to 20, 30 or 40% WHC and amended (0.1, 0.25 and 0.5% p/p) with 3 organic residues (compost, 34.4% C, 2.3% N, 14.9 C/N; anaerobic digestate 37.9% C, 4.4% N, 8.7 C/N; rapeseed meal 45.9% C, 6% N, 7.7 C/N) and incubated for 30 days at 10, 20 and 30 °C. During incubation CO₂ and N₂O emissions were measured by means of an automated gas-chromatographic system. The amount of C mineralization followed the range rapeseed meal >> anaerobic digestate > compost. The rate of C mineralization increased passing from 10 to 20° C and from 30 to 40% WHC. N₂O emission were recorded only for rapeseed meals and anaerobic digestate and were favored by high temperature and water content. The cumulative amount of N₂O-N was in the range 0.1 -1.0% of added N. The higher dose caused a disproportionate increase in N₂O emissions. Our results show that it is necessary to identify appropriate managements to enhance the potential and avoid the negative effects of organic residues with respect to climate change.



S05.01-P -15

CHANGES IN SOIL CHEMICAL PROPERTIES AFTER THE SECOND APPLICATION OF COMPOSTED SEWAGE SLUDGE

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The general way for plant nutrition is the use of chemical fertilizers. In this way the important nutrients can be replaced to the soil but artificial fertilizers are able to damage the soil quality. Sandy soils of our region are poor in organic and inorganic colloids which quantity, however, can be increased by using sewage sludge compost. This treatment increases also the macro- and microelement content of soil which need for the plant nutrition. The small plot experiment was established for studying the effect of regular sewage sludge compost application on the soil chemical properties and on the test plants (triticale, maize and pea), in five replicates. The compost was applied at 9, 18, 27 t ha⁻¹ doses, ploughed into the soil before sowing. The pH of the soil was 4.58, its humus content was 0.31%. Some additives were used in the composting process, such as bentonite, rhyolite and wheat straw because these materials have good effects on light textured sandy soils, especially if they are combined with organic material. Data were collected after the second application of the composted sewage sludge in 2007-2009, after the harvesting. The pH, humus, macro-and mesoelement content of the soil were increased after the compost application. Positive effects of compost application were indicated also by the increased yield of test plants.



S05.01-P -16

COFFEE BYPRODUCTS UNTREATED AND COMPOSTED AS SOIL AMENDMENTS SUITABLE FOR ORGANIC PRODUCTION.

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*In Italy 400 Mton•y⁻¹ of green coffee were imported to be roasted. The roasting process produces about 0.02% of organic byproduct (coffee chaff) which resulted rich in organic carbon (475.2 g•kg⁻¹) and total nitrogen (31.5 g•kg⁻¹). Previous studies have shown that a compost produced from coffee chaff feedstock (in the experimental composting facility of the Mediterranean Agronomic Institute of Bari – MAIB) resulted in high nitrogen content (40.7 g•kg⁻¹) and in dissolved organic matter characteristics similar to those of typical soil. Coffee byproduct composting could be a valid alternative to coffee-chaff landfill disposal; however there is a lack of scientific literature about the effect of those matrices amendment on soil and on soil fertility and crop response. A randomized block design trial was started on a sandy-clay-loam soil, poor in organic carbon (10.7 g•kg⁻¹), with four treatments in triplicates (T1: composted coffee chaff, T2: raw coffee chaff, T3: commercial Bio-Rex, T4: no amendment) balanced for nitrogen. The experiment was conducted (in the framework of Mediterranean Organic Agriculture Master of Science of MAIB) to evaluate the effect of different amendments on *Brassica rapa* (supsp. *sylvestris* var. *esculenta*) growth and yield under organic farming rules. Bio-Rex treatments resulted significantly the best in terms of *B. rapa* dry matter and marketable yield, probably due to the slow mineralization rate of T1 and T2 amendments. Moreover, the measured parameters in T2 and T3 were not significantly different from T4 used as negative control. The effect on soil parameters should be evaluated on a longer period.*



S05.01-P -17

COMPARISON OF DIFFERENT CHEMICAL AND BIOLOGICAL INDEXES TO EVALUATE COMPOST MATURITY

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Immature and poorly stabilized composts may cause number of problems during storage, marketing and use. Active decomposition of these materials into the soil matrix, or growth media, has detrimental effects on plant growth due to reduced oxygen and nitrogen availability or to the presence of phytotoxic compounds. Maturity refers to a specific state of composted organic matter which is related to the quality and quantity of organic compounds remaining after the active phases of the process and to the intensity of the biological activity in the final product. In order to verify the effectiveness of lipids as indicators of compost maturity, different organic substrates (cow-dung, chicken and cheese industries residues) were composted in diverse piles. A C/N ratio between 27-30 was obtained by mixing the organic waste with bulking agents. Diethyl ether (DEE) and chloroform (CHCl₃) extractable lipids have been evaluated and compared to other parameters commonly utilized to study compost stability and maturity (organic carbon, total and inorganic N, CO₂ evolution rate, microbial biomass C, phytotoxicity test, humic-like acid characterization), since as usually observed, maturity is better described by different compost parameters, both of chemical and microbiological origin. Our results showed a positive correlation between these parameters and the extractable lipid fractions, which confirm their usefulness as synthetic index for the evaluation of compost maturity.



S05.01-P -18

COMPOSTED BIOCHAR AND PURE COMPOST EFFECTS ON PLANT GROWTH FACTORS AS REPORTED FOR OAT (AVENA SATIVA L.) IN A GREENHOUSE TRIAL

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Since ten years there is a major increase in research concerning biochar applications to soils trying to mimic effects known from Terra Preta do Indio (Glaser 2002). Our experiment uses biochar which was blended with fresh organic material and underwent the whole composting procedure leading to the first known composted biochar. As pure biochar is not directly enriching the soil with nitrogen (Glaser 2002, Birk 2011); while elevating the C/N-ratio it might even decrease N-availability (Bridle & Pritchard 2004) which is supposed to be smoothed if combined with nutrient rich compost. Our hypothesis is that the process of composting activates the carbon surface generating a reactive substance for soil amendment (Lehmann and Joseph 2010) which later serves a nutrient source and nutrient retention agent likewise. Therefore we designed composted biochar mixes with biochar fractions rising stepwise from 2.5% to 50% from which we established a four replicate full random block design pot trial in loamy and in sandy soil using pure compost and null treatments as controls. Whereas compost on loam showed a seed weight 2 times higher than on pure loam control and seed weights 1.6 times higher compared to compost with highest biochar amounts, on sand the pure compost was even slightly less productive than pure sand control (factor: 0.8) and the highest biochar applications yielded 13.8 times the seed harvest of the sand compost (10.4 times sand control). We will try to present possible explanations based on TOC, TN, pH, NO₃, NH₄ and electrical conductivity data.



S05.01-P -19

DETERMINATION OF NITROGEN MOVEMENT IN AGRICULTURAL SOILS WITH PIG SLURRY APPLICATION IN CENTRAL CHILE

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On the world's agricultural lands, nutrients transport by farming systems has overwhelmed natural nutrient cycles. In systems with organic amendment, slurry, composts, manure or green material applications, nitrogen (N) mineralization continues beyond the period in which crops take up N. All of these N sources are subject to transformations and can contribute to environmental losses. The objective of this study was to determine the N losses by leaching in coarse-textured soils under a corn (Zea mays)-fallow rotation system with pig slurry application in the fallow period. To achieve this goal, in situ N mineralization and leaching rates were determined. The experiment was carried out in two basins of central Chile (San Pedro and Pichidegua) and in each location two conditions were evaluated: a treatment with pig slurry applications and a control without these organic amendments (control). In each site, triplicate 4 x 4 m experimental units were set up, with five PVC columns at 25 cm deep and a monitoring system (datalogger/sensors, for soil water and temperature) connected, to assess in situ N mineralization rates. During the study period, soil nitrate and ammonium status along season were determined by collecting soil samples using an auger within fixed depth intervals of 20–30 cm, 45–55 cm and 95–105 cm. With those values of N and a parallel physical characterization of soil profile, leaching rates were estimated. Preliminary results show that mineralization rates and N leaching are higher in soils with pig slurry applications than control treatments.



S05.01-P -20

DIRECT CHARACTERIZATION OF PEAT HUMIC SUBSTANCES BY POTENTIOMETRIC TITRATION.

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Peat has been used to improve both the physical and chemical soil properties for agriculture purpose and environmental recuperation of disturbed soils. Porosity, hydraulic conductivity, bulk density, cation exchange capacity and buffering has been studied. The results showed expressive modifications for those soil properties in that peat can be recommended as a remarkable auxiliary in disturbed areas in environmental recuperation programs (Franchi, 2003, Couillard, 1994). This work deals with direct characterization of humic substance from peat by potentiometric titration. The procedure in doing direct titration of turfa, without removing metals, is justifying by the fact that the only metals present in appreciable amounts are K and Na, and those metals contribute only for the ionic strength, not interacting with the acid and basic groups of humic substance. The amounts (in mmoles) of the groups present, per g of peat, are: the phenolic acidity, represented by the sum of mmols of phenol, two times catechol and salicylic groups is 0.32 mmol per gram of peat, and the carboxylic acidity, represented by the sum of carboxylic, two times phtalic, and salicylic groups is 0.37 mmol/g. This procedure has been reported for humic acids. The amounts (mmoles) of oxygenated groups present in the humic substance per gram of peat were determined and their average pKas were also calculated by direct titration of the experimental suspension of peat.



S05.01-P -21

DYNAMICS OF SOIL ORGANIC CARBON AND NUTRITIONALLY RELEVANT ELEMENTS WITH COMPOST APPLICATIONS ON ARABLE LAND

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The use of compost in agriculture aims to close material loops, to conserve finite resources as phosphorus and to contribute to soil fertility. The Austrian Agency for Health and Food Safety (AGES) conducts a field experiment in Upper Austria on a loamy silt soil since 1991 to investigate the influence of compost application on soil parameters and crop yields. The field trial consists of a control plot (zero N), minerally fertilised plots (40 kg N, 80 kg N, 120 kg N ha⁻¹ y⁻¹) and plots amended with biowaste compost (from source-separated organic waste, OWC), green waste compost (GWC), cattle manure compost (MC) and sewage sludge compost (SSC), each compost treatment corresponding to 175 kg N ha⁻¹. Within 17 years of application, 380 - 610 t ha⁻¹ of compost have been applied according to the N content of the composts. Soil samples were taken every two to three years in 0-25 cm soil depth and were analysed for soil organic carbon (SOC), Nt, pH, "plant available" nutrients (e.g. calcium-acetate-lactate-extractable P and K, CaCl₂-extractable Mg) and selected aqua regia soluble trace elements (Cd, Pb, Hg, Cr, Cu, Zn, Ni). This contribution will highlight the supply of organic matter (OM) and plant nutrients (N, P, K, Mg) with the different kinds of compost. Nutrient balances will be estimated and the efficiency of nutrients will be addressed. The effects of compost application on selected soil parameters, i.e. SOC, Nt, pH, carbonate content, plant available nutrients as well as trace elements, will be discussed.



S05.01-P -22

EFFECT OF COMPOSTING ON PLANT RESIDUES MINERALISATION IN SOIL: A $^{13}\text{C}/^{15}\text{N}$ LABELLING APPROACH

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Composts are often applied on arable soils to sustain the content in soil organic matter (SOM). The mechanisms leading to an increase of SOM content are still poorly understood. The changes of OM during the thermophilic phase might be different from the changes naturally occurring in soils, which might influence the dynamics of composted OM compared to non composted OM in soils. Our objectives were to better understand the effect of composting on the dynamics of C and N in soils and to investigate the relationships with the chemical composition. To this aim, we used ^{13}C and ^{15}N labelled plant materials composted (12 weeks) or not. Composted (COM) and non-composted (NCOM) plant materials were then incubated with arable soils during 3 years under controlled condition (20°C, 80%WHC). Throughout the experiment, ^{13}C and ^{15}N concentrations were analysed in the mineralised fraction (CO_2 or nitrates) and the microbial biomass (fumigation extraction technique) using GC- or EA-IRMS. The composting processes reduce the C/N ratio from 11 to 7 (loss of 69% of C and 21% of N). Molecular analysis of plant residues performed by GC-MS showed that COM was depleted in non-cellulosic carbohydrates and enriched in lignins compared to NCOM. The C mineralisation of NCOM was higher than COM and 3 years after the amendments in soil, the loss of C due to composting process were compensated. The N mineralisation of NCOM was lower than COM during the first year, due to higher amount of N assimilated to the microbial biomass.



S05.01-P -23

EFFECT OF LIGNITE COAL-DERIVED AMENDMENTS ON GERMINATION AND VEGETATIVE GROWTH OF PASTURE SPECIES AND CARBON SEQUESTRATION IN ACIDIC SOILS.

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*The occurrence of acidic soils in Australia limits agricultural productivity. It is claimed that commercially available lignite-derived products have the capacity to buffer soil pH. In addition, manufacturers of these products and farmer anecdotal evidence suggests that these products promote an improvement in seed germination rate and plant growth, which has the potential to facilitate carbon sequestration. This study investigated the impact of these products on the rate and percentage of germination, and early stage growth of a pasture legume, lucerne (*Medicago sativa*), and a pasture grass, annual ryegrass (*Lolium rigidum*), in two soil types common to south eastern Australia in a glasshouse setting. Measurements of root and shoot biomass, nutrient content and soil chemistry were taken after 8 weeks of growth. A number of differences were observed between the treatments, particularly in terms of lucerne nutrition in the highly acidic loam soil. Additional results presented will include the germination index and mean time to germination of each pasture species and characterisation of the soil carbon content and its form. The results of this study will assist farmers in making decisions about the value and effectiveness of lignite-derived products on plant growth, as well as their potential to improve soil health and contribute to a carbon credit scheme.*



S05.01-P -24

EFFECT OF PRIMARY TREATED SEWAGE SLUDGE ON CLAY SOIL FETILITY AND CROP PRODUCTIVITY IN MAIZE-MAIZE ROTATION SYSTEM IN CROATIA

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Abstract: Reuse of sewage sludge to agricultural soil is a common practice worldwide because of low costs, recycling of nutrients and beneficial role on soil fertility and crop productivity. A long term field experiment was conducted to evaluate effect of different rates of the primary treated sewage sludge as an organic fertilizer on soil fertility characteristics and yield of maize in comparision to standard fertilization with NPK. Heavy textured clay soil, pure in fertility was used at experimental site near Zagreb pilot waste water treatment plant. Applied rates of sewage sludge are suitable for local conditions respectively to content of Cu, Mn, Zn and Cd in the soil at higher applied rates evenly. Continuosly application of sewage sludge discharged of heavy metals can meet maize nutrient demands especialy in combination with half doses of mineral fertilizers without risk of accumulation of hevly metals in the soil or in the harvested plant parts. In comparision to the standard mineral fertilization, sewage slude applied alone in small doses decreased maize yield significantly. In general, soil fertility can be improved or sustained by used sewage sludge doses. In comparision to standrad NPK fertilization sewage sludge significantly increased level of P, K, and pH and humus content. In maize–maize crop rotation system Zn, Cd and Cu content in soil increased significantly as dose of sewage sludge increased.



S05.01-P -25

EFFECT OF TREE VEGETATION AND WASTE AMENDMENT ON MINE SOILS ORGANIC CARBON CONTENT

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Mine spoils are usually very poor in organic matter. This work was carried out in a mine tailing without vegetation and very low organic carbon content at Touro mine (Northwest Spain). Some areas in this mine were vegetated with eucalyptus and pines and/or amended with organic wastes (sewage sludges and paper mill residues). Four areas were selected in the mine tailing: i) M1 as control sample (without treatments), ii) M2 was vegetated with pines 21 years ago, iii) M3 was amended 6 months before sampling and iv) M4 was both vegetated with eucalyptus and amended 10 years ago. Some general characteristics were analysed: total nitrogen content, pH, cation exchange capacity, electrical conductivity, bulk density, porosity, particle size distribution and stoniness. In addition, both soil organic and inorganic carbon were also analysed and it was carried out the total carbon fractionation. It was determined free organic matter, dissolved carbon, humin and both fulvic and humic acid content. Total carbon content, especially organic carbon, significantly increased in all treated soils, particularly in the amended ones (8 times more carbon than M1). This treatment increased the organic carbon 3 times more than tree vegetation. The results suggest that the humification and mineralization of the soil organic matter in the amended areas was faster than in the reforested but unamended one since M3 had the highest content of both humic and fulvic acid. These concentrations were lower in M2 and M4 had the lowest ones.



S05.01-P -26

EFFECTS OF MUNICIPAL SOLID WASTE COMPOST ON STAMNAGATHI (CICHORIUM SPINOSUM) GROWTH IN CLAYEY AND IN SANDY SOILS.

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Municipal solid waste compost (MSWC) has been found to improve the physicochemical and biological properties of the soils and soil fertility due to the high content of MSWC in organic matter, macronutrients and essential trace elements. However, critical issues associated with MSWC use in agriculture include heavy metal accumulation in edible plant tissues and N availability. This study investigates the effects of MSWC applied at rates 0, 90, 180 t/ha, on soil physicochemical properties, trace elements content, as well as the growth and plant nutrient status of stamnagathi grown under controlled conditions. In addition particular emphasis is given on the role of mycorrhiza on heavy metal accumulation and N cycling. The results are presented and discussed.



S05.01-P -27

EFFECTS OF ORGANIC WASTES ON SOIL MOISTURE CONSTANTS AND RELATIVE SATURATION OF A CLAY FIELD

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*Effects of manure (M), hazelnut husk (HH), tobacco (TW) and tea (TEW) wastes on field capacity (FC), permanent wilting point (PWP), available water content (AWC), relative saturation (RS) and air field porosity (Fa) were determined in a clay field after 8 months of organic wastes were incorporated from 0 to 15 cm soil depth at four different doses (0, 36, 67 and 100 ton ha⁻¹) in a randomized plot design with three replicates. The organic waste applications increased FC, PWP and air filled porosity and decreased RS values significantly. While the lowest FC (38.55%), PWP (27.99%), Fa (18.47%) values were determined in the control application, the highest FC (44.92%) and Fa (45.51%) values were in 100 ton ha⁻¹ of HH application, and the highest PWP (32.2%) was in 100 ton ha⁻¹ of TEW application. Mean AWC values of HH (13.15%) and TEW (11.68%) applications were higher than that of the control (10.56%). Decreases in mean RS values by the organic waste applications were in the following order; control (69.02%) > M (57.94%) > HH (53.79%) > TEW (47.56%). RS values gave significant negative correlations with total porosity (-0.886**), soil organic matter content (-0.433**), FC (-0.365*) and PWP (-0.347*). Fa values gave significant positive correlations with FC (0.414**) and PWP (0.369*). Organic waste applications decreased the RS values of clay soil while increasing total porosity. HH and TEW applications increased AWC of the clay soil compared with the control treatment.*



S05.01-P -28

ENRICHMENT OF SOME ORGANIC WASTES (RESIDUES) WITH MINERAL FERTILIZERS IN RELATION TO GROWTH, YIELD AND NUTRIENT UPTAKE OF LETTUCE GROWN ON A SANDY SOIL

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A pot experiments was conducted at the National Research Centre, Cairo, Egypt, to study the response of lettuce to various types of organic compost enriched with mineral fertilizer and the effect of available forms of nitrogen and potassium fertilizers on productivity and nutrient uptake. The results indicated that the highest mean values for fresh and dry weight of roots and leaves, and N, P and K uptake by lettuce were obtained when chicken manure was applied with different sources of N and K fertilizers, especially, ammonium sulfate and potassium sulfate. For a mixture compost and Nile compost if mixed with mineral fertilizer elements it was noticed that the addition of N as ammonium sulfate and K as potassium sulfate with chicken manure significantly increased the fresh and dry weight of roots and leaves and uptake of N, P and K respectively. The lowest yields were obtained when chicken manure addition was with calcium nitrate and potassium chloride. Key Words: chicken manure, Lettuce, Nile compost, nutrient uptake, organic, yield.



S05.01-P -29

ENVIRONMENTAL EFFECTS OF DIGESTATE AND BENTONITE APPLICATION IN CASE OF SANDY SOILS

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Sandy soils have low organic and inorganic colloid content. Digestate can be used for plant nutrition because has high macro- and micro nutrient and organic matter content, thus can improve the organic colloid content and the nutrient capacity of sandy soils. Besides adding digestate, bentonite was also applied as an inorganic component. The research was carried out in small-plot experiments as follows: 10 and 30 t ha⁻¹ bentonite was cultivated into the soil. The plots were treated with digestate containing 170 kg ha⁻¹ N and with the same quantity of water because of the high water content of the digestate. The treatments were the following: control, digestate and water without bentonite, digestate with 10 t ha⁻¹ and 30 t ha⁻¹ bentonite, water with 10 t ha⁻¹ and 30 t ha⁻¹ bentonite. Different soil chemical and microbiological analyses were carried out. Compared to the control, the soil pH was increased by water and digestate treatment but combined with bentonite, the effect was stronger. The soluble salt content was increased by the digestate, which is a negative effect of its use. Similar effect was observed in the case of the NO₃-N concentration, but increasing the available N content of sandy soils is very important for plant production. Also an increase was observed of the macroelement content, especially in the quantity of potassium. The increase of some soil enzyme activities and the CFU of some bacterial groups after digestate and bentonite treatment contribute to the improved fertility of sandy soils.



S05.01-P -30

EVALUATION OF ALTERNATIVE ORGANIC AMENDMENTS ON CEREAL CROP PRODUCTION AND NITROGEN DYNAMICS IN THE SOIL.

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Limited research exists for organic cereal producers using various organic amendments as their major Nitrogen (N) source for their affects on crop yield, grain quality, plant N- uptake and N fate in the soil. Several cereal crops (winter wheat, barley, oats, winter spelt, and corn) were grown in 2011 on 8 organic farms in southern Ontario, Canada on a range of soil types. Amendments (composted turkey litter, composted dairy manure, fresh broiler litter and an industrial bacterial by-product) were applied to the crops in a randomized complete block design, at rates ranging from 0% to 150% of the N requirement for the specific crop to achieve maximum yield. At 3 sites, incorporated red clover under-seeded as an N source, was evaluated for its potential in-season N contribution to the cereal crop. The cereals were harvested for measurements of dry matter yield and grain N content. Soil inorganic N (0-15cm and 15-30cm) was measured in samples taken prior to application, post-harvest and mid-winter. Based on these field experiments an N availability model will be constructed to evaluate best management strategies for ensuring that N release is coordinated with crop N uptake demand, and that N losses from the soil by leaching are minimized.



S05.01-P -31

EVALUATION OF PIG SLURRY ANION EXCHANGE MEMBRANE EXTRACTABLE PHOSPHORUS THROUGH DIFFERENT PROCEDURES

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Anion exchange resins in the membrane form (AEM) are commonly used as an extraction method in soil analysis and they constitute an index significantly correlated to P bioavailability. Its use has been spread out to evaluate P bioavailability of soils submitted to the application of different inorganic and organic fertilizers, namely animal manures. However, more information on manure P dynamics and bioavailability is needed as P contents and speciation in soil and manure differ. To rapidly assess bioavailable P from pig slurry, a short term anaerobic incubation was set up. A fixed amount of P (1000 mg) as fresh pig slurry was placed in 60 mL syringes, adjusted to a 25 mL volume with deionized H₂O, and incubated during 7 days at 25°C. The syringes were daily shaken for 1 hour in an overhead rotator shaker. For the AEM extraction, three different procedures were considered: (i) Seven successive 24 hour extractions, with the AEM being replaced every day by a regenerated one; (ii) Continuous extraction with a single AEM during seven days; (iii) Post 7 day extraction during a 16 hour period with one AEM in an overhead rotator shaker. After the extractions the AEM was removed and P was eluted in 0.5M HCl during 1 hour and determined by the molybdenum-ascorbic acid blue method in a segmented flow auto analyser (AEM-P).



S05.01-P -32

FERTILIZING EFFECTS OF “TERRA PRETA MATERIALS” ON POOR SANDY SOILS OF NORTHEASTERN GERMANY – RESULTS OF POT EXPERIMENTS

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“Terra preta” or “Indian black earth” is a very fertile soil in Amazonia that contains high amounts of stable organic matter and nutrients and has a favorable structure and microbial activity. Its development has decisively been influenced by man who added manifold municipal waste materials including charcoal to the tropical soils undergoing decomposition, fermentation and humification processes. The joint project “LaTerra” takes up a new technology for the production of “Terra preta material” in a pilot plant to test its application for soil improvement, reclamation and remediation purposes. Processing organic waste materials or residues and biomass and the creation of high quality organic soil improving materials will close material cycles and contribute to the value added in the regions. One focal point of the project is the application of different “Terra preta materials” in agriculture and reclamation on poor sandy soils of Northeastern Germany. In the model region, soils used for agriculture usually have low humus contents. Furthermore, lignite mining leaves raw soils without humus on dumps and tips. The project aims to find out the impact of “Terra preta material” application on soils and plants and to derive quality criteria and recommendations for practice. The poster will show results of pot experiments with two different soils (natural and dumped soil) treated with various amounts of “Terra Preta materials” in comparison to rising applications of mineral fertilizers in order to find out the fertilizing capacity of the “Terra Preta materials”. *Dactylus glomerata* L. served as the test plant.



S05.01-P -33

FINGERPRINTING OF SOLUBLE ORGANIC MATTER IN IRON MINE TAILING AFTER SEWAGE SLUDGE-BASED RECLAMATION

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The chemical speciation of organic carbon in soil has a major role on biogeochemical processes, e.g the bioavailability of nutrients and contaminants. Despite the chemical heterogeneity of dissolved organic matter (DOM), similar fluorescence spectra has been presented in the literature for DOM excitation(Ex) –emission(Em) matrices (EEM), indicating the presence of common pools of fluorophores. EEM spectroscopy is accepted as suitable to examine slight changes in DOM fluorescence and therefore alterations of the DOM pool composition. The DOM pool was evaluated after treating soil from an abandoned mine tailing (Granada, Spain) with stabilized sewage sludge (SS) and compost from sewage sludge plus green wastes (SVC). Plot-scale field and laboratory experiments were carried out. Soil subsamples were incubated with 5% of SVC or SS at 25° C and 40% of field capacity for 45 days. Small plots were amended with 5% SVC during summer and episodically irrigated for three months. Additionally, the effect of a biofertilizer was tested. The soil solutions were collected for all treatments and analyzed by luminescence spectroscopy. The fingerprinting of the DOM pool was related to biomass and enzymatic activities.

The fraction of UV and visible humic-like (Ex/Em 320-360/400-460), highly stable, DOM greatly increased for the addition of SVC compared to non-amended soil. Besides, the increased fluorescence intensity suggests metal complexation with DOM, which might reduce the potential leaching of soluble trace metals. However, the biofertilizer had only a slight effect, while for treatment with SS the DOM analyzed in the soil solution corresponded to labile organic matter.



S05.01-P -34

GROWTH OF EUCALIPTUS GRANDIS AND TABEBUIA ROSEA BY THE USE OF ARACHIS PINTOI (LEGUMINOUS) AS MULCHING

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Intensive production of Eucaliptus grandis is taken place in Tabasco, southeastern Mexico. Despite the generation of new genetic varieties of this plant for resisting tropical conditions, the requirement of agrochemicals is strong for controlling pests. Native plants with fast growth as Tabebuia rosea can be an alternative of wood and paper production in the region. Mulching and earthworms have showed to enhance the initial growth of plants in tropics. Fresh organic matter is obtained and soil structure is enhanced with the presence of mulches. Earthworms participate in organic matter dynamics and their activity has shown to promote the straightness of plants. Arachys pintoii is a leguminous wide spread at Tabasco. Pontoscolex corethrurus is an earthworm species that use to inhabit the acrisols of Eucaliptus grandis plantations. The objective of this study is to enhance the growth of Eucaliptus grandis and Tabebuia rosea by the use of Arachys pintoii (leguminous) as mulching and P. corethrurus (Oligochaeta, glossoscolecidae). Four treatments per plant species with 7 replicas per treatment were installed: a) A. pintoii + P. corethrurus, b) A. pintoii, c) P. corethrurus, d) Control (treatment without earthworms without mulching). Soil properties (organic matter, total nitrogen, nitrates, available phosphorus) and plant characteristics (growth rate, biomass) were evaluated during the experiment. After 90 days the highest growth of T. rosea was observed in plants with A. pintoii as amendment, not significant differences were observed between this treatment and mulching+earthworms treatment. The growth of this species with amendment was 3-fold higher than control treatment.



S05.01-P -35

IMPACT OF MUNICIPAL COMPOST ON MINERAL PHOSPHORUS FRACTIONS IN SOME CALCAREOUS SOILS

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The phosphorus (P) resources worldwide are limited, and the prices for commercial P fertilizer continue to increase. Therefore, the use of P containing wastes is important for P recycling in agriculture. The P fractionation methods has been widely applied to characterized the effect of land use practice on soil P dynamics. Information about effect of organic manures on inorganic P (Pi) fractions in calcareous soils of Chaharmahal va Bakhtiari province is limited. The objective of this research was to study the effect of municipal compost (MC) on Pi forms in 5 calcareous soils. Municipal compost was applied at rates of 0. 0.5 1.0 1.5 and 2.0 % (w/w). Samples were incubated at 25 ±1 °C and 20 % moisture content for 150 days. At the end of incubation, Pi forms was fractionated chemically into labile P (LP), non-occluded P(NP), re-adsorbed P (RP), occluded P (OP), calcium phosphates (CaP) and residual P. The results showed that a sharp increase in LP, NP and CaP and decrease in residual P concentration occurred in all soils with MC application. It can be concluded that MC applied to calcareous soils may enhance P nutrition of plants. Furthermore applied P partitioning into the relatively available forms, means that potential erosion losses of P to streams and other bodies of water. Key words: Municipal compost, Phosphorus, Fractionation, Calcareous soils



S05.01-P -36

IMPACT OF SPATIAL DISTRIBUTION OF EXOGENEOUS ORGANIC MATTER ON ISOPROTURON FATE IN SOIL

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Organic matter (OM) is known to impact the behavior of pesticides in soil (transfer, degradation, retention) by affecting physical, chemical and biological properties of soil. In cultivated soils, crops residues and compost incorporation by ploughing results in a heterogeneous OM distribution in soil with formation of spots with a mm to cm size. However, to our knowledge, the effect of the heterogeneity of OM distribution on the fate of pesticides in soil has not been assessed yet. Consequently this study aimed to compare the impact of an addition of organic matter (straw and compost) and its distribution in soil on the fate of isoproturon. ¹⁴C isoproturon was uniformly added at the regular agronomical dose on soil and organic matter separately. Immediately after application, soil cores were confected with different spatial distributions of OM (homogeneous vs heterogeneous). For the heterogeneous distribution, OM was distributed in 12 small spots of 6×6×6 mm or in a big spot of 12×12×18 mm in the soil core. Controls consisted in soil cores without OM and OM incubated alone. We followed IPU mineralization, extractable and non-extractable ¹⁴C residues during 43 days. We analyzed the fate of ¹⁴C at the column scale but we also characterized what happened separately on soil and spots of OM after their separation. Results showed that i) the addition of exogenous OM impacted the biodegradation of isoproturon ii) the spatial distribution of OM in soil induced different fates of isoproturon and iii) these effects depended on the quality of buried OM.



S05.01-P -37

**LABILE SOIL ORGANIC CARBON FRACTIONATION AND CHARACTERIZATION DURING
TRANSITION TO ORGANIC FARMING**

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Labile SOM fraction, e.g. light fraction (LF), particulate organic matter (POM), and mobile humic acid (MHA) have shown to be responsive to land management. Transition from conventional to organic farming, 2- to 4-yr period, may disrupt the soil organic carbon (SOC) balance through introduction of new agronomic practices. To better manage the transition period, it is important to quantify and characterize labile SOC fractions and their changes. A sequential fractionation procedure was used to separate SOC fractions: LF, POM, MHA and Ca++ bound humic acid (CaHA) from 2 fields, during transition period, with cereal/leguminous rotation treated with permitted amendments (compost and fertilizers). Soils were sampled in September 2009, and after harvest of 2010 and 2011. Isolated fractions were quantified and analyzed for their content of C, N, carbohydrates and amino compounds fingerprints. Results showed that LF largely fluctuates with changes in crop residues input and fertilization treatment. Likewise, POM and MHA were responsive to land management inputs but with a lesser extent than LF. Compost application contributed to significantly higher quantities of LF, POM and MHA than did fertilizers application. Carbohydrates content, over 2-yr scale, decreased in LF while increased noticeably in POM and slightly in MHA fractions, indicating that decomposing materials are incorporated, within humification continuum, into mature SOC fractions. Amino acid explained up to 30% of total soil N and was found to be more responsive to seasonal variation than to land management.



S05.01-P -38

LINKING SPATIAL DISTRIBUTION OF MANURE AMENDMENT WITH SOIL O₂ DISTRIBUTION AND N₂O, CH₄, AND CO₂ EMISSIONS

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The oxygen concentration is an essential factor for the production and consumption of nitrous oxide, methane and carbon dioxide in the soil and thereby the potential emission of these greenhouse gases to the atmosphere. The O₂ availability in the soil microenvironment is dependent on the respiratory activity as well as the gas diffusivity in the soil matrix, which is heavily dependent on soil water content. These factors are affected by soil properties, precipitation, temperature and spatial distribution of organic matter. Heterogeneous addition of organic matter (e.g. from animal manure, urban waste) creates hotspots of greenhouse gas emission. The objective of current study was to examine the linkage between spatial distribution of manure amendments and O₂ distribution, the resulting greenhouse gas emissions. The experiments were conducted with homogeneous/heterogeneous application of solids fraction of pig manure. The spatial distribution of O₂ in soil was examined, and fluxes of N₂O, CH₄, and CO₂ were routinely measured. An O₂-specific planar optode was mounted on the flank of an open chamber which was filled with soil. Manure solid fraction was either homogeneously mixed with soil or placed heterogeneously as a layer in the soil. This work demonstrates the importance of microscale O₂ dynamics for the greenhouse gas emissions following manure application.



S05.01-P -39

LOW OXYGEN VERSUS ANAEROBIC COMPOSTING FOR THE TREATMENT OF SEPTIC TANK BIOSOLIDS IN RURAL AREAS OF VIET NAM

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Whatever the method used to supply air during composting, the maintenance of aerobic conditions requires large energy inputs and use of costly equipment. On the other hand, suboxic or anaerobic conditions may not grant a sufficient speed of stabilization and sanitization of waste materials and the growing number of rural families that use septic tank toilets in Viet Nam, urgently requires new safe ways to recycle septic tanks sludge, avoiding direct application to farmland. This work compared a conventional anaerobic system with a low oxygen input treatment for composting rice straw together with septic tank biosolids or cow dung. Composting was carried out for 75 days, in open concrete biocells protected from rainfall, after inoculation with selected micro-organisms. The partially aerobic treatment maintained a significantly higher temperature than the anaerobic one, during the whole composting period. Organic C decreased from 32% to 25-27% at the end of process, remaining slightly higher in the anaerobic piles; on the opposite humic C showed a linear increase up to 8 mg g⁻¹, reaching the highest values in the aerobic piles. Both composting systems were able to sanitize the organic wastes since no viable intestinal parasite eggs were found at the end of the process. Compost made from septic tank biosolids represents a valuable source of P, but has lower N and K than compost from cow dung. Anaerobic composting is a viable alternative to conventional aerobic systems to recycle organic residues and safely treat septic tanks sludge biosolids in rural areas of VietNam.



S05.01-P -40

MULCHING WITH CHOPPED PINE RESIDUES IN SOIL RESTORATION PROJECTS: PROS AND CONS IN A MEDITERRANEAN SEMIARID EXPERIMENT.

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Soil restoration of dry Mediterranean quarries is still a challenge for environmental managers. We evaluated the positive and negative effects of mulching with chopped pine residues (FM) on soil erosion, and on the survival and growth of different native plants replanted in experimental plots of a limestone quarry. Survival rates and growth in FM plots were compared against control plots (C), and plots with gravel mulching (GM). Before planting, organic amendments were added to the experimental plots. After planting in May 2008, all plots were weakly irrigated during the summer season of the 1st year to favour plant survival. No signals of surface erosion were found in FM plots, but native plant survival and growth were the lowest from the beginning of the restoration (59% and 33 cm in FM, 72% and 41 cm in GM and 55% and 37 cm in C plots) despite higher rates of soil water content (up to 15 %) and less soil pH values (7.5 against 8.2). Surprisingly, many pine seedlings emerged and grew up to 1 m height in FM after 3 years since the beginning of the experiment. The addition of organic amendments doubled the growth of pines with regard to C. The use of chopped pine residues in soil restoration projects is a low-cost technique which improves soil water conservation and decreases soil erosion, but may not favour revegetation of native plants. However the growth of pine seedlings from the pine nuts resting in FM adds a positive value.



S05.01-P -41

N STABILIZATION IN SOIL AMENDED WITH ^{15}N -LABELED PLANT RESIDUES

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The distribution in different soil physical fractions, of the N derived from the degradation of ^{15}N -labeled residues of barley alone or in the presence of an organic nitrogen fertilizer (tannin tanned leather) was studied over a year. The plants of barley were chopped at the stage of barrel, mixed to the soil and placed in plastic containers with perforated bottom that were buried in the field. The experimental plan consisted of three replicates per treatment and four samplings in which the barley residues were quantitatively recovered, and soil total N and its isotope ratio was measured. The soils were physically fractionated in water with recovery of 3 fractions (>250microns; 250-53microns and <53microns). The mineralization rate of residues N was very high during the first 3 months of incubation with a release, in both treatments, of almost 80% of labeled N, then it slowed down. In the first 3 months, in the absence of plant roots, 42% (soil+barley) and 33% (soil+barley+leather) of N from barley was found in soil, while the rest was probably lost by leaching or volatilization. Afterwards, there were no significant changes in the amount of N from barley in the soil, in spite of the complete mineralization of the residues observed by the end of the year. Among the physical fractions, only the intermediate was able to accumulate N from barley. In general the use of leather in combination with green manure, did not improve the stabilization in soil of N derived from barley.



S05.01-P -42

NATIVE AND INVASIVE PRAIRIE PLANTS DIFFER IN THEIR RESPONSE TO BIOCHAR

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*The addition of organic carbon to prairie soils has the potential to immobilize plant-available nitrogen and may limit the growth of nitrophilous weeds during tallgrass prairie establishment. A series of greenhouse experiments were used to evaluate the effect of biochar, a carbon-rich product, on the growth of and competition between a native perennial grass, *Andropogon gerardii* (big bluestem), and a non-native herbaceous perennial, *Lespedeza cuneata* (sericea). After six months, percent organic matter, cation exchange capacity, and the availability of phosphorus, potassium, and magnesium were greater in soils with biochar than soils without biochar. *A. gerardii* height and biomass were significantly greater in biochar-amended soils than in unamended soils. However, *L. cuneata* height and biomass were not affected by biochar amendments and the addition of biochar did not alter competitive outcomes between the native and non-native species. Competition between *L. cuneata* and *A. gerardii* was asymmetrical; *A. gerardii* growth was reduced by *L. cuneata* but *A. gerardii* had relatively little effect on the growth of *L. cuneata*. This study suggests that, although biochar amendments have the potential to improve *A. gerardii* growth, biochar alone may not alter competitive outcomes between *A. gerardii* and *L. cuneata* species.*



S05.01-P -43

NITROGEN AND PHOSPHORUS USE EFFICIENCY FROM POULTRY MANURE APPLICATION TO FORAGE GRASSLAND

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More than 80% of poultry (chicken, *Gallus gallus domesticus*) manure produced annually is applied as a plant nutrient source, particularly N and P, to pastures. However, N losses during the process of manure N mineralization limit availability of N to crops. This study determined poultry manure N and P availability and apparent use efficiency (ANUE, APUE) to bermudagrass [*Cynodon dactylon*.] during the first year after manure application. Treatments consisted of three manure rates (3.3, 6.6, and 13.2 Mg ha⁻¹), a commercial N fertilizer rate that provided 358 kg N ha⁻¹ as ammonium nitrate (NH₄NO₃), and an untreated control. Results showed bermudagrass dry matter (DM) yield increased significantly with increase in manure rate. Commercial N fertilizer produced significantly greater DM yield than 3.3 and 6.6 Mg ha⁻¹ of manure, but produced less DM yield than 13.2 Mg ha⁻¹ of manure. The overall average of ANUE from manure was 39% compared to the 59% from fertilizer. The mean manure N availability to bermudagrass during the first year after manure application was 48.5, 112.5, and 222 kg ha⁻¹ corresponding to the 3.3, 6.6, and 13.2 Mg ha⁻¹ manure rates, respectively. The overall mean of manure N mineralization, which was surface broadcast to bermudagrass plots during the first year, was 59.5% of the total manure N applied. The APUE, averaged across the rate and locations, was 13.6%, which was quite smaller than ANUE of 39%. This finding of small APUE also validates the potential for P accumulation in soil after longterm animal manure application.



S05.01-P -44

NITROGEN KINETICS AND MINERALISATION IN A COMPOST-SEWAGE EFFLUENT AMENDED SOIL

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Integrated soil fertility management promotes usage of locally available amendments and inorganic fertilisers for sustainable crop and soil management. We wanted to understand nitrogen (N) kinetics and mineralisation due to the combined amendment of compost and treated sewage effluent. An incubation experiment was carried out using different combinations of compost and effluent ((37.5compost + 37.5effluent), (112.5compost + 37.5effluent), (75compost + 0effluent), (150compost + 0effluent), (0compost + 37.5effluent)) on sandy loam and clay loam soils to supply 37.5, 75 and 150 kg total N ha⁻¹. Soil samples were incubated for 120 days under a controlled environment of 25°C at field capacity. The one pool Stanford and Smith model was fitted to mineral N data. The results for treatments in clay loam were well described by the model, with the highest potentially mineralisable N (N_o) of 127 and 124 mg kg⁻¹ observed in treatments (0compost + 37.5effluent) and (37.5compost + 37.5effluent) respectively. Increasing compost amount (112.5compost + 37.5effluent) reduced N_o to 117 mg kg⁻¹ (p > 0.05). Due to N immobilisation, the model could not be fitted to treatments in sandy loam soil. In clay loam soil, net N mineralisation (NM_{net}) was influenced by the addition of effluent and the characteristics of the soil. NM_{net} in sandy loam soil was influenced by the addition of compost though it was significantly lower (p < 0.05) than in clay loam soil. Modelling N kinetics in soils receiving combined amendments is largely affected by the mineralisation/immobilisation patterns of the soil. Keywords: Nitrogen, mineralisation, kinetics, model, immobilisation



S05.01-P -45

ORGANIC AMENDMENTS ENRICHED WITH SCRAPS OF POPLAR PRUNING: SLOW DEGRADATION BIOMASS TO IMPROVE SOIL ORGANIC MATTER CONTENT OVER TIME

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One of the most worrying aspects of intensive agriculture is the gradual loss of soil fertility due to organic matter (OM) decrease. The delicate balance between OM accumulation and consumption must be retained in agricultural systems in order to prevent reduction in soil fertility. The maintenance or even the improvement of OM content in soil can be achieved through the use of different types of organic amendments. Most of the studies carried out on different Italian soils indicated that the application of organic amendments characterized by easily decomposable material (low C/N) could lead to a not persistent increase of OM. Aim of this work was to study how to maximize the recovery of soil OM in agricultural soils under intensive agricultural farming by using slow degradation biomass. The study has been carried out in two farms with contrasting geopedologic characteristics, for two years. Mixtures of organic amendments prepared with compost from municipal solid waste and wood (scraps of poplars pruning), as slow degradation source, were yearly supplied. After addition of organic amendments, soil fertility was periodically monitored for main chemical and biochemical properties. Results showed generally positive effects of organic amendments on soil chemical and biochemical properties, in particular as increase in organic carbon and nutrient contents, as well as in enzymatic activities. Our results demonstrated that the supply of compost enriched with low mineralization materials, such as wood scraps, can enhance soil chemical and biochemical properties over time, thus representing a promising alternative to conventional use of synthetic fertilizers.



S05.01-P -46

ORGANIC CARBON ALLOCATION IN POOLS OF DIFFERENT STABILITY IN A
MEDITERRANEAN AGRICULTURAL SOIL AFTER FOUR YEARS OF COMPOST
AMENDMENTS

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Soil amendments with compost derived from the organic fraction of urban wastes is an environmentally friendly strategy for both fertilization and waste recycling. However, there is also an increasing interest in compost amendments as a tool to promote carbon sequestration in soil. From this point of view, it is essential to understand the dynamics of compost carbon conversion in soil carbon. A field trial was started in 2007 on a sandy-loam Mediterranean soils. The fertilization treatments were: mineral fertilization; compost amendment with 30 t ha⁻¹ of dry matter; compost amendment with 15 t ha⁻¹ (d.m.) integrated with ½ of nitrogen supplied in conventional fertilization; untreated control. The compost was applied once a year in early spring. After four years of annual amendments, soil samples were collected from each plot and the soil organic carbon allocation in pools with different stability was investigated by size fractionation of organic particulate carbon inside water resistant aggregates and by organic matter hydrolysis with H₂SO₄. The results obtained by physical fractionation showed, in the compost amended soils, an increase of organic carbon in organo-mineral fractions inside aggregates, where organic compounds are less accessible to microbial activity. The results derived from chemical fractionation by acid hydrolysis showed that, in compost treated soils, most of the organic carbon increase was allocated in the more recalcitrant fraction. These data indicate that most of the carbon increase is recoverable in pools with low susceptibility to decomposition, suggesting a role of compost amendment in carbon sequestration.



S05.01-P -47

PHOSPHORUS AVAILABILITY IN BIOCHAR AMENDED SOILS

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Abstract Phosphorus (P) availability was investigated in a wide range of biochar amended soils (0.5%, 1%, 2% and 4% biochar; w/w) under laboratory conditions. Water soluble P (WSP) in soils increased as a rule upon biochar addition ranging from -5 to 250% and was highest at an application rate of 1% equivalent to 12-15 Mg biochar to soil (0-10 cm). However, most of the WSP present in biochar was retained (33-100%) in soil upon application. Among the mechanisms responsible for P retention, adsorption on positive charged chelate surfaces and precipitation of WSP with Ca present in the ash of biochar were discussed. Precipitation of P with ash-derived calcium can theoretically explain P retention in soil and decreasing WSP concentrations in soils at biochar applications greater than 1% followed by a pH increase of 0.3-0.7 units was also in line with this mechanism. No significant correlations were found between WSP and soil parameters such as extractable Al, Fe and Ca (with ammonium acetate lactate), degree of P saturation, organic C, clay, and pH. We concluded that (a) low and high additions of biochar can have different effects on P availability; (b) ash present in biochar is a major component affecting P availability; and (c) biochar cannot be used to bind excessive P in soil.



S05.01-P -48

PHYTOEXTRACTION OF CHROMIUM CONTAMINATED SOIL BY THREE BRASSICA SPECIES: EFFECTS OF MICROORGANISM AND COMPOST AS SOIL AMENDMENTS.

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*In the framework of a phytoremediation project in Apulia region for remediation of heavy metal contaminated soils (chromium in particular), greenhouse experiment was monitored in order to optimize the heavy metal mobilization/absorption and/or the root to shoot translocation in *B. alba*, *B. carinata* and *B. nigra* species. The influences of root colonization by bacteria strain *Bacillus licheniformis* BLMB1 and compost addition on ability of these species to tolerate and accumulate Cd, Cr, Cu, Ni, Pb and Zn were evaluated. The used soil was contained concentration of metals up to 1.62 (Cd), 1,977.8 (Cr), 188.8 (Cu), 74.75 (Ni), 202.31 (Pb) and 679.5 (Zn) mg kg⁻¹, respectively. The data obtained confirmed that all cultivars are accumulators to different metals, and using compost, *Bacillus* and a combination of both of them enhanced metals accumulation. The accumulation of all the metals was found maximum in shoots followed by roots, typical behavior of an accumulator species. Although high efficiency to accumulate high concentration of metals (Cr in particular) in above ground parts of Brassica species were recorded, and the phenomenon of hyperaccumulation was observed in *B. alba* which accumulated more than the threshold of Cr hyperaccumulators plants (1000 ppm), it is important to emphasize that phytoremediation by Brassica species should not be considered the appropriate choice for all metal polluted soils in the studied area according to the remediation time needed. According to our findings, several centuries were calculated to remediate one hectare of studied polluted soil to achieve the established Italian limits.*



S05.01-P -49

POTASSIUM HUMATES AND PLANT GROWTH – SEEKING UNDERSTANDING FOR OBSERVED EFFECTS

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Potassium humates and solutions of fulvic acids containing potassium salts have recently attracted considerable scientific and commercial interest. The application of such materials results in non-linear growth response, where low rates of application often give better plant growth response than high rates. Increases in plant nutrient and micronutrient uptake have also been reported^{1,2}. The effects of commercial lignite-derived potassium-humate and a potassium rich fulvic acid were investigated in a greenhouse trial, applied to tomato plants in soil and sand culture as well as a foliar treatment. Low rates of K-humate and K-fulvate application in growth media and in foliar treatments resulted in significant ($p < 0.001$) increases in fresh/dry biomass of shoot and fruits, and increased macronutrient and micronutrient uptake. Low rates of application were more effective than the higher rates. Surprisingly, foliar applications at a low rate, gave growth responses that were similar to growth media applications, suggesting that biochemical signalling plays a role in the beneficial effects of humate applications³. The results of a meta-analysis that has been used to identify the range of appropriate dose rates for optimum growth responses and potential differences in plant species responses, will also be presented. References 1. M.M. Tahir et al, 2011, Pedosphere, 21 (1), 124-131 2. R. Shahryari and V. Mollasadeghi, 2011, Advances in Environmental Biology, 5(3), 516-518 3. S. Trevisan et al, 2010, Plant Signal Behav., 5(6), 635–643.



S05.01-P -50

POTENTIAL USE OF RESIDUES FROM ANAEROBIC DIGESTION FOR BIOGAS PRODUCTION TO IMPROVE SOIL FERTILITY: AN HOLISTIC APPROACH

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Production of biogas through anaerobic digestion of energy crops generates residues that can represent a valuable resource to improve soil fertility and soil organic matter content, reducing the costs for mineral fertilization. The residues from anaerobic digestion contain organic fractions and available nutrients that make them suitable for use as fertilizers and soil conditioners. However, some unknown aspects of digested residues utilization remain to explore: i) the nutrient supply and the real potential for mineral fertilization substitution, ii) the impact on the structure and functioning of soil microbial communities, iii) the direct and indirect effects on soil structure, organic matter and C mineralization. These aspects were studied in a maize field in North Italy, comparing mineral fertilization (250 Kg N ha⁻¹) with digested residues addition (at the dose of 25 % and 50 % of mineral fertilizer). Residues from digestion showed a N content of 0.4 % (60 % as N-NH₄) and a C/N ratio of 3. Changes in soil quality after residues application were studied with a multidisciplinary approach, involving microbiological, physical and chemical aspects of soil fertility. In particular, abundance and diversity of bacterial soil community, total, soluble and protected soil organic matter, CEC, main macro and micro nutrients (N, P, K, Ca, Mg, Fe, Zn, Mn, Cu), bulk density, aggregate stability were determined. From the first results, the absence of significant changes in plant productivity after residues application, at both doses, is a promising indication for the potential use of residues as substitute of mineral fertilizers.



S05.01-P -51

PREDICTING THE PH BUFFERING CAPACITY OF COMPOST VIA TITRATION WITH DILUTE SULFURIC ACID

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Composts are typically have neutral or alkaline pH, and they increase soil pH when added in large amounts as a soil amendment for high value horticultural crops. We developed a quick test (titration with dilute H₂SO₄; 72-h equilibration at 22C) to estimate the pH buffering capacity or "liming effect" of diverse composts. Compost feedstocks included manure solids + bedding (horse or dairy), urban yard debris (deciduous tree leaves or grass + prunings from landscape maintenance), and farm by-products (grass seed screenings, spent hops, or peppermint distillation residue). Compost pH response to acid dilute addition was approximately linear. Compost pH buffering capacity was 0.2 to 0.4 mol H⁺/kg dry compost/pH unit (3 to 6 g S/kg dry compost was required to decrease pH one unit). Recommended titration method: Add dilute H₂SO₄ at 0, 0.2, 0.4, 0.6 and 0.8 mol H⁺ per kg dry compost. Maintain 1:10 ratio of dry compost to liquid (dilute acid). Measure compost pH after equilibration for 72 h at room temperature (22C). Plot 72-h compost pH (y axis) vs. acid addition rate (x axis). Slope of line = pH buffering capacity.



S05.01-P -52

RE-INVENTING ANTHROSOLS: AN ANCIENT ANSWER FOR MODERN-DAY PROBLEMS CONCERNING CLIMATE CHANGE, SOIL DEGRADATION, NATURE CONSERVATION AND AGRICULTURAL YIELD DECLINE?

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To mitigate the low inherent fertility of the sandy soils of the Campine area during Medieval times, farmers developed a management system that included the collection of litter and sods (plaggen) in common grounds (outfields). After composting and mixing with manure, the sods were applied on certain agricultural fields (infields). The long term results of this infield-outfield system are soils with deep, dark, man-made surface horizons, i.e. Plaggic Anthrosols. Although the practice has been abandoned for centuries, the thick A-horizons, relatively high carbon stocks and improved soil fertility still remain. Today, plaggen are a by-product of nature management to counteract eutrophication in heathlands: due to the atmospheric deposition of nitrogen, sods need to be removed every 10 to 20 years to preserve heathland vegetation and its associated biodiversity. The produced plaggen are very expensive to dispose of, whereas surrounding agricultural fields are suffering from soil degradation and a considerable decrease in topsoil carbon due to climate change and management. Hence, this study assesses the possibilities of using sods as a biosolids in a modernised version of the historic infield-outfield agricultural system, with the aim of providing alternative use for heathland sods and introducing a stable form of soil carbon in agricultural fields. It encompasses on two in-field experiments and one controlled experimental site, which aim at examining the combined effects of the addition of various amounts of plaggen, lime and nitrogen fertiliser on the acidity, carbon pools and nitrogen dynamics of the soil.



S05.01-P -53

SOIL AMENDMENT WITH DIFFERENTLY TREATED PINE BARKS AND WOOD IN THE RESTORATION OF A MINE SITE

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Mine soils are frequently located in hardly accessible sites, and their restoration often require high energy consumption to transport materials for in situ treatments. We studied the effectiveness of locally available pine barks, untreated and composted, and biochar from pine wood residues to complex metal ions on their surfaces and therefore reduce bioavailability of inorganic contaminants. The study was performed on a mine degraded soil from a dumping site in Cave del Predil (NE, Italy), heavily contaminated by Zn, Pb, Tl, As and Cd. Three doses (0, 0.5, 2% w/w) of untreated pine bark, composted pine bark and pine wood charcoal (biochar) were applied to the soil. Two plant bioassays (cress germination test and barley root elongation test) were performed on 15 days incubated soils. Water soluble Zn, Pb, Tl, As and Cd in the treated soils were detected at different incubation times (0, 15, 20, 90 days). Moreover, the ability of the amendments in retain pollutants were measured in adsorption experiments. All the amendments were able to increase significantly cress germination and barley root growth, with a dose response effect, and to subtract metals from the soil solution, with a higher effect of biochar for Zn and Cd and of untreated barks for Tl. Our results indicate that the addition of an organic amendment is a prerequisite for success of revegetation of heavily polluted mine sites.



S05.01-P -54

SOIL AND PLANT RESPONSES IN THREE CONTRASTING SOILS AFTER AMENDMENT WITH ORANGE WASTE COMPOST AS BY A MESOCOSM EXPERIMENT

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The decline of organic matter content of many soils in Europe is becoming a major process of soil degradation; especially in Mediterranean croplands where climatic conditions and anthropogenic pressures accelerate the processes of mineralization. Addition of organic amendments is an efficient practice to recover the soil's productivity. In Southern Italy, 720.000 t of by-products from citrus processing plants are produced yearly, thus composting may represent a valuable strategy for recycling this waste biomass for potential use in agriculture and alleviating the serious environmental problems concerning its safe disposal. This work aimed to investigate soil and plant responses after amendment with orange waste compost in three contrasting soils (a Typic Haploxeralf, a Typic Xerofluvent, a Vertic Eutrudept) as by a mesocosm experiment. Mesocosm soils were added with compost at two rates (0 and 60 t ha⁻¹), and managed across the growing season with forage legumes (vetch and tick-bean) or forage grasses (orchard-grass and tall fescue). Soil chemical variables (pH, TOC, TN, CEC, EC) were monitored at sowing and harvest. Shifts in the molecular structure of soil bacterial community were assessed by denaturing gradient gel electrophoresis (DGGE) analysis. TOC and TN were responsive to compost addition depending on soil type. DGGE fingerprinting revealed that soil bacterial community structure was fairly resilient to the short-term soil treatments (compost amendment, cropping systems). Compost addition was found to influence selectively the above-ground biomass production. Results indicate that orange waste compost may represent a valuable organic resource for managing soil fertility in Mediterranean degraded agricultural lands.



S05.01-P -55

SOLUTE TRANSFER FROM RUNOFF UNDER SIMULATED RAINFALL IN AN AMENDED IRON-MINE TAILING WITH SEWAGE SLUDGE COMPOST

Sevilla Perea Ana*^[1], Fernández Gálvez Jesús^[1], Díaz Cobos Manuel^[1], Mingorance Álvarez María Dolores^[1]

^[1]Instituto Andaluz de Ciencias de la Tierra ~ Química de suelos y ambiental ~ Armilla ~ Spain

Wastewater sludge amendment is a common practice in the recovery strategies of mine tailing, due to its organic matter and nutrient content. However, the excess of nutrients and other chemicals may pose potential health and environmental problems. In this study, rainfall simulation experiments on small field plots were performed over a mine tailing amended with compost made up with a mix of sewage sludge and green wastes (SVC) to evaluate the effect of solute transfer by runoff. The SVC was homogenised with soil (10 cm depth) at two rates (35 and 195 t/ha) and left under natural environmental conditions for 15 months. Afterwards, rainfall simulation experiments over nearly flat 0.5x0.5 m² plots were performed at rainfall intensities corresponding to typical storms measured in the region. During simulations, both runoff water and sediments were collected at regular times. Samples were analyzed for pH, conductivity (EC), anions (NO₃⁻, PO₄³⁻), cations (NH₄⁺, Ca, Mg, K, Na) and dissolved C. Results indicate that SVC disposal increases the average concentration of nutrients in runoff water compared to the control plot, with higher concentration at higher application load. Nutrient concentration in runoff water decreased after one year of application and an increase in EC was observed. Otherwise, solution pH decreased after SVC application probably due to organic matter mineralization. These findings stress the importance of selecting amendments adapted to the conditions in order to minimise the risks of nutrient loss by runoff and therefore to secure this practice into sustainable agriculture.



S05.01-P -56

STEROLS IN SOIL SOLUTION AS BIOMARKERS IN POULTRY MANURE AMENDED SOIL

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Fertilisation of soils by using waste materials, can improve both physical and chemical soil properties and is one of the tools to increase organic C stock. However, the mineralisation of not stabilised organic matter in soil, can produce amounts of very mobile organic compounds, which could represent an environmental threat. A study was carried to assess the effect of a not stabilised organic waste material (fresh poultry manure) when added to a soil (fine silty, mixed, mesic Typic Haplustalf). Soil solutions were sampled weekly for a period of three months by plate lysimeters placed at two different depth (30 and 50 cm), each time after a simulated rain of 25 mm. In parallel, a control experiment was run in the laboratory, washing the poultry manure with water and collecting the leached solution. In order to assess the release, mobility and degradation of soluble compounds with potential hazard derived from the poultry manure, sterols as biomarkers were used. Molecules such as cholesterol and coprostanol showed a high chemical stability in the soil solution and a different distribution along soil profile. Despite the different sorption on soil (K_f cholesterol 15613, K_f coprostanol 35), a larger amount of cholesterol has been found in the solutions from the deeper lysimeters, as a consequence of the higher amount of this molecule released from manure. These data were confirmed also by laboratory experiments. Moreover, we calculated different ratios between sterols isomers as possibly secondary biomarker of the rate of manure added or its age in the environment.



S05.01-P -57

THE EFFECT OF AGED BIOCHAR ON THE GROWTH OF NATIVE AND INVASIVE PRAIRIE PLANTS.

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The effect of biochar on soil characteristics and plant growth can change over time. We examined the effect of biochar "ageing" on the growth of two perennial species found in North American prairies. Big bluestem (*Andropogon gerardii*) is a grass species native to North America and sericea (*Lespedeza cuneata*) is a leguminous species native to Europe. Individuals from each species were grown singly in pots filled with soil that previously contained *A. gerardii* or *L. cuneata*, with and without biochar. No differences were detected between species when they were grown in soil that previously contained *A. gerardii* and biochar did not increase the growth of either species. However, in soil that previously contained *L. cuneata*, *A. gerardii* total dry weight was 5.0 g/plant \pm 0.84 in soil with biochar but only 2.9 g/plant \pm 0.39 in soil without biochar. *L. cuneata* total dry weight was not affected by biochar in soil that previously contained *L. cuneata*. *A. gerardii* partitioned more biomass to roots than to leaves which suggests that its growth was limited by soil nutrients. *L. cuneata* produced nodulated roots and partitioned more biomass to leaves than to roots, which suggests that soil nutrients may not have been a limiting factor in its growth. Biochar did not affect the number of root nodules produced by *L. cuneata*. This study supports the hypothesis that prairie plant species may differ in their interactions with biochar amended soil.



S05.01-P -58

THE EFFECT OF ASPEN PULP SLUDGE MIXTURE WITH CLINKER DUST ON SOIL PROPERTIES

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*In the context of sustainable plant production maintaining and increasing soil fertility is an important target. The aim of the study was to evaluate the pulp and paper industry residual sludge (from *Populus tremula* L.) mixture with alkaline clinker dust (applied 20 and 40 t ha⁻¹ in 2009 and 2011 and 20, 30, 40 t ha⁻¹ in 2010) as a soil conditioner and fertiliser in three crop-rotational (spring-wheat – potato – spring barley) field experiment on a sandy loam Stagnic Albeluvisol. The sludge mixture produced in Ltd. Estonian Cell (located in Kunda, Estonia) dry matter (DM) content was 23-25%, pH 10.6-11.2, total N 2.93-3.4%, P 0.24-0.43%, K 3.72-1.14%, Na 0.67% per DM, and C:N ratio 8.1-8.6. Heavy metal concentrations of the EC mixture were below the limit values set by the Estonian legislation. The results were compared to unfertilised plots, manure treatment (40 t ha⁻¹ each third year) and mineral nitrogen rates 80 and 160 kg ha⁻¹. Fertilisation with sludge mixture showed an increase in soil pH_{KCl} and plant available K content compared to unfertilised plots. The change in soil organic carbon content is a slow process. Thus, no statistically significant change in soil organic carbon content can be reported based on this study time span. Use of aspen pulp sludge mixture with alkaline clinker dust has potential as an alternative organic fertiliser improving soil properties and increasing crop yields.*



S05.01-P -59

THE EFFECTS OF BIOCHAR APPLICATION ON WATER RELATION AND SOIL QUALITY IN VITIS VINIFERA

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Soil water status plays an important role on the growth-yield response on Vitis vinifera and on the quality of productions. Moderate water stress periods are in some cases needed to ensure high quality productions, but especially in dry Mediterranean environment, water stress may lead to an unbalance of the sugar/acidity ratio due to berry dehydration. Biochar is a co-product of thermochemical conversion of lignocellulosic biomass and it is well recognized to exert, if incorporated to the soil, an amendant action and an increase of water retention. The scientific literature on soil biochar application show a small overall, but statistically significant, positive effect of the biochar on plant productivity. In this work we investigated the effect of biochar amendments on Vitis vinifera (cv. Merlot) in a acid soil (pH 5.5) in Central Italy for two consecutive seasons. The biochar was applied at two rates 22 and 44 t ha⁻¹ in a strip plot design with 5 replicates During summer 2011 the seasonal course of leaf water potentials, chlorophyll content, and chlorophyll fluorescence were measured as potential indicators of water stress. Detailed soil samples were also made during the entire season to detect the effects of the biochar application on soil parameters and on their dynamic. Preliminary results that will be reported in this presentation are showing that the soil pH increased by about one unit after biochar application and that a substantial reduction of water stress effect of plant treated with biochar has occurred.



S05.01-P -60

THE EFFECTS OF DIFFERENT ORGANIC AMENDMENTS ON THE EVOLUTION OF SOIL STRUCTURE AND FERTILITY

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Soil fertility is related to soil structure and nutrient availability. Intensive agricultural practices adopted in the modern agriculture accelerate losses of organic matter (OM) which in turn leads to a cascade of adverse effects including erosion, structure degradation and reduced fertility. The application of organic amendments to restore soil organic carbon in croplands is a win-win situation because it improves both soil fertility and increases yield. A field study is carried out in Koiliaris River Basin (KRB) Critical Zone Observatory (CZO) to assess the effects of different organic amendments in the evolution of soil structure and soil (bio)chemical properties related to fertility as well as the yield of tomato plants and the quality of the fruits. Four treatments in triplicate (plot size 4 m x 5 m) are under investigation in a 35-years set aside field including: i) control, conventionally fertilized plots, ii) plots amended with municipal solid waste compost (MSWC), (50 t/ha), iii) plots amended with manure (50 t/ha) derived from sheep/goats, and iv) a 30/70 mixture (50 t/ha) of manure and MSWC. Results of the 1st year of operation regarding pH, electrical conductivity, OM, TN, NO₃-N, NH₄+N macro- and micro-nutrients, microbial activity, water stable aggregates, growth and yield are presented and discussed.



S05.01-P -61

USE OF FOOD BY-PRODUCTS AND WHITE ROT FUNGI IN THE PRODUCTION OF BROWN COAL-BASED COMPOSTS

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^[1]CRA ~ Center for Study of Plant Soil Systems ~ Turin ~ Italy ^[2]SGGW ~ Agricultural Crops ~ Warsaw ~ Poland

^[3]Research Institute of Horticulture ~ Agrotechnics ~ Skierniewice ~ Poland

Composts were produced by use of brown coal from the Mine in Belchatow (Poland), with the following additions: a) Vinassa - a waste product in the production of bakery yeasts (10% of the total weight of the organic matrix), b) Whey – a dairy waste product (10% of the total weight of the organic matrix) c) an inoculum of either *Pleurotus ostreatus* or *Lentinus edodes* - white rot fungi (1% of the total weight of the organic matrix). Composts were analyzed for nitrogen and carbon content, organic carbon fractions (TEC, HA and FA), and humification indexes were calculated. The composts were utilized in a trial carried out in field mesocosms with strawberries and plant growth parameters were measured. The two types of fungi showed different effects in the decomposition of organic compounds. The two waste products, added to the compost matrix also differently affected the hydrolysis process of brown coal and the final composition and quality of the composts produced. Those obtained with Vinassa showed the highest N and soluble organic C forms content. Addition of the composts to the mesocosms improved most of the studied plant growth parameters. Among the different composts used, those obtained with the use of vinassa and *Pleurotus ostreatus* resulted the most promising.



S05.02-P - IMPACTS OF SOIL AMENDMENTS ON TRANSFORMATION AND SORPTION OF BIOLOGICALLY ACTIVE SUBSTANCES IN SOIL

Thursday 05 July 2012 from 17:00 to 18:30. Room Poster Areas

S05.02-P -1

A NOVEL SYNTHESIZED MN (OXY)HYDROXIDE AS A POSSIBLE AMENDMENT FOR METAL STABILIZATION IN CONTAMINATED SOILS

Michael Komarek, Prague - Czech Republic

S05.02-P -2

ACTIVATED BIOCHARS FOR THE IN-SITU SEQUESTRATION OF ORGANICS, MERCURY AND CARBON IN SEDIMENTS

Upal Ghosh, Baltimore - United States

S05.02-P -3

IMPACT OF HYDROCHAR APPLICATION ON SOIL NUTRIENT DYNAMICS AND PLANT AVAILABILITY

Inge Bargmann, Berlin - Germany

S05.02-P -4

OPTIMISING PHOSPHORUS SUPPLY FROM NUTRIENT ENRICHED SLUDGE GRANULES USING DIFFUSIVE GRADIENT IN THIN FILMS (DGT)

Ruben Sakrabani, Cranfield - United Kingdom

S05.02-P -5

PREPARATION OF MAIZE-DERIVED BIOCHAR FROM PYROLYSIS AND HYDROTHERMAL TREATMENT FOR SORPTION EXPERIMENTS

Judith Pielert, Berlin - Germany

S05.02-P -6

SUSTAINABLE LAND-USE BY REGIONAL ENERGY AND MATERIAL FLOW MANAGEMENT USING "TERRA-PRETA-TECHNOLOGY" ON MILITARY CONVERSION AREAS AND LOW-YIELD-LOCATIONS (LATERRA)

Konstantin Terytze, Berlin - Germany



S05.02-P -7

THE HETEROGENEITY OF PIG SLURRY AND HIS INFLUENCE ON SOIL

Diana Hofmann, Julich - Germany

S05.02-P -8

UNDERSTANDING PHOSPHORUS (P) DYNAMICS IN SOILS AMENDED WITH REPEATED APPLICATION OF DIFFERENT ORGANIC AMENDMENTS USING THE DIFFUSIVE GRADIENTS IN THIN-FILMS (DGT) TECHNIQUE.

David Kane, Cranfield - United Kingdom



S05.02-P -1

A NOVEL SYNTHESIZED MN (OXY)HYDROXIDE AS A POSSIBLE AMENDMENT FOR METAL STABILIZATION IN CONTAMINATED SOILS

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A novel synthetic Mn (oxy)hydroxide (HMO) was synthesized using a modified protocol commonly used for the preparation of birnessite using the sol-gel synthesis. This (oxy)hydroxide is studied as a possible chemical stabilizing agent for metals in contaminated soils. Its stability in deionized water and the sorption of Cu and Pb were studied using batch experiments. The dissolution of the HMO in water reached indicates that the phase could be fairly stable in soils. The Langmuir isotherm parameters were calculated. The sorption parameters of the HMO were compared to those of birnessite. While the HMO was a more efficient sorbent for Cu, birnessite is more efficient for Pb, Cd and Zn; however, for practical use as a chemical stabilizant, our Mn (oxy)hydroxide could be promising due to its easy synthesis. The adsorption edge of Cu on HMO indicates that 50% adsorption occurs at pH 5.5. Furthermore, batch experiments and rhizos were used to evaluate the immobilization potential of the HMO in three different soil types at three different w/w ratios. Results show that soil pH has been modified by the HMO, approaching the pH of the phase in water. The stability of the HMO was studied in three contrasting soils with pH of 4.2, 5.4 and 7.2 by laboratory pot experiments as a function of time (up to 90 days). The mineralogical investigation using X-ray diffraction (XRD) and transmission electron microscopy (TEM) indicated that a small amount of MnCO₃ formed at the HMO surfaces in soil with higher pH.



S05.02-P -2

ACTIVATED BIOCHARS FOR THE IN-SITU SEQUESTRATION OF ORGANICS, MERCURY AND CARBON IN SEDIMENTS

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This study evaluated the potential of a series of especially formulated biochars (derived from pine wood, peanut hull, barley straw and acai pit) and activated poultry litter biochars to sequester organic and metal contaminants in sediments, while reducing or even reversing the carbon footprint of sediment remediation efforts. PAH, PCB and DDT isotherm studies were conducted at environmentally relevant concentrations using polyoxymethylene solid-phase extraction (POM-SPE), to evaluate the sorption capacity of the different biochars. Freundlich isotherms were constructed and biochar performance was compared with that of commercially available activated carbons (AC). Biochars were effective at sorbing organics with K_f values ranging from 6.4 to 7.2 for PCB 47, a mid-range tetra-PCB. This sorption was highly non-linear, with n values ranging from 0.53 to 0.81 for PCB 47. However, ACs consistently removed more PCBs from solution, followed by the activated poultry litter biochars suggesting surface area is a key parameter controlling organic contaminant sorption potential. The difference in sorption potential between CACs and biochars was greater for the less chlorinated PCBs with lower K_{ow} . The activated poultry litter biochars removed >99% mercury from solution over the pH range of 3-11, whilst the AC's removed between 18 and 95% depending on pH level. This suggests the surface functionality of the biochars make them more effective for mercury removal, than the AC's. A better understanding of how biochar characteristics affect contaminant sorption is necessary to select the appropriate biochar amendment to achieve site specific contaminated soil/sediment remediation goals.



S05.02-P -3

IMPACT OF HYDROCHAR APPLICATION ON SOIL NUTRIENT DYNAMICS AND PLANT AVAILABILITY

Bargmann Inge*^[1], Greef Jörg Michael^[2], Kücke Martin[□]

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The influence of soil application of different hydrochars (from sugar beet pulps and brewer's grains) on soil nutrient dynamics as well as on plant growth and plant nutrient uptake was determined in soil incubation and pot experiments. Soil pH increased by 0.5 to 2.5 pH units after HTC application. Furthermore, the plant available nitrogen decreased to almost zero in the first week after HTC-addition, followed by a slow re-release of nitrate in the following weeks. A similar immobilization of soluble phosphate was observed to a lower extent. The plant availability of phosphorus in hydrochars and biochars is subject of current trials as is the extent of N immobilization by soil microorganisms. Hydrochar application decreased germination of barley, both with and without direct contact of grains with HTC, indicating that toxic gaseous compounds can be released from HTC. The pot experiments with various crop species (barley, phaseolus beans, leek) showed that with increasing addition of HTC, the N uptake and N contents in plants were significantly lower compared with the untreated control. The plant growth response was different for each tested crop. Biomass yield of barley and beans was generally increased by HTC application whereas leek biomass production was reduced. Our experiences show that HTC-materials should be incorporated into soils several weeks before planting/sowing, similar to straw incorporation. Alternatively, HTC can be pretreated by composting or fermentation with fresh organic material to destroy toxic compounds microbially.



S05.02-P -4

OPTIMISING PHOSPHORUS SUPPLY FROM NUTRIENT ENRICHED SLUDGE GRANULES USING DIFFUSIVE GRADIENT IN THIN FILMS (DGT)

Sakrabani Ruben^[1], Pawlett Mark^[1], Deeks Lynda^[1], Read Rob^[1]

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Sewage sludge recycling is an important source of phosphorus in agricultural systems especially as inorganic phosphorus supply is a declining resource. The purpose of this study was to investigate the role of sewage sludge enriched with urea (known as organo-mineral fertilisers - OMF) in reducing agricultural demand for phosphorus. A field trial was established to investigate OMF's influence on phosphorus dynamics, optimal application rates for ryegrass yield, and the potential for phosphorus accumulation. The results were compared to application of urea and biosolids as fertilisers. Diffusive gradient in thin films (DGT) and the more conventional Olsen-P method were used to observe phosphorous. DGT is a passive sampler that has a layer of ferrihydrite gel that selectively adsorbs phosphorus in soils. It is thought that the DGT method better reflects plant bioavailable P fraction. Comparison of the two methods showed a significant positive correlation ($R^2=0.63$ $p<0.001$). Soil analysis of pre-fertiliser application showed that both the OMF and urea fertilisers plots had lower P (54mgkg^{-1}) levels than control and biosolid (62mgkg^{-1}) plots. After post-harvest there was reduction of P as determined by the Olsen method where urea had been applied. This reduction was not observed in the DGT results. Differences between Olsen-P and DGT methods observed after urea application may be the result of different P pools being observed. Results indicate that DGT data may be a better indicator of plant available P than Olsen-P and thereby its use may prevent unnecessary application of phosphorus fertiliser.



S05.02-P -5

PREPARATION OF MAIZE-DERIVED BIOCHAR FROM PYROLYSIS AND HYDROTHERMAL TREATMENT FOR SORPTION EXPERIMENTS

Pielert Judith^{*[1]}, Martin Kaupenjohann^[1], Daniela Häntzschel^[1], Hannes Rose^[1]

^[1]Berlin University of Technology ~ soil science ~ Berlin ~ Germany

Global soil degradation and food scarcity call for new approaches to improve soil fertility in a sustainable way. Recent studies, following the “terra preta concept”, highlight the ability of biochar to improve the water and nutrient storage capacity in soils. However, the interpretation of the results of many studies is hampered because (1) the biochar used in individual studies is diverse and often not sufficiently characterised and (2) standardized preparation and analysis methods are missing. Thus, the objective of our study was to develop a standardized method for the preparation of different biochars for sorption experiments to enable comparable results. We used maize-derived biochar from pyrolysis (P) and hydrothermal treatment (H) and conducted the following consecutive steps: (1) physical fractionation of biochars by wet sieving into six grain size classes, (2) removal of dissolved and soluble non-biochar compounds by washing with de-ionised water and hydrochloric acid and (3) equilibration of the biochar with electrolyte. The effects of the preparation procedure were determined by analyzing solid (SEM, EDX, specific surface area & porosity, zeta-potential, elemental composition, pH-buffering capacity) and solution samples (elemental composition, pH, EC). Our recommendations for the preparation of defined material for sorption studies are: (1) use of grain size fractions of 100-1000 µm (H) and 200-1000 µm (P), (2) wash with de-ionised water (H) and 0.05 M HCl (P) and (3) and equilibrate with 0.05 M CaCl₂ (P and H).



S05.02-P -6

SUSTAINABLE LAND-USE BY REGIONAL ENERGY AND MATERIAL FLOW MANAGEMENT USING "TERRA-PRETA-TECHNOLOGY" ON MILITARY CONVERSION AREAS AND LOW-YIELD-LOCATIONS (LATERRA)

Terytze Konstantin^{*[1]}, Ines Vogel^[1], Karin Friede^[1], Florian Worzyk^[1], Schatten René^[1], Michael Haubold-Rosar^[2], Ursula Weiss^[2], Anne Rademacher^[2], Karlheinz Weinfurter^[3], Dmitrie Drabkin^[3], Stefan Zundel^[4], Sfehanie Trabelsi^[4]

^[1]Freie Universität Berlin ~ Geoecology ~ Germany ~ Germany ^[2]Forschungsinstitut für Bergbaufolgelandschaften - FIB e.V. ~ agricultural reclamation ~ Finsterwalde ~ Germany ^[3]Fraunhofer Institute for Molecular Biology and Applied Ecology ~ - ~ Schmallenberg ~ Germany ^[4]Hochschule Lausitz ~ - ~ Senftenberg ~ Germany

The interdisciplinary and transdisciplinary joint research project seeks innovative system solutions for resource efficiency, climate protection and area revaluation by means of an integrative approach. The project's fundament is set by implementing the zero-emission-strategy, launching a regional resource efficient material flow management as well as utilising "Terra-Preta-Technology" as an innovative system component. As the centrepiece of optimised regional biogenic material flows Terra Preta Substrate (TPS) shall be utilised exemplarily in model regions. In regional project 1 (state of Brandenburg) TPS shall be used on military conversion areas, which are contaminated with polycyclic aromatic hydrocarbons and mineral oil hydrocarbons. It will be examined, whether the use of TPS causes accelerated pollutant reduction and whether this area is available for renewable raw material production. In regional project 2 (Western Lusatia, county Oberspreewald-Lusatia) reclamation and renaturation of post-mining-landscapes is first priority. In this case, the project seeks for an upgrade of devastated soils for plant production as well as for restoration of soil functions and setup of organic soil substances. In regional project 3 (state of North Rhine-Westphalia, city of Schmallenberg) reforestations of large scale windbreakage areas shall be supported by using TPS. Soil stabilisation, increased growth and survival of young trees and decreased nutrient losses are desired achievements. The crop production effectiveness and environmental compatibility of TPS will be determined by tests in laboratories, by lysimeter and open land taking into account chemical and physical as well as biological parameters. Currently diverse chemical, physical and biological examinations are performed. First results will be presented.



S05.02-P -7

THE HETEROGENEITY OF PIG SLURRY AND HIS INFLUENCE ON SOIL

Hofmann Diana^{*[1]}, Arenz-Leufen Martina^[4], Steffen Bernhard^[3], Thiele-Bruhn Sören^[2]

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Liquid manure is used as an organic fertilizer in agricultural practice. Manure in general as shown in literature affects the sorption and mobility of antibiotics in soil. However, liquid manures are extremely heterogeneous matrices, varying with live stage of animals, feeding, and finally manure collection systems at the farm. The fourier transform ion cyclotron resonance mass spectrometry (FT-ICR-MS) with an outstanding mass resolution and mass accuracy is the key technique to characterize complex natural systems by simultaneously providing molecular level details of thousands of compounds. It has already been successfully applied to investigate the chemical characteristics of natural organic matter (NOM) from sources like water, soil, sediment, bog, and crude oil. The characteristics of measured manure- as well as two soil-DOM mass spectra are demonstrated. Furthermore, an algorithm to compute all chemically relevant C,H,O-, C,H,(O,S),N- as well as C,H,(O),S molecular compositions, designed and exercised by our self using Scilab routines, was used for structure elucidation of single components. For the interpretation of the entire amount of data graphical methods were used - the van Krevelen diagram to classify the DOM compounds regarding polarity and aromaticity, the Kendrick diagram allow to identify ions with elemental formulas that differ only in CH₂ and molecular formulas with similar Kendrick Mass Defect (KMD) can be sorted by nominal mass series.



S05.02-P -8

UNDERSTANDING PHOSPHORUS (P) DYNAMICS IN SOILS AMENDED WITH REPEATED APPLICATION OF DIFFERENT ORGANIC AMENDMENTS USING THE DIFFUSIVE GRADIENTS IN THIN-FILMS (DGT) TECHNIQUE.

Kane David^[1], Sakrabani Ruben^[1], Tyrrel Sean^[1]

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Global P resources are limited, and gradually depleting with over 85% of mined phosphate rock is used annually in agriculture. Organic amendments can provide a sustainable alternative to traditional inorganic fertilisers but the concentration of phosphorus in organic amendments is variable and its availability when applied to soils is relatively unknown. Widely used soil tests to measure soil P such as Olsen-P are based on extraction techniques. An alternative method is the Diffusive Gradients in Thin-films (DGT) which can measure the form of P available to the plant. DGT is a passive sampler that has a layer of ferrihydrite gel which selectively adsorbs phosphorus in soils. Since the DGT technique reflects plant available P, it has a better potential to be used as a tool to make P use in agriculture more sustainable. The objectives are (1) To quantify available P pools in soil associated with application of superphosphate (SP) and different organic amendments (cattle slurry(SLRY), cattle manure (FYM) and green waste compost(GW)) and estimate the timescale required to make P available. (2) To quantify soil response to added P in relation to different application rates of the various organic amendments. Work to date has shown that: (a) The most efficient treatments at releasing P were SP>GW>SLRY>FYM (b) Increasing application rate in organic amendments did not increase P (c) There was a poor relationship between added P and plant uptake for all amendments (d) Olsen P and DGT measurements quantify P from different pools in soils.



S05.03-P - BIOCHAR EFFECTS ON SOIL PROPERTIES, PROCESSES AND FUNCTIONS

Thursday 05 July 2012 from 17:00 to 18:30. Room Poster Areas

S05.03-P -1

"POTENTIAL OF ANTHROPOGENIC CHARCOAL DEPOSITS FOR ASSESSING THE FATE OF BIOCHAR IN EUROPEAN SOILS"

Ian Mugford, Swansea - United Kingdom

S05.03-P -2

BIOAVAILABILITY OF HEAVY METALS IN CONTAMINATED SOIL TREATED WITH BIOCHAR

David Houben, Louvain-la-Neuve - Belgium

S05.03-P -3

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Tamara Benjamin, West Lafayette - United States

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Maren Oelbermann, Waterloo - Canada



S05.03-P -1

"POTENTIAL OF ANTHROPOGENIC CHARCOAL DEPOSITS FOR ASSESSING THE FATE OF BIOCHAR IN EUROPEAN SOILS"

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The debate about biochar systems within the scientific and environmental communities has focussed not only on the potential contribution of biochar to carbon sequestration, but also on its value as a fertilizer and soil-amendment product. Despite detailed studies of historical black carbon (BC)-rich soil deposits such as the Amazonian Dark Earths, limited long-term research and field trials have been undertaken to investigate the longevity of biochar in European soils, its behaviour in the soil environment, and variations in biochar-soil interactions within and between different climate regimes. This study is investigating the mechanisms by which three factors have influenced the fate of biochar in European soils: i. Climate (temperate, sub-alpine, alpine and Mediterranean): How does climate affect the complex interrelationships between the physical and chemical properties of biochar and its host soils? ii. Age (Bronze Age to Modern): What effect does the age of the charcoal deposits have on soil-charcoal interactions and on the stability of the carbon structure within the charcoal particles? iii. Feedstock: Is there a relationship between the woody species that were originally charcoaled and the persistence of refractory BC in soils? What impact does wood selection for charcoal production have on soil properties e.g. the concentrations of toxic metals? This poster will present the first results of physical and chemical analyses of soil samples collected from European, historical (Post-Mediaeval) charcoal production sites, known as Meilers. Historically situated within dense forest stands, Meiler deposits are now located within a range of temperate, sub-alpine and alpine ecosystems.



S05.03-P -2

BIOAVAILABILITY OF HEAVY METALS IN CONTAMINATED SOIL TREATED WITH BIOCHAR

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*The use of biochar as a possible amendment to immobilize heavy metals and promote the establishment of a vegetation cover on contaminated soils was investigated. To this end, various rates of biochar (1.25%, 2.5%, 5% and 10%) and lime were applied to a soil contaminated by heavy metal-rich atmospheric fallouts. Results showed that the higher the amendment rate, the more the CaCl₂-extractable (0.01 M) metal content decreased. This reduction represented up to 78%, 94% and 92% for Cd, Pb, and Zn, respectively, in soils where 10% of biochar was added. The greatest reduction in CaCl₂-extracted metal, however, was observed in limed soil (99%, 97% and 99%, for Cd, Pb and Zn, respectively). Regression analysis showed that pH accounted for most of the variability in CaCl₂ extractability of metals, though including CEC in regression equations slightly improved predictions of extractability. This suggests that, in addition to increasing alkalinity, biochar could also induce metal immobilization by directly improving the soil CEC. Metal uptake by *Lolium multiflorum* was reduced by 67%, 50% and 73% for Cd, Pb and Zn, respectively, in soils where 10% of biochar had been added. Overall, the addition of 1.25 or 2.5% of biochar did not induce a significant reduction in metal uptake. Conversely to the observations with CaCl₂ extraction, lime and 10%-biochar treatments had similar effects on the metal plant uptake. Our promising results suggest that biochar application in heavy metal-contaminated soils could not only sequester carbon but also remediate polluted sites.*



S05.03-P -3

BIOCHAR AMENDMENT OF SANDY SOIL FROM WESTERN CAPE, SOUTH AFRICA: EFFECT ON SOIL QUALITY AND FERTILIZER LEACHING

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Soil degradation and nutrient pollution of ground waters are most acutely expressed on sandy soils, which are common in the Western Cape Province, South Africa. In an effort to improve the quality of these soils, we carried out a greenhouse and laboratory study investigating the application of locally-produced pinewood biochar (slow pyrolysis at 450 °C) at varying levels on sandy soil chemical and physical properties, beneficial microbes, fertilizer leaching and growth of wheat (monocot) and beans (dicot). We found that biochar, when added in moderate amounts (not exceeding 0.5 % w/w), increases: the growth of wheat (21%) and beans (35%), wheat water use-efficiency, availability of basic cations and P, the soil water-holding capacity, and aggregate stability of the sandy soil. It also stimulated microbial activity and enhanced N-fixation in beans, but negatively affected mycorrhizal colonization of wheat roots. However, biochar appeared to reduce N and trace element availability in the soil when applied over 0.5 % w/w, due to the wide C:N ratio and alkalinity present in the biochar. The addition of biochar to the sandy soil significantly reduced the leaching of ammonium nitrate fertilizer (up to 95 %) from the sandy soil. Biochar has the potential to enhance carbon sequestration, microbial activity, and nutrient and water retention in low potential sandy soils, as our study has shown. However, the majority of biochars are alkaline and have a wide C:N ratio. These two factors should be taken into consideration when applying biochar to poorly-buffered and nitrogen-poor sandy soil.



S05.03-P -4

BIOCHAR AND CLAY AMENDMENT OF SANDS: EFFECTS ON P RELEASE, LEACHING AND AVAILABILITY

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Low nutrient retention and availability are key constraints to plant production on sands. We examined the effect of biochar and clay additions to sands on leaching of P and its availability to plants. Fresh biochar prepared from chicken manure (CMB) or wheat straw (WSB) contained high P concentrations (1.16 and 0.42 % P, respectively) which dominated in subsequent release over sorption of additional P. During an initial desorption, more of the P was released by WSB than by the CMB. After 5 successive desorption steps, solution P concentrations were 10 mg/L with CMB but declined to only 2 mg/L with WSB. When added to a grey sand (1 % clay) at 20 t/ha, P in biochar was leached through 30 cm columns. Addition of kaolinite clay at 50 t/ha together with the biochar had minimal effect on P leaching. The biochar at 5 t/ha drilled with seed increased wheat yields by about 0.5 t/ha on a deep grey sand. The effect of biochar on yield was additive to that of P fertiliser applied at 14 kg P/ha. These results suggest that P in biochar from wheat straw and chicken manure was readily soluble, and prone to leaching losses, with more rapid release from WSB. Hence the rapid release and availability of P in fresh biochars need to be considered when fertilising crops. The reaction of aged or weathered biochar in sands with the native soil P and with added fertiliser P warrants further investigation.



S05.03-P -5

BIOCHAR AND ITS EFFECT ON SOIL NUTRIENT STATUS AND PLANT YIELD- RESULTS FROM POT AND FIELD EXPERIMENTS

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*Biochar (BC) results from pyrolysis, which is the anoxic, thermal decomposition of biomass. It is investigated as a direct and indirect contributor to soil nutrient status. However, detailed information on nutrient status after BC application on agricultural soils in temperate regions is scarce. This study presents results of a pot experiment using three agricultural soils and four different BCs (mixed woodchips [pyrolyzed at 525°C], straw [525°C] and vineyard pruning [400 and 525°C]). Selected pots were planted with mustard (*Sinapis alba* L.), followed by barley (*Hordeum vulgare*). N- fertilisation ranged from 0- 200 kg N ha⁻¹. Soil sampling was carried out after barley harvest. The investigated parameters included plant yield, pH, electrical conductivity (EC), cation exchange capacity (CEC), as well as CAL extractable P and K. The results of two field experiments in Austria will also be presented. EC and pH of BC treated pots was significantly increased. CEC significantly increased with increasing BC concentration for the sandy soil. Plant-available P and K significantly increased with increasing BC concentration for all three soils. Mustard yield decreased by 67% for pruning BC compared to the control; however, straw-derived BC only caused a 2% decrease of mustard yield. Barley yield was still significantly lower in BC-treated pots. Only straw-derived BC treatments showed significantly higher barley yield, presumably caused by comparatively high nutrient inputs. Unlike the pot experiments, BC application in the field experiments showed significant increases in plant yields.*



S05.03-P -6

BIOCHAR AS A CATALYST FOR SOIL CARBON SINK ENHANCEMENT: A LYSIMETER STUDY

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In New Zealand, approximately 50% of soil carbon (C) is under grazed pasture management with most of it in the 0–10 cm topsoil depth. Grazed pasture systems with deep rooting plant species may be able to increase the C stocks at depth by means of stimulating soil mineral weathering and organic matter (OM) stabilisation through organo-mineral complexes. A lysimeter study has been established to investigate the effect of biochar on (i) root growth at depth, (ii) soil C and N pools and (iii) GHG emissions. A low-ash biochar (pine sawdust pyrolised at 350 °C) was incorporated into a silt loam soil (Tokomaru, a Typic Fragiaqualf formed from siliceous loess, TK), whereas a high-ash biochar from a mixture biosolid-greenwaste (50:50 wt:wt) pyrolised at 550 °C was incorporated into a sandy soil (Foxton, Typic udipsamment, FX). Soils were collected in 40 cm long pipe lysimeters. To simulate ploughing the 20–40 cm depth remained in the lysimeter base, soil from the 0–10 cm was mixed with the corresponding biochar (10 t/ha) and repacked at the 10-20 cm depth, and finally the soil from the 10-20 cm was placed on top. On the FX soil, ryegrass, a mixture of red clover & cocksfoot and lucerne were planted; on the TK soil, ryegrass, the same mixture and chicory were used. This paper presents the first years pasture yields, the drainage water nitrogen concentrations and the results from periodic measurements of CO₂, CH₄ and N₂O emissions.



S05.03-P -7

BIOCHAR AS A COPPER STABILIZER IN VINEYARDS

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Copper has long been used to fight fungal diseases within vineyards. As a heavy metal, copper either builds up in the soil or is leached into the ground water. Its use has been shown to impact the environment and organisms around the grape vines. However, as there are no sufficient substitutes for its use, it is necessary to discover a range of remediation methods that would prevent copper from negatively impacting soil microbial communities and soil fertility indicators. Here we investigated one method called pyrolysis using biochar. Biochar is said to be a copper stabilizer and a carbon sequester within the topsoil. An in situ block design was created in 2010 by the Delinat Institute (Wallis, Switzerland) with four treatments: biochar, compost, biochar and compost, and no amendment. Our analyses will look into the effects of the amendments on the abundance of bioavailable copper in soil, total copper in the soil and aboveground plant biomass, the abundance and function of soil microorganisms, and soil chemistry parameters. Ultimately, its ability to mitigate copper's negative effects on soil will be assessed. Our hypothesis is that biochar will provide a binding site for bioavailable copper, reducing its abundance, while increasing carbon levels and changing soil microorganism abundance and function.



S05.03-P -8

BIOCHAR FROM NUISANCE PLANTS: A WIN-WIN SOLUTION?

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Control of invasive and nuisance plants is often achieved using labour-intensive mechanical methods, incurring high costs and a significant carbon debt. Disposal of cleared biomass may be heavily regulated. The commonly used method, burning, is wasteful of a potentially valuable resource. Biochar production may offer a safe, cost-effective solution to the problem of disposal. Large areas of Wales are covered by bracken (*Pteridium aquilinum*) (37x103 ha) or invasive rhododendron (*R. ponticum*) (area currently not quantified). Clearance of these plants is often necessary for agriculture or maintenance of biodiversity (bracken), or to curb the spread of *Phytophthora ramorum*, a plant pathogen infecting rhododendron (the host plant) and commercial timber stands. In preliminary trials, biochars were produced using a tube furnace. This will be followed by production using a pilot-scale pyrolysis-gasification unit. Biochars formed by slow pyrolysis using the tube furnace at 515°C under N₂ comprised 76.9% C, 1.86% N, 0.71% K, 0.067% P (bracken) and 85.3% C, 1.62% N, 0.55% K, 0.108% P (rhododendron). Neither contained toxic-element concentrations exceeding recommended limits (International Biochar Initiative, 2011). Potentially harvestable bracken in Wales covers 14.4 x 103 ha, yielding 10.5 Mg.ha⁻¹.yr⁻¹ dry mass with a maximum greenhouse-gas abatement of 39 Gg CO₂-Carbon equivalent.yr⁻¹ if applied to soil as biochar. Total rhododendron biomass is yet to be determined. Biochars produced from these feedstocks will be evaluated to establish their economic value, to offset the costs of clearance, and their sequestration of recalcitrant C when used as soil amendments, to offset the respective carbon debts incurred.



S05.03-P -9

BIOCHAR IN CONSERVATION FARMING IN ZAMBIA - IMPROVED SOIL FERTILITY AND CROP YIELD

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Large parts of the agricultural land in Zambia are located on acidic and/or sandy soils. These soils are infertile and give rise to small crop yields. Biochar may improve soil fertility due to its alkalizing properties and positive effects on water holding capacity (WHC). However, only a few scattered studies on effects of biochar have been conducted in tropical soils. In this study we determined effects of organic waste biochar (corn cob and charcoal dust) on crop yield (greenhouse pot trials and field tests at nine sites in Zambia) and physical and chemical soil properties (field trials and laboratory studies). Field tests were combined with Conservation farming where only 10-12% of the land is tilled. Greenhouse trials revealed enhanced growth of maize with addition of biochar. Biomass production was greatest using biochar in combination with some fertilizer which reduces the required amount of synthetic fertilizer. Also, field trials indicated a significant positive effect of biochar on maize growth. The effects were strongest in the least fertile sandy soils with low WHC. By contrast, in fertile loamy soils biochar addition resulted in no or even negative effects. Biochar addition increased cation exchange capacity. The acid saturation was significantly reduced with biochar addition at sites with acidic soils. In sandy soils, the WHC was significantly increased. Our findings suggest that biochar has a great potential for improving soil quality and thus crop production in acidic and sandy tropical soils.



S05.03-P -10

BIOCHAR REDUCES SOIL NITROGEN LEACHING: RESULTS FROM LEACHING CYCLES IN A POT EXPERIMENT.

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One of the mechanisms that could explain the increased fertility of biochar amended soils is the modification of nutrient cycling by direct adsorption of nutrients on biochar surfaces or through interaction with soil organic matter. Within this framework nitrogen (N) can play an important role because biochar could increase N plant availability and reduce N losses in highly fertilized soils. This hypothesis was tested in a two-year, factorial pot experiment in which biochar effects on plant productivity and N leaching were evaluated together with different levels of soil soluble N. Four N levels were considered: unfertilized soil, addition of crop residues (0.02 g N kg⁻¹ soil), addition of ammonium sulphate (0.05 g N kg⁻¹ soil), and the combination of both. These treatments were combined with two levels of biochar: no biochar and 1% biochar (10 g biochar kg⁻¹ soil). During the first year, Sorghum bicolor-Sorghum bicolor var. Sudanese was grown for five months and above-ground biomass harvested twice. No leaching was allowed during this first year. No significant differences in biomass were detected among treatments at any time. In the following spring, 11 leaching cycles were carried out in a two-week period. Leached water was collected and analyzed for total N, carbon and nitrate content. Cumulative, biochar reduced the total N leached, independently from the soil N applied. In addition, treatments with crop residues and biochar had the tendency to retain more N than treatment with only fertilizer suggesting an active interaction between biochar and organic N.



S05.03-P -11

BIOCHAR TRANSNATIONAL FIELD TRIALS IN THE NORTH SEA REGION

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Biochar has shown to have positive impacts on soil characteristics and crop growth in tropical regions, but little is known about the effect of biochar in temperate climates. Before biochar becomes an agronomical success, consistent improvement of soil quality and crop yields after biochar application must be documented for a range of soil types and climates. If a new agricultural practice is not reinforced by an on going perception that benefits outweigh costs, the changes will only be temporary. Transfer of knowledge and experience about soil incorporation of biochar at the farmer field scale is the key for success for introducing biochar to future farming systems. The EU Interreg IVB North Sea Region project 'Biochar: climate saving soils' aims to demonstrate the potential of biochar as a soil amendment in temperate climates. In autumn 2011, the consortium established a transnational biochar field trial. Participating countries are the Netherlands, Germany, Belgium, UK, Denmark and Norway. In each country, the same wood-based biochar is applied in 3 or 4 replicates at a rate of 20 ton per hectare and the effect of biochar on soil and crop growth characteristics is compared against 3 or 4 control plots. In most countries, the 2012 crop is spring barley. This poster presents the characteristics of the biochar used and the first results measured, including mineral nitrogen evolution in the 0-90 cm soil layer during winter, crop growth and soil moisture characteristics.



S05.03-P -12

CARBON FRACTIONS IN CHARCOAL FROM ARCHAEOLOGICAL MAORI SOILS OF NEW ZEALAND

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Understanding the stability of biochar in soil is of paramount importance because, if quantified, it provides the evidence to allow biochar to attract carbon credits and monetary value, over and above any agricultural value. The stability of biochar in soil as yet remains unclear, particularly with respect to different soil types and climatic factors. It is simply not possible to do long-term experiments. Old anthropogenic charcoals, which in New Zealand are found at historical Maori gardening sites, can help to identify molecular markers associated with the long-term stability. These sites provide ideal conditions to study biochar decomposition in New Zealand environments similar to those to which it is anticipated the addition of biochar. In this research we have assessed the chemical composition of three archaeological Maori charcoal samples from Horotiu (Waikato) and Papamoa (Bay of Plenty). Characterisation included elemental analysis, thermogravimetric (TG) analysis, solid-state ¹³C nuclear magnetic resonance (NMR), pyrolysis gas-chromatography/mass spectroscopy (Py-GC/MS), and X-ray photoelectron spectroscopy (XPS). Results obtained using the different techniques concur in the description of the C fractions present in the charcoals investigated. The presence of microbial C associated with the charcoal structure was identified and semi-quantified with Py-GC/MS. In addition, mid-term biotic and abiotic incubations will help (i) to evaluate the stability of organic C in historical charcoals and model C mineralisation, as well as (ii) to estimate their mean residence time. Results from these and complementary studies will allow us to have a better understanding of the long-term changes of biochar over time.



S05.03-P -13

DYNAMICS OF EXTRACTABLE P AND K IN SOIL AFTER APPLICATION OF ASHES AND BIOCHARS FROM THERMALLY-TREATED SOLID MANURES

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In areas with high livestock density it can be advantageous to export a solid manure fraction after slurry separation to avoid overload of P. By combustion or gasification of solid manure energy is produced and nutrients are concentrated and therefore less expensive to transport. However, some studies have indicated that the plant availability of P and K is decreased by combustion. The dynamics of extractable P and K in soil was compared during 16 weeks after application of equal amounts of P in ashes, solid slurry fractions and superphosphate to a sandy soil. Concentrations of water-, bicarbonate- and resin-extractable P and exchangeable K were measured. The ashes/biochars studied derived from gasification (ca 730°C) of poultry manure, gasification of solid manure (ca 730°C), co-combustion of solid manure with straw (ca 700 and 900°C) and slow pyrolysis of solid manure at different temperatures (250, 400 or 500°C, biochars). The proportion of applied P found as resin-extractable P in soil decreased from superphosphate > solid manure=manure biochar 250-500°C >poultry gasification ash>solid manure gasification ash>manure co-combustion ash. Thus, biochar production by manure pyrolysis did not decrease extractable P in soil, but decreased citrate soluble P. Only 20-60% of ash/biochar K was water-soluble, but after application to soil 58-88% of the applied K was exchangeable relative to a KCl treatment. The heavy metal content of the tested ashes/biochars was below the Danish threshold value for waste application, except for Ni in the poultry ash, and they could be used directly as a fertilizer.



S05.03-P -14

ECOTOXICOLOGICAL IMPLICATIONS OF BIOCHAR-BOUND PAH CONTAMINANTS IN RUNOFF FROM BIOCHAR-ENRICHED SOILS: A PILOT STUDY

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*Aquatic systems and sediments are likely to be relevant sinks for biochar particles that are lost from amended soils, through processes such as runoff. The occurrence of biochar-bound contaminants (e.g. polycyclic aromatic hydrocarbons -PAHs), has raised concerns in relation to potential detrimental effects on aquatic organisms. Much information is required on the influence of biochar aging in soil, as determined by interactions with soil components and environmental factors, on enhancing the bioavailability and ecotoxicological implications of such a fraction in runoff from biochar-enriched soils. This pilot study aims at evaluating the ecotoxicity of biochar-bound PAH contaminants in runoff from treated soils, based on dry/wet cycles for augmenting soil-biochar interactions and PAH-water extraction. Aqueous extracts were derived from standard LUFA 2.2 soil, to which pine wood biochar was mixed at common application rates (80 t ha⁻¹ soil) and subjected to 1, 6 or 12 dry/wet cycles. Ecotoxicological evaluation of soil-biochar elutriates was carried out using standard monospecific bioassays, with species (*Vibrio fischeri*, *Pseudokirchneriella subcapitata* and *Daphnia magna*) that are representative of different trophic/functional levels. For all test species, dose response curves were obtained from acute and chronic exposure. The extent and pattern of observed toxicity was found to be species-specific, and therefore the use of multiple test species has shown to provide more robust results. Toxicity was also determined by the number of dry/wet cycles to which biochar-amended soil was subject, suggesting that interactions between biochar and soil components might greatly influence the bioavailability, toxicity and fate of biochar-bound PAHs.*



S05.03-P -15

EFFECT OF BIOCHAR APPLICATION ON TRACE GAS EMISSION IN A SANDY SOIL

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The impact of biochar application to soils in terms of trace gas emissions is not well understood so far. It is hypothesized that biochar applications to soils sequester carbon in the long term and reduce the emissions of nitrous oxide and methane. To examine the effects of biochars to soil, laboratory and field experiments will be made with the focus on laboratory incubations. Primarily biochar was produced via hydrothermal carbonization (HTC), but materials from pyrolysis were also used. Different materials (e.g. wheat straw, digestate) were utilized for the carbonization (HTC) and varying post carbonization treatments were tested. First results of laboratory incubations show that biochar amended soils release less nitrous oxide (25 to 60%) than control treatments and that HTC-biochar is less stable than pyrolysis biochar, but more stable than non-carbonized material. After 84 days of incubation, non-carbonized material (digestate) lost 16%, HTC char 6% and pyrolysis char 2% of its initial carbon content. Washing the biochar reduces the initial carbon dioxide release about 25 %. Methane emission and uptake play a minor role, but are up to 40% reduced in the biochar amended soils compared to the control. First results of the field experiment are expected in 2012 and will compare soils that were amended with pyrolysis char to soils that were amended with hydrothermal carbonized char.



S05.03-P -16

EFFECT OF BIOCHARS ON ADSORPTION OF BENTAZONE AND PYRACLOSTROBIN TO A SILTY CLAY SOIL

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The recent interest on the use of biochar as soil amendment is due to the beneficial properties attributed to biochars. There are limited studies dealing with the effect of biochar on the behavior of pesticides applied to crops. The objective of this work was to study the effect of different biochars on the adsorption of the herbicide bentazone (3-isopropyl-1H-2,1,3-benzothiadiazin-4(3H)-one 2,2-dioxide) and the fungicide pyraclostrobin (methyl 2-[1-(4-chlorophenyl) pyrazol-3-yloxymethyl]-N-methoxycarbanilate) to a silt loam soil. Bentazone is used to control broadleaf weeds in crops such as corn, rice, and soybeans. It is an anionic herbicide and it is considered mobile in soil, with the subsequent risk of run off or leaching and surface and/or ground water contamination. Bentazone was completely adsorbed by the soils amended with the biochars produced from wood pellets. However, lower sorption of the herbicide was observed in the soil amended with the biochar made of macadamia nut shells as compared to the unamended soil, which can be attributed to the interactions and competition of the dissolved organic carbon (DOC) of the biochar with bentazone for the adsorption sites. Pyraclostrobin is a foliar fungicide considered very toxic for aquatic organisms. Our results showed that it is highly adsorbed to soil, and addition of biochars to soil did not increase adsorption. Thus, addition of sorbents to increase its retention in soil is not necessary. Biochars with high surface areas and low content on DOC can increase the adsorption of highly mobile pesticides in soil.



S05.03-P -17

EFFECT OF CHARCOAL FROM DIFFERENTLY AGED CHAR PRODUCTION SITES ON SOIL CARBON AND FERTILITY

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Soils play an important role in mitigation of climate change. Soil organic matter is an important indicator also of soil quality, however most agricultural soils contain lower soil organic carbon pool than their potential capacity. Use of char in soils can increase the amount of stable organic carbon fraction and at the same time increase soil fertility through its positive effect on soil physical, biological and chemical properties. The purpose of this study was to investigate the effect of charcoal originating from wood charcoal production in the North-Eastern hilly forest region of Hungary on soil properties determining the fertility of soils. Soil samples from several depth were taken from sites where charcoal was produced with traditional methods and comparison was made between the differently aged sites and also control soil samples. Soil organic carbon content, organic matter quality, soil pH, cation exchange capacity, NPK content, bulk density and soil microbial respiration were measured to determine the effect of char on soil physical, chemical and biological properties.



S05.03-P -18

EFFECTS OF BIOCHAR ADDITIONS TO SOIL ORGANIC CARBON MINERALIZATION AND PHYSICAL AGGREGATION

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Biochar (BC) production has been proposed as a means to mitigate climate change by increasing C sequestration in soils. However research to date has shown that BC addition can either stimulate or suppress C mineralization in soils, depending on soil type, the BC feedstock and pyrolysis conditions. Additionally, BC addition may further stabilize soil organic C by increasing physical aggregation of soil organic matter (SOM). We conducted a long-term laboratory incubation, where by means of stable C isotopes and SOM size-fractionation methods, we partitioned the contribution of BC vs soil organic C to CO₂ losses and soil C stores in different SOM size fractions. To assess the effects of BC additions and soil type, we added 0, 1, 5, 10, and 20% oak-derived BC ($\delta^{13}\text{C} = -27\text{‰}$) by weight to four soils varying for texture class and SOM content, but all with low $\delta^{13}\text{C}$ values (-12 to -21‰). Results on CO₂ dynamics and soil C size fractions for the two years of incubation will be presented. BC suppressed SOC respiration in C-poor soil, while stimulated that of C-rich soil, and did not significantly affect soil aggregation. Overall only small amounts (<10%) of BC were respired during the incubation, and SOC respiration was minor as compared to C input via BC. Thus, soil BC addition resulted in C sequestration linearly related to addition rates in all soils.



S05.03-P -19

EFFECTS OF BIOCHAR AMENDMENT ON SOIL GREENHOUSE GAS FLUXES IN AGRICULTURAL SOILS

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A major reason for the application of biochar to soils is the mitigation of the greenhouse gas carbon dioxide (CO₂) by increasing long-term soil carbon sequestration. To evaluate this practice as a sustainable, future mitigation strategy, the soil-atmosphere flux of CO₂ but also of non-CO₂ greenhouse gases have to be considered. The gases of interest are nitrous oxide (N₂O) and methane (CH₄) with a global warming potential of 298 and 25, respectively. Strategies to optimize biochar qualities and amendment levels for specific soil types and bioclimatic zones have to be developed in order to maximize carbon sequestration, while increasing plant production and decreasing environmental risks such as nutrient leaching and soil greenhouse gas emissions. This study aims at the evaluation of soil GHG fluxes from biochar treated versus non biochar treated soil. Gas flux measurements were conducted at several stages of plant development in a pot experiment and in a field experiment. The closed chamber technique was used. Gas samples were taken after 0, 5, 10 and 20 minutes and analysed by gas-chromatography. Our hypothesis was that biochar-treated and non-treated soils would show significant differences in soil GHG emission. In agreement with our hypothesis, we found a significant effect of biochar on N₂O, CO₂ and CH₄ fluxes. A reduction of soil GHG fluxes was however not consistent over time.



S05.03-P -20

**EFFECTS OF BIOCHAR ON THE WATER AND NITROGEN DYNAMICS OF A SANDY SOIL:
COMPARING ORGANIC AND CONVENTIONAL AGRICULTURAL SYSTEMS**

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Intensive agriculture relies on artificial fertilisers for high productivity resulting in reductions in soil organic matter (SOM), lowering the retention of nutrient ions and water. Organic management can increase SOM, but tend to lower productivity. Biochar is produced by heating organic materials in anaerobic conditions and has been proposed to mitigate soil fertility reductions. The objective of this research is to elucidate how the addition of biochar can affect the interaction between water and nitrogen dynamics of a sandy soil due to changes in the physical and chemical properties. A water release curve (WRC) and an incubation experiment have been set up using organic and conventionally managed soils applied with biochar at application rates of 0, 30 and 60 t/ha. The WRC showed an increase in water content at field capacity between 0.4 and 1% by mass with 60 t/ha biochar. The incubation experiment showed reductions in ammonium and increases in nitrate over 30 days and a decrease of pH indicating nitrification. Nitrate levels increased from 32.7 to 52.8 mg/kg dry soil with increasing biochar application rate in the conventional system, however the opposite trend was found in the organic system (decreased from 46.1 to 35.8 mg/kg dry soil). This indicates either adsorption of ammonium to biochar surfaces or utilisation of available soil organic carbon in the conventional system. Biochar has the potential to increase the water holding capacity and nitrogen availability of a sandy soil, therefore improving availability to crops. This could be more beneficial under a conventionally managed agricultural system.



S05.03-P -21

ENHANCED GROWTH AND INDUCED SYSTEMIC RESISTANCE BY BIOCHAR COMBINED WITH ORGANIC FERTILIZERS AND BIOCONTROL AGENTS

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*The effect of biochar combined with organic fertilizers (vermicompost and poultry manure) and beneficial microorganisms (*Trichoderma harzianum* IMI 395248 and *Bacillus subtilis* AB 4410) on plant growth and defense against pathogens and herbivorous insects was studied. Experiments were implemented in the greenhouse and the field using three crops: tomato (*Lycopersicon esculentum*), pepper (*Capsicum annuum*) and cucumber (*Cucumis sativus*). Biochar additions were found to enhance tomato plant growth and defenses against whitefly when amended with vermicompost and inoculated with *B. subtilis* and *T. harzianum*, but no differences were found when biochar was used without inoculation. Biochar with poultry manure and inoculated with both *B. subtilis* and *T. harzianum* also enhanced cucumber productivity, providing yields similar to synthetic fertilizer amended plots. Additionally, treatments with biochar slowed the spread of bacterial wilt (*Pseudomonas syringae*) in tomato crops with and without organic and synthetic fertilizers, but did not prevent the plants death after 53 days. In the pepper experiment, it was found that after 30 days biochar increased plant growth when combined with poultry manure and vermicompost, but no differences were found with the inoculation of microorganisms.*



S05.03-P -22

EXAMINATION OF THE EFFECT OF BIOCHAR ON SOIL RESISTIVITY AND POLARISATION

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Geophysical methods, namely electromagnetics, electrical resistivity, (spectral) induced polarisation and magnetic resonance are successfully applied for soil studies. These measurements are minimal invasive and able to bridge the gap between small and bigger scales. Biochar addition to soil changes hydraulic conductivity significantly, but additionally resistivity and polarisation of the soil are changed markedly. These changes have been studied in laboratory scale (samples of some cm size). The more biochar is added the lower the resistivity and the higher are the induced polarisation effect. To study these effects on larger scale different lysimeters ($r=15\text{cm}$ / $h=81\text{cm}$) are filled with soil with different amounts of biochar added. These lysimeters are irrigated and the water percolation through the lysimeters is observed by time lapse ERT. The method enables to visualise the percolation process. The resolution of preferential flow paths is challenging due to the limited resolution of the ERT method. However, the design of the lysimeters on scales and with ceramic bottom layer and suction, enable the detection of any out flowing water. These studies serve as first test for the possible application of geophysical measurements on field scale in order to study the physical effect of biochar amendment with regard to water retention and preferential flow.



S05.03-P -23

EXPERIMENTS WITH BIOCHAR IN EUCALYPTUS BENTHAMII PLANTATIONS ON PROPERTIES OF FAMILY FARMERS IN THE STATE OF PARANA – BRAZIL

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The Central Southern Region of Parana is composed mostly by small family farming properties, characterized by low Human Development Index (HDI), where the main activity is tobacco cultivation. With the objective of use diversification of properties to generate income to farmers, a Eucalyptus benthamii plantation project is being developed using biochar to improve physical, chemical and biological soil properties, and obtain higher productivity. The experiments in a randomized complete block design with four treatments and four blocks were established in 14 properties in the municipalities of Irati, Inacio Martins, and Fernandes Pinheiro, in the state of Parana- Brazil. The treatments had increasing rates of biochar: 0, 10, 20 and 40 ton/ha. Soil preparation consisted of weed mechanical removal, limestone application and biochar incorporation. Planting rows were marked with a ripper. Planting was made with a manual planter using a 3 m x 2 m spacing. After planting, 150 g per plant of NPK 10:30:10 fertilizer was applied. Soil samples were collected for evaluation of chemical and physical properties and plant height and diameter was measured. Data was statistically analyzed using the Assistat® software, for analysis of variance at the 5% probability level, followed by comparison of means by the Tukey test. In six of the experiments some of the following results were observed: a) increasing levels of biochar promoted increased moisture retention; b) levels of Ca, Mg, K and P were also increased; c) soil density and acidity decreased; and d) improved plant growth was observed.



S05.03-P -24

FOUR STANDARDIZED BIOTOXICITY TESTS FOR BIOLOGICAL CHARACTERIZATION OF 18 BIOCHARS

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Biochars and Hydrochars produced via dry pyrolysis or hydrothermal carbonization, respectively, are discussed as soil carbon additives to improve fertility and increase carbon sequestration in soils. Since there is a broad variety of feedstock and process conditions (and even different processes), standardized biological test procedures are urgently required that (i) enable identification of potential toxicity risks in a given char before soil application and (ii) allow standardized comparison of very different chars. In a first step, we selected and modified four different test procedures from ISO guidelines or compost quality tests, to be used with chars and tested if the methods would be reproducible with the same char (Busch et al., 2012). In a second step, we used the procedures to compare 18 different biochars and hydrochars and analyzed them for potentially harmful toxic substances (PAH, heavy metals, PCB, Dioxins). The toxicity tests identified contaminated biochars quite reliably, e.g. a heavily PAH-loaded wood gasifier biochar or a biochar with heavy metal concentrations above German law recommendations. The hydrochars, however, mostly had negative effects in most tests. This could only partly be explained by the accompanying measurements. Thus, the proposed test procedures may be used as an appropriate tool for fast, cheap char screening preceding soil application, accomplished within no more than two weeks.



S05.03-P -25

GREEN WASTE BIOCHAR REDUCES N₂O EMISSION IN FIELD EXPERIMENT

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Biochar, a pyrolysis product of organic residues, is seen as an amendment for agricultural soils to improve soil fertility, sequester CO₂ and to reduce N₂O emissions. Mainly used in highly weathered tropical soils, the interest of using biochar in intensively managed temperate soils is increasing. Our previous laboratory incubations have shown reduction potentials from 20 to 100% for N₂O emission from temperate soils after biochar application (Felber et al., in preparation). To assess the effect of biochar application under field conditions, a plot experiment (3 control vs. 3 biochar amended plots of 3x3 m size at a rate of 15 t ha⁻¹) was set up in a temperate intensively managed grassland soil. N₂O and CO₂ emissions were quasi-continuously measured by static chambers under standard management practice. In parallel soil samples were taken from all plots every month and their N₂O and CO₂ productions were measured in the lab. From the beginning of the field measurements in April 2011 to the end of September 2011 cumulative N₂O fluxes from control plots were first below those of biochar amended plots, but the pattern changed towards reduced fluxes from biochar plots after 3 months. The reduction compared to the control reached ~15% by September 2011. The biochar effect on reducing N₂O emissions in the laboratory was two times that of the field measurements. These data from a temperate managed grassland indicate a substantial reduction of N₂O emissions with biochar in the field but at a lower efficacy compared to simultaneous laboratory incubations.



S05.03-P -26

IMMOBILIZATION MECHANISMS OF HEAVY METALS IN CONTAMINATED SOILS WITH BIOCHAR AMENDMENTS

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Biochar has drained considerable attention as a potential carbon sequestration agent in soils and as a soil quality improver but its ability to positively interact with contaminants in soils has been relatively neglected so far, particularly regarding trace elements in contaminated soils. A few studies underline the variability of the effects on heavy metals mobility depending on the studied element, the soil properties and the biochar nature. Thus, more results are needed for modeling the effect of biochar amendments on heavy metals mobility. Adsorption kinetics and isotherms experiments in solution were done in order to determine the influencing parameters of soluble heavy metals retention with a woody biochar produced at a temperature around 450°C. The kinetic results for Cu(II), Cd(II) and Ni(II) show that several days are needed for reaching equilibrium and that intraparticle diffusion of metals may limit the adsorption process. The adsorption isotherms are best described by Freundlich equation and are not entirely correlated with the evolution of pH, soluble organic matter or base cations, which suggests the participation of several different retention mechanisms on biochar. Complementary sorption and desorption experiments at various pH will complete these results. Continuous solution analysis in specific column experiments with biochar alone and biochar-amended contaminated soils along with the characterization of these matrices before and after the trial will then provide a detailed view of trace element dynamics in biochar amended soils with a modeling perspective.



S05.03-P -27

INCORPORATING BIOCHAR ENHANCED SOIL PROCESSES AND EFFECTS INTO THE MODELLING OF BIOCHAR CARBON SEQUESTRATION.

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To effectively model the potential for sequestering carbon through the addition of biochar to soils a number of processes must be incorporated into the model parameters. This research uses carbon cycle models to assess the UK and global potential for carbon sequestration using biochar, therefore soil characteristics and processes after biochar addition are important factors in the work. Initial experimental work examines the yield and quality of a number of different biomass feedstocks including agricultural residues, wood and forestry waste. Analysis then moves to scenario development which uses different governance strategies and mechanisms to determine factors such as available land and deployment timescales. After the development of these deployment scenarios, carbon cycle models will be used to analyse the sequestration potential of each scenario. The carbon cycle modelling work will involve determining and constraining a number of parameters within the carbon cycle. A large part of this work will involve determining the effects of biochar on soil and related processes. This will include fluxes of CO₂, particularly between the atmosphere and vegetation, effects of C from biochar within soils, effects of biochar on fluxes such as N₂O, CH₄ and other greenhouse gases from soil and the effects of biochar addition on factors such as crop yields and fertilizer demand (see for example Graber et al, 2010; Major et al, 2010; Merino et al., 2004). The poster presentation will discuss how the soil parameters and interactions are determined and incorporated into the wider interdisciplinary research.



S05.03-P -28

INFLUENCE OF BIOCHAR INCORPORATION ON TDR-BASED SOIL WATER CONTENT MEASUREMENT

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Biochar incorporation into agricultural soil varies soil hydraulic properties such as water retention and permeability and thereby alters soil moisture environment in agricultural fields. To elucidate the effects of biochar incorporation on soil moisture environment, soil water regime is measured in biochar-amended agricultural fields. Time domain reflectometry (TDR) is a widely used and established technique for measuring soil water content in agricultural fields. The soil water content is estimated from apparent permittivity measured by TDR. These measurements are affected by soil conductivity. Biochar formed at higher pyrolysis temperatures have high conductivity. Therefore, biochar incorporation may affect apparent permittivity measured by TDR. Thus, we investigated the influence of biochar incorporation on TDR-based soil water content measurement. The soil was calcareous dark red soil. The biochar were produced from pyrolysis (400, 600 and 800°C) of sugarcane bagasse. Apparent permittivity of soil amended by biochar formed at 800°C with 3% w/w was higher than that of non-amended soil, while apparent permittivity of soil amended by biochar formed at 400 and 600°C with 3% w/w was same as that of non-amended soil. In general, biochar formed at >700–800°C have high conductivity. In addition, bulk electric conductivity of biochar (800°C)-amended soil was higher than that of non-amended soil. These results showed that high conductivity of the biochar formed at 800°C would increase apparent permittivity of biochar (800°C)-amended soil. In conclusion, incorporation of biochar formed at higher pyrolysis temperatures tend to overestimate TDR-based soil water content.



S05.03-P -29

INFLUENCE OF LIGNITE ON SOIL PHYSICO-CHEMICAL PROPERTIES AND MICROBIAL FUNCTIONS

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In the coal mining basin of Provence (South-East of France), the lignite veins can reach the surface from place to place. This peculiar situation allows for studying the long term effect of fossil carbon on soil characteristics. The lignite from Provence can be considered as a biochar because it is a fossil fuel originating from peat formed 75 million years ago. The aim of this study is to identify the presence of lignite in soil using various markers and to assess the impact of lignite on physico-chemical, mineralogical and microbiological properties of soil horizons. We compared 2 soil profiles that were 10m apart and developed either on limestone or limestone plus lignite. All soil horizons were described and analysed for mineralogy (DRX), physico-chemical characteristics, SOM quality (¹³C SS CPMAS NMR) and microbial variables (respirometry, CNPS mineralizing enzymatic activities, catabolic profiles of microbial communities by Biolog® Eco). Results show that the presence of lignite modifies soil physico-chemical properties (granulometry, chemical element concentrations, soil density...) and also most of microbial functions. Aromatic groups are increased in NMR spectra of soil horizons with lignite. The difference in OM quality of the soil with lignite as compared to the soil without lignite is probably responsible for the differences in functional patterns. Lignite increases the organic carbon percent in some horizons and thus may change the organic matter turn-over. For these reasons, we conclude that lignite has significant impacts on both physico-chemical and biological soil properties which may affect pedogenetic processes.



S05.03-P -30

INTERACTIONS BETWEEN BIOCHAR AND SOIL MICROBIAL COMMUNITY ABUNDANCE AND COMPOSITION

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Biochar addition to soil has been observed to affect soil greenhouse gas (GHG) emissions. This effect may be mediated by changes in soil microbial biomass and community composition. In fact, biochar can alter microbial communities through changing substrate availability, pH, and the soil physical environment. Our objective was to determine the effect of biochar addition rates on soil microbial biomass and community composition, and relate those changes to changes in GHG efflux. We conducted a laboratory incubation adding 0, 1, 5, 10, and 20% oak derived biochar (pyrolyzed at 550°C) by weight to four soils differing in land use and texture. Phospholipid fatty acids (PLFA) were extracted and quantified by GC-FID at the beginning and after 1 yr incubation. PLFA abundance was used to calculate the relative proportion of fungi, Gram-positive bacteria, and Gram-negative bacteria. Microbial biomass was measured by fumigation centrifugation method. Throughout the incubation, CO₂, NO₂ and CH₄ efflux were measured. Biochar addition initially suppressed CO₂ emissions from soil, but after 3-4 months, respiration increased proportional to biochar addition rates, in all soils. Furthermore, biochar contribution to total respiration fluxes varied with soil type and the amount of biochar added, suggesting an interaction with microbial activity and the possible need for the microbial community to adapt to the new C source. We will report microbial community structure and abundance as affected by biochar addition rate and soil type, and discuss them in the context of the observed changes in GHG efflux.



S05.03-P -31

LABORATORY CHARACTERIZATION AND BIOASSAY OF DIFFERENT BIOCHAR OBTAINED FROM A HIGH TEMPERATURE PROCESS (GASIFICATION)

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The study reports about laboratory characterization of different biochar obtained from an industrial thermo-chemical process at high temperature (gasification) and about the effects on plants growing when this kind of materials are applied to the soil. Biochar was obtained from different woody and herbaceous materials, agricultural residues and waste. Charcoals were first analyzed with European Standard methods for their main physical and chemical properties and polycyclic aromatic and heavy hydrocarbons burden. To better understand stability of biochar in the soil, chemical reactivity of some materials has been determined after acid hydrolysis and chemical oxidation, following the assumption that labile carbon can be removed by chemical treatment. Furthermore, biochar mixed with soil and inert sand was incubated and the respiration rate of mixtures was measured. Finally charcoals have been tested with bioassay (lettuce) and germination test (cress) in order to investigate the growing effects at different rates. The treatments were calculated to simulate average field soil application. The study confirms that different feedstock gives charcoal that differs greatly in its physical and chemical properties; also stability is different with regard to feedstock. About bioassay and germination test, the data generally show positive effects on plants growing, but dynamics and consequently optimum rates are different according to the starting feedstock processed. In conclusion the study confirms the strong heterogeneity of biochar that must be characterized prior to field application in order to better understand its behaviour in the soil and the possible plant growing benefit, avoiding counter-effects that can damage final yields.



S05.03-P -32

LABORATORY SIMULATION OF GEOCHEMICAL WEATHERING OF GRANULAR, ASH-RICH BIOCHAR

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Biochars are highly variable in nutrient composition and availability, this being determined by the type of feedstock and pyrolysis conditions. Ash-rich biochars produced from high-quality biosolids low in pollutants might be an option to recycle these wastes while recycling the nutrients they contain and improve the properties of a range of soils. An effort is needed to improve the knowledge on the mineral fraction of ash-rich biochar and its weathering, as this has key implications on nutrient availability in the soil. A laboratory experiment using a modified Soxhlet reactor was conducted to simulate the geochemical weathering of biochars produced from granulated biosolids under laboratory conditions, mixed with a surface horizon of a sandy soil at a rate of 7.5 t/ha, and compared to that of fresh biosolids. The biosolids were pyrolysed at a final temperature of 550 °C. The Soxhlet reactor conditions were: (i) temperature ~ 22 °C; (ii) flow rate of 1.8 mL/min; and (iii) weathering period of 312 h. Other treatments considered were (i) the use of ground biochar (and compared the behaviour to the original granulated sample), and (ii) the addition of ground roots to increase the presence of chelating compounds. The kinetics of nutrients (N, P, and K) leached out of the reactor was studied. Results obtained to present reveal differences in the kinetics of N and P released, these being influenced by (i) thermal treatment (carbonisation vs. fresh feedstock), (ii) delivery form (granule vs. fine powder), and (iii) presence of a decomposing roots.



S05.03-P -33

LIKELIHOOD-BASED MULTIDIMENSIONAL MODELLING OF NITROGEN MINERALIZATION FROM ORGANIC FERTILIZERS IN A TEMPERATE SANDY LOAM SOIL INCUBATED WITH BIOCHAR

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We applied nonlinear and linear modelling to the data of Tammeorg et al. (2012) on the N mineralization of different organic fertilizers in a sandy loam soil incubated with different amounts of biochar at field capacity and at 15C. We postulated two distinct N mineralization mechanisms, namely a first order rate kinetics (FORK) growth function for the low C:N fertilizer and background exponential N mineralization from the soil itself. The latter was assumed to be due to the autumn population collapse of opportunistic soil biota in response to lack of organic substrate after breakdown of crop residue. Biochar slowed down N mineralization in a dose-dependent manner in all situations. Partially linear modelling was performed for the low C:N fertilizer with the FORK process and the background exponential process. For the high C:N fertilizer and the control data, we built a separate log-linearized model, whose parsimony we maximized using the Akaike information criterion after using Box-Cox transformations of the dependent variable in profile log-likelihood plots. The final result was a four-parameter four-dimensional Gompertz model, which we verified using non-linear techniques. Regression diagnostics were performed for autocorrelation, heteroscedasticity and normality. In all models $R^2 > 0.90$. The biological interpretation of these results is that autumn-applied biochar may support r-strategists of soil biota and thus reduce N emissions to the hydrosphere and the atmosphere. The turnover of microbial biomass might facilitate plant-availability of autumn-sequestered N early next season. The dynamics of the process probably depend largely on the amount of non-aromatic C in biochar.



S05.03-P -34

MASS BALANCE AND ISOTOPIC ARTIFACTS FROM SOIL ORGANIC MATTER AND BIOCHAR MINERALIZATION MONITORED BY DIRECT HEADSPACE METHOD

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Incubation of soil samples with direct headspace CO₂ measurement is an increasingly popular method to determine mineralization rates of organic materials in soils. When combined with isotopic ¹³CO₂ measurements, this technique allows us to apportion the produced CO₂ between two different sources of organic materials, for example soil organic matter and Biochar. Biochar is generally a high-pH product and at high pH an increasing fraction of the CO₂ released remains dissolved in the soil solution as carbonates. Up to now, it is not clear how this will affect incubations of soils amended with biochar, and whether this potential effect would also induce isotopic discrimination artifacts. The objective of this study was to determine mass balance and isotopic artifacts for headspace sampling of CO₂ in soil-biochar incubations, and find potential solutions to overcome these problems. First, we determined the mass-balance and isotopic changes (artifacts) by monitoring CO₂ and ¹³CO₂ headspace values under increasing pH conditions. Results suggest that substantial artifacts occur already at pH 7. Second, we tested a semi-flow-through method by flushing the incubation vials with CO₂-free air and measuring the CO₂ and ¹³CO₂ on the total recovered headspace gas. Results suggest that at pH over 7, hours of flushing are needed to reduce the artifact within acceptable limits. At pH higher than 8, the artifact remains very substantial after numerous flushings. These preliminary results suggest that extreme caution must be used when applying the CO₂ headspace method to high-pH products such as biochar.



S05.03-P -35

MODIFICATIONS IN SOIL PH INDUCED BY BIOCHAR: DO THE EFFECTS CHANGE OVER TIME?

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Deforestation and intensive land use can increase acidification of tropical soils, with negative impacts on nutrient availability and sustainable agriculture. Biochar can enhance soil nutrient availability possibly through increases in the soil pH. However, little is known about the duration of such changes under field conditions. This research aimed to quantify the effects of biochar, Crotalaria juncea and PK fertilizers on soil pH in a North-eastern Brazilian oxisol, over two cropping seasons. Biochar (0, 5 and 10 t ha⁻¹) was applied on the soil surface without incorporation. Additionally, plots with and without C. juncea and PK fertilizer were established in randomized blocks with four replications in a factorial 3x2x2. Soil pH was measured yearly (2009 and 2010) after the harvest of the main crops (maize + cowpea intercropped). In the first cropping season, the highest biochar rate significantly increased soil pH at 0-5 (0.39 pH units), 5-10 (0.32 pH units), 10-20 (0.25 pH units) and 20-40 cm (0.21 pH units). In the second cropping season, PK fertilizer significantly decreased pH values in all soil depths, compared to the control. No significant effects of C. juncea in all depths and of biochar at 0-5 and 5-10 cm were observed. However, at 10-20 and 20-40 cm, contrary to the first year, higher biochar rates resulted in lower pH values. These results suggest that the increases on soil pH caused by biochar may be due to the effects of ash compounds present in the biochar and that such effects are transitory.



S05.03-P -36

N₂O EMISSIONS AND GROSS SOIL N TRANSFORMATIONS IN TWO AMAZONIAN DARK EARTH AND CORRESPONDING ADJACENT SOILS

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Amazonian Dark Earths (ADE) usually have higher nutrient contents, pH values, cation exchange capacities, water-holding capacity and microbial activity, correlated to higher soil organic carbon contents, including charcoal. They serve as archetypes; recent biochar research aims at understanding these soils and their functioning in order to copy them, and subsequently improve the fertility of degraded soils. However, high-SOC soils can have larger undesirable N₂O emissions. We investigated the fluxes of CO₂, N₂O and CH₄ in soils from two ADE, locally known as Terra Preta de Índio, sites located near Manaus, Brazil, and their corresponding adjacent soils. One site was covered by secondary forest the other under agriculture (cassava plantation). Subsequently, 15N-NH₄⁺ and -NO₃⁻ were added, and N₂O emissions and gross-N transformations of the different N species were closely followed over two weeks (15N signal, N concentrations; work on-going), using the methodology of Müller et al. (2004; 2007). While significantly larger CO₂ effluxes from ADE at three temperatures indicated significantly larger biological activity of TP than adjacent soils, and secondary-forest than agricultural soils, N₂O fluxes from all soils (including ADE) were very low without mineral-N additions. While the secondary-forest soils showed CH₄ uptake this was not the case in the agricultural soils. The results of the gross N transformations and N₂O emissions after mineral-N addition will be reported. Müller et al. (2004) *Soil Biology & Biochemistry* 36:619-632. Müller et al. (2007) *Soil Biology & Biochemistry* 39:715-726.



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N₂O EMISSIONS FROM DIFFERENT BIOCHAR TYPES MIXED WITH AN AGRICULTURAL SOIL

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When biomass is charred and used as a soil amendment it is called biochar. Its application to soil is supposed to have effects on the N cycle and the potential to reduce N₂O emissions via inhibition of nitrification-denitrification processes. Primarily, the processes are influenced by the C and N availability, the pH and the oxygen content that vary considerably with the biochar type. We produced biochars from digestate, woodchips and miscanthus by hydrothermal carbonization (HTC) at 200°C and 250°C for 8 hours and by pyrolysis at 800 °C for 30 minutes. Our hypotheses are: 1) Biochars from HTC may retard N₂O-emissions as long as the degradability of biochar-C guarantees microbial N-immobilization. 2) Biochars from Pyrolysis may bind N to its surface and therefore reduce N₂O emissions. 3) The low pH of HTC-biochars may suppress denitrification more than Pyrolysis-biochars under anoxic conditions. The N₂O emissions from an agricultural loam mixed with either HTC-biochar or Pyrolysis-biochar or uncharred feedstock (1:20) were evaluated in an incubation experiment. Half of the samples were fertilized with 100 mg NO₃-N as Ca(15NO₃)₂ at the beginning while the other half received no fertilizer. The water content was set to 60 % or to 85 % WHC. Gas samples were taken manually with 10 ml vacuum vials daily for the first two weeks and then monthly for 6 months and measured by GC. Physico-chemical analyses were made before the experiment started and at the end, except of pH and the N_{min} concentration that were measured in between.



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NATURE OF PRECURSOR, A KEY FACTOR OF BIOCHAR QUALITY

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Biochar are of high interest for improving soil fertility and increasing soil carbon sequestration. The biochar fate and effects in soil depend on the production process. However, for the same industrial production, it is also expected that the biochar characteristics result from the nature of the precursor material. In this work, we characterised the precursors and the biochar obtained through the gasification (AGT, Italy) of three types of plant residues: wheat straw (WS), poplar (POP), olive residue (OR). The hydrothermal carbonization process was also tested on corn residues (CS, Germany). Elemental composition (C, N, O, H, P) and Oxidation Resistant Elemental Carbon (OREC) content were measured. The chemical composition was characterized with pyrolysis-GC-MS (CuPy). Whatever the type of carbonization and the precursor, the effect of charring on the C, H and O concentrations appeared similar. The OREC content in biochar was strongly related to the C concentration increase through carbonization process. The OR sample presented a distinct behaviour considering its resistance to oxidation and N content. The C/N decreased in OR, whereas it increased upon charring in other precursors. The CuPy also showed expected differences in the aromaticity of biochar obtained through different processes, but also with the same process and different precursors. Especially unaltered or slightly altered compounds were still visible in OR biochar and not in POP biochar from gasification. This work suggests that the precursor quality is important for the future fate of biochar in soil.



S05.03-P -39

PRODUCTION PROCESS DETERMINES BIOCHAR DEGRADATION

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Biochar (BC) production is an emerging business targeting market shares in renewable energy, agriculture and GHG reduction schemes. Presently two basically different production processes are competing. The objective of the present study was to examine BC degradation in soil with BC derived from the alternative production processes of pyrolysis (PyrBC) and hydrothermal carbonization (HTC-BC). The laboratory study presents rates of biodegradation of PyrBC and HTC-BC, both of them produced from the C4 species *Miscanthus*. The natural ¹³C-labelling of the educt allowed the quantification of degradation by means of weekly measurements of the ¹³CO₂ efflux using a wavelength scan cavity ring down spectrometer under standardized conditions. Biodegradation was principally different between HTC-BC and PyrBC. The HTC-BC was easily biodegradable with degradation ranging between 0.4% and 0.8% of applied BC based on the mean degradation rate of week 3–21 after incubation and four different soil types. Contrastingly, PyrBC showed no significant degradation over the first months, but based on the ¹³CO₂ exchange rates rather a tendency to absorb additional CO₂. Only from month 3 onwards, Pyr-BC showed positive ¹³CO₂ exchange rates, but degradation was < 0.06%. The qualitative differences revealed in the degradation of HTC-BC and Pyr-BC suggests that biodegradability is predetermined by the BC production process.



S05.03-P -40

SHORT TERM EFFECTS OF BIOCHAR IN SOIL NITROGEN DYNAMICS

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One of the gaps in biochar research is the understanding of biochar's short- and long-term interactions with the nitrogen cycle. Some potential effects of biochar on the N-cycle are linked with 1) mineralization of soil organic matter, 2) abiotic N-immobilization due to biochar's charge and high surface area and 3) biotic N-immobilization during respiration of the labile carbon fraction of biochar. The objective of this study was to get detailed, mechanistic insight into the effect of biochar on soil nitrogen dynamics in the short term. A ¹⁵N tracing experiment was performed in which two maize biochars produced at 350°C and 550°C were mixed into soil. Soil extractions were carried out 0.25, 2, 4, 24, 72 and 168 h after ¹⁵N application and extracts were analyzed for concentrations of NH₄⁺ and NO₃⁻ and their respective atom% ¹⁵N. Gross N transformation rates were quantified via a numerical ¹⁵N tracing model. Preliminary results show that biochar addition increased gross mineralization rates, while it also stimulates biotic ammonium immobilisation, probably due to biochar's high C:N ratio. In addition an increase in gross nitrification rate was observed. For nitrate net adsorption was observed, which was higher for the biochar treatments compared to the control treatment. Thus the observed net nitrate immobilisation was likely due to nitrate adsorption to the biochar. To conclude, biochar seems to accelerate soil N transformations in the short-term, which is function of biochar's processing temperature.



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SHORT-TERM STABILITY AND FUNCTIONAL PROPERTIES OF BIOCHAR

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The objectives of this study were to assess the levels of oxidation in biomass derived black carbon (BC) and their effect on soil function using a chronosequence methodology spanning a total of ten years. Charcoal fragments recovered from historical charcoal production sites in the Wenchi district, Ghana were characterised for both their surface and bulk properties and charge characteristics. Samples of increasing age showed a decrease in pH as well as an increase in cation exchange capacity (CEC). X-ray photoelectron Spectroscopy (XPS) was used to reveal elemental ratios of carbon and oxygen as an indicator of oxidative weathering in BC. Surface oxygen to carbon ratios in fresh samples were approximately 0.3, increasing to 0.7 for the 10 year old samples. The analysis of whole ground fragments as well as a 'depth profile' of oxidative penetration, revealed the extent of BC weathering within individual fragments. Boehm titration and Fourier-transform infrared (FT-IR) spectroscopy suggested that formation of carboxylic functional groups was responsible for the increase in CEC over the ten year period. Decadal oxidation of BC in tropical soils has significance for its stability as well as for its effects on soil nutrient interactions and biogeochemistry.



S05.03-P -42

SOIL APPLICATION OF WHEAT STRAW BIOCHAR FROM GASIFICATION IN THE INTENSIVE LEAFY VEGETABLES PRODUCTION IN TUNNEL

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*The production of leafy vegetables in tunnel for fresh-cut consumption is an intensive agricultural practice that can cause problems of soil exhaustion due to repeated short cycles, frequent tillage, continuous use of fertilizers and pesticides, reduction of organic matter, diseases onset. In the present study biochar produced from wheat straw by means of an industrial thermo-chemical process (gasification) was used in tunnel in a fresh-cut specialized farm in southern Italy (Lecce) as soil amendment for ground renaturation. Biochar was first analyzed in laboratory for the main physical-chemical properties and polycyclic aromatic and heavy hydrocarbons content, then assessed with bioassay and germination test in order to verify the presence of plant toxic compounds and investigate the growing effects at different rate. Afterward straw biochar was mixed in tunnel to the native topsoil at the rate of 10 Mg per hectare and then cropped with lamb's lettuce (*Valerianella* spp.). At the harvest, productivity was measured both fresh and dried and soil samples were analyzed for the main physical, chemical and biochemical parameters (the latter after six months from soil application). This paper reports in detail the results of laboratory and field tests. To summarize, the work reveals that biochar can be an important tool in the specialized agriculture in order to remediate at the possible decline of production due to intensive practices.*



S05.03-P -43

SOIL GHG EMISSIONS IN A MISCANTHUS PLANTATION AS AFFECTED BY INCREASING RATES OF BIOCHAR APPLICATION.

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Biochar is defined as charcoal produced by pyrolysis intended for application to soil to improve its fertility and carbon (C) storage capacity. Biochar physical and chemical properties can vary depending on the original feedstock and pyrolysis conditions. The potential agricultural benefits and CO₂ carbon sequestration were assessed in field trials with well characterised biochar, produced from Miscanthus biomass at 450 °C. Biochar was added at 3 application rates: (10, 25 and 50 tons ha⁻¹ in 25m² plots) to a 6 year old Miscanthus plantation in Brattleby (Lincoln, UK). Each treatment had 4 replicates according to a randomised block experimental design. Biochar was incorporated to a depth of 10 cm in the soil between plant rhizomes following biomass harvest. Soil CO₂ emissions from biochar amended and controls plots were measured bi-weekly using a portable infrared gas analyser (IRGA) and closed dynamic chamber methods. Soil N₂O fluxes were monitored using a closed static chamber technique with manual gas sampling and subsequent gas chromatography. Cation/anion exchange resin lysimeters were buried 20 cm deep in order to capture the leached nitrogen. Biochar applications at 25 and 50 ton ha⁻¹ reduced the CO₂ effluxes in the first 10 weeks after addition and the emission of N₂O was significantly reduced at these addition rates. The application of biochar increased soil temperature, however the temperature sensitivity of soil respiration in the biochar treated plots decreased with increasing application rates.



S05.03-P -44

SORPTION OF MTBE TO SYSTEMATICALLY CHARACTERIZED MAIZE-STRAW DERIVED BIOCHARS

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The feasibility of using biochar as an effective sorbent in organic contamination has been proved. Knowledge about the sorption mechanism of biochars along with the pyrolytic temperatures remains obscure. In present study, biochars of maize-straw were produced under different pyrolytic temperatures (200 to 800°C, referred as BC200-BC800). The sorption mechanisms of methyl tert-butyl ether (MTBE) to the biochars were studied in batch experiments. The biochars (before and after sorption) were characterized systematically via thermogravimetry (TG-DTG), Brunauer Emmett Teller (BET)-N₂ surface area (SA), X-ray diffraction (XRD), elemental analysis, scanning electron microscope (SEM) and Fourier Transform infrared spectroscopy (FT-IR). The experimental data of sorption kinetics and equilibrium were fitted by different models, which are correlated to quantitatively structural characteristics of biochars.



S05.03-P -45

STABILITY OF MISCANTHUS BIOCHAR UNDER FIELD CONDITIONS IN NORWAY AND EFFECTS ON AGRONOMIC PARAMETERS

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Biochar refers to carbonized biomass used for the purpose of improving soil quality and sequestering carbon in soils. While biochar can be a solution to improve the carbon footprint of agriculture it should also, as a minimum requirement, maintain current grain yields. Our objective was to determine the mineralization rate of an agronomic biochar in a field experiment under Norwegian conditions, and to assess the effect of biochar on grain yield and soil quality parameters. The biochar was produced from a miscanthus C4 feedstock between 650-750C with a PYREG (DE) pyrolyzer, and applied in October 2010 to Norwegian C3 soil at rate of 8 and 25 t C ha⁻¹. A no-biochar control and non-pyrolyzed miscanthus control were also included. The contrasted 13C signature between the C4 miscanthus products and the C3 soil and CO2 flux data was used to determine mineralization rates. First year results indicated that biochar-C was relatively stable contributing between 1-3% of the C-CO2 compared to 20% from non-pyrolyzed miscanthus. Agronomic results differed minimally between treatments but biochar applied at 25 t ha⁻¹ achieved slightly greater yield and grain N content than the control, confirming at least that miscanthus biochar applied at high rates is not detrimental to plant production in the first season.



S05.03-P -46

**SUITABILITY OF BIOCHAR FOR FIXING HEAVY METALS IN FORMER SEWAGE FIELD SOILS
- RESULTS OF POT VS. FIELD EXPERIMENTS**

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*Due to the irrigation with waste water for centuries, the former sewage field soils south of Berlin are severely contaminated with heavy metals. Since termination of the land disposal in 1996 soil pH and organic matter content decrease which leads to increasing mobility of the contaminants. We conducted a lab and a field experiment to study if and to what extent the addition of biochar to the soil could decrease plant uptake and leachability of the heavy metals. In a pot experiment with oat (*Avena sativa*), increasing additions of biochar made from maize (wt/wt 0, 1, 2.5 and 5%) improved plant growth and the Zn and Cd concentrations in the plant tissue decreased significantly from 182 to 38 mg/kg and 3 to 1 mg/kg, respectively. However, reduction of the Cu content was not significant ($p=0.09$). In contrast soil solution concentrations of the heavy metals did not decrease but even strongly increased for Cd from 5.4 $\mu\text{g/l}$ to 9.5 $\mu\text{g/l}$. Soil chemical equilibrium and nutrient uptake modeling suggests that the precipitation of heavy metal salts, e.g. phosphates, in the rhizosphere may explain this discrepancy. Recent research is looking for microscopic and spectroscopic evidence for this suggesting (REM, EDX). Further field experiments with similar rates for biochar addition were established in spring 2011 on the former sewage fields. Data on heavy metal contents of the plants and concentrations in the leachate are being collected and evaluated, recently. The results shall be compared with those obtained from the pot experiments.*



S05.03-P -47

SURFACE OXIDATION OF MODERN AND FOSSIL BIOCHARS

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The degree of surface oxidation strongly influences the reactive properties of biochars such as cation exchange capacity and soil aggregation. This is due to the creation of phenolic and carboxylic groups on the edges of the aromatic core. We used scanning electron microscopy combined with energy-dispersive X-ray spectroscopy (REM-EDX) to characterize spatial distribution of oxygen-containing functional groups of biochars differing in age and treatment comprising freshly produced biochars from different feedstocks (wood chips, poplar, olive residues and wheat straw), microbial altered ones by composting and fossil biochars from terra preta and archaeological sites in northern Italy. The results proved the assumption of a higher O/C ratio of fossil biochars (average 0.7). Composted biochars showed intermediate O/C ratio of about 0.4 while fresh biochars exhibited low O/C ratio of about 0.1. Our results clearly showed that biochar surface oxidation can be accelerated by microbial aging such as composting which should be used before biochar is added to soil because in soil this process might take much longer due to lower microbial activity (compared to compost) and special availability. In addition, our results demonstrated that even composted biochar are far away from material properties of biochars aged over long periods of time in natural conditions such as archaeological environments.



S05.03-P -48

THE EFFECT OF BIOCHAR AMENDMENT ON THE SOIL MICROBIAL COMMUNITY – PLFA ANALYSES AND ¹³C LABELING RESULTS

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The response of the soil microbial community to biochar amendment was investigated by phospholipid fatty acid (PLFA) analysis in a large scale pot experiment and a ¹³C labeling study. Three different agricultural soils from Austria and four different types of biochar were investigated in the large scale pot experiment. The results showed no significant influence of biochar amendment on the total microbial biomass in the first 51 days after biochar addition. However, discriminant analysis showed a distinction of biochar and control soils as well as a strong effect of the pyrolysis temperature on the microbial composition. Variability in the small scale ¹³C labeling study was lower and consequently many PLFAs were significantly affected by biochar amendment. The effect of biochar was dependent on the type of soil. In the sandy, low pH and low organic matter soil, PLFA biomarkers of gram negative bacteria, actinomycetes and, after 2 weeks, gram positive bacteria increased under biochar amendment whereas in the loamy carbonate soil total microbial biomass and gram positive bacteria were negatively affected in the long term. The ¹³C incubation study confirmed the low degradability of the biochar, i.e. decreased CO₂ emission after biochar addition, little ¹³C signature from the biochar in the respired CO₂ and no alteration of the content and the δ¹³C in the soil organic matter within 100 days. The uptake of the labeled biochar into the microbial PLFAs is currently being analyzed and the long term effects of biochar amendment on the microbial community will be explored.



S05.03-P -49

THE EFFECT OF BIOCHAR ON CLAY SOIL AGGREGATE STABILITY

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In Finland, the erosion of cultivated clay soils is linked to the eutrophication of receiving water ways. Reducing soil erodibility by increasing the surface soil aggregate stability is a one way to reduce the amount of phosphorus lost from the fields in association with soil colloids and particles. In this incubation study, we aimed to find out the effect of biochar on aggregate stability of two clayey surface soils (clay% 48 and 32). A sieved (<0.5 cm) soil (ca 150 g dry matter) was placed in plastic containers and after addition of biochar soil was gently mixed and compacted slightly (10 kg). The biochar additions corresponded 0, 15 and 30 t/ha. The moisture was kept constant during the incubation. After 3 weeks the aggregate stability was tested with wet-sieving method and in addition to the amount of water-stable aggregates, the turbidity of the water used in wet-sieving and the mass of detached soil material was measured. Biochar additions increased the amount of water-stable aggregates for 5-11%. For biochar amended soil, the detachment of colloids during wet-sieving decreased 19-45% and the mass of disintegrated soil material decreased 14-28%. These preliminary results suggest that biochar additions can improve the stability of aggregates in clayey soil and therefore can decrease the erodibility of soil.



S05.03-P -50

THE EFFECT OF BIOLOGICAL AND CHEMICAL AGING ON THE CEC OF BIOCHARS

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The properties of biochar vary based on the pyrolysis temperature and feedstock. Fresh biochars do not contribute much to cation exchange capacity, and it may take months to years before it generates the high CEC. Biological and chemical activation of the carboxyl groups are possible mechanisms of this CEC increase. The objective of this study is to chemically oxidize 15 fresh biochar via a hot water extraction, NaOCl and H₂O₂. Additionally the biochars were biologically aged through a soil incubating for 14 weeks. Of these treated chars and of the fresh biochars we measured the CEC.



S05.03-P -51

THE EFFECT OF CHARs AND THEIR WATER EXTRACTABLE ORGANIC CARBON (WEOC) FRACTIONS ON ATRAZINE ADSORPTION-DESORPTION PROCESSES

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Chars are carbonaceous material produced from different type of biomass by pyrolysis. They are known as highly effective adsorbents for atrazine therefore limiting its degradation and its diffusion into the aqueous phase. The aim of the present work is to study the effects of different chars and char's derived WEOC on atrazine sorption-desorption processes. The five chars been used in this study derived from: 1) fast pyrolysis from hard wood (FP1); 2) flash pyrolysis from soft wood (FP2); 3) slow pyrolysis from deciduous wood (CC); 4) gasification from deciduous wood (GC) and 5) the market, purchased as activated charcoal standard (AC). Short-term batch equilibration tests were conducted to assess the sorption-desorption behavior of ¹⁴C-labeled atrazine on the chars, with a special focus on the desorption behavior using successive dilution method with six consecutive desorption step. Chars and their WEOC were physically and chemically characterized. Results demonstrate that biomass and pyrolysis process used to produce chars affect their physical and chemical properties, and atrazine adsorption-desorption behavior. Atrazine desorption resulted from the positive and competitive interactions between WEOC and chars surfaces. WEOC pool play important role in atrazine adsorption-desorption behavior. FP1 and FP2 with higher concentration of WEOC showed higher desorption rates, whereas GC, CC and AC with insignificant WEOC concentration strongly adsorb atrazine with low desorption rates. According to our results, when high WEOC pools chars are concerned, an increase in atrazine desorption can be observed but further studies would help in confirming the present results.



S05.03-P -52

THE EFFECTS OF FEEDSTOCK TYPE AND PYROLYSIS TEMPERATURE ON THE PROPERTIES OF BIOCHARS AND THEIR EFFECT ON SOIL HYDROLOGY AND AGGREGATE STABILITY

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*Application of biochar to soil can lead to improvements in soil fertility, crop yield and soil water-holding capacity. Relatively little is known, however, about the effects of: (i) feedstock material and pyrolysis temperature on biochar hydrophobicity and cation-exchange capacity (CEC); and (ii) biochar additions to soil on plant-available water and aggregate stability. We present the results of the following investigations: (i) The effect of pyrolysis temperature and feedstock material on biochar hydrophobicity and CEC. Biochars were produced from deciduous, coniferous, and graminoid feedstocks, each pyrolyzed at 350, 500, 650 and 800°C. Measurement of water-droplet contact angles demonstrated that biochar hydrophobicity decreased with increasing pyrolysis temperature. CEC was measured using the ammonium acetate method. (ii) The effect of pyrolysis temperature and particle size of biochar, applied to soil in different proportions, on plant-available water. Biochars from three particle-size ranges of short-rotation coppiced willow (*Salix viminalis*) chips pyrolysed at 500°C, and from softwood pellets produced at 400, 500, 600 and 700°C, were mixed with a sandy loam in a ratio of 50g kg⁻¹ and soil water-release curves obtained using the filter-paper method. (iii) The effect of different biochar application rates on soil aggregate stability. A proprietary biochar was ground to <2mm and mixed with soil at three different application rates. These soil-biochar mixtures were stored at constant temperature and subjected to bioturbation and wetting-drying cycles. The aggregate stability of each mixture was then assessed through rainfall simulation. Acknowledgements: This study is funded by NERC (the UK Natural Environment Research Council).*



S05.03-P -53

THE IMPACT OF ACTIVATED CHARCOAL ON NPK LEACHING

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In regions where annual precipitation exceeds evaporation there is a need to implement practices that minimize nutrient leaching. The objective of the research was to investigate whether incorporation of activated charcoal into soil decreases NPK leaching and increases soil water retention and crop yield. The experiment was established in 2010 at the Eerika Experimental Station, Estonian University of Life Sciences (58°23'32" N, 26°41'31" E).The experiment used mini-lysimeters (depth 30 cm, area 0.0706 m²). The experiment was set up as 2 x 5 factorial design with four replicates. The treatments were: (i) two substrates (sandy loam soil and the sandy loam soil mixed with activated charcoal) and (ii) five fertilizer (mineral fertilizer, pig slurry, pig digestate, sewage sludge digestate and control where no fertilizer was applied). Activated charcoal was added per mini-lysimeter 350 g. Barley was grown on all the treatments. The measurements (percolated water quantities and NO₃, NH₄, P and K content in leachate) were performed once a month. The water percolation, NO₃ and P leaching was significantly reduced and K leaching increased in case of soil enriched with activated charcoal substrate. Higher K leaching can be explained by extremely high K content in activated charcoal. NH₄ leaching and barley yield did not vary significantly with either type of substrate. Our results after the first year suggested that the activated carbon incorporation within soil increases the soil water retention ability and decreases the nutrient leaching but its impact on fertilizer efficiency is insignificant.



S05.03-P -54

THE USE OF BIOCHAR ON THE QUALITY OF SOILS AND THE ORGANIC PRODUCTION OF CACAO (THEOBROMA CACAO L.) IN AGROFORESTRY SYSTEMS IN THE BRIBRI INDIGENOUS RESERVE, TALAMANCA, COSTA RICA

Hojah Da Silva Juliano^[2], Soto Gabriela^[2], Cerda Rolando^[2], Oduber Jose^[2], Benjamin Tamara*^[1]

^[1]Purdue University ~ Forestry and Natural Resources ~ West Lafayette ~ United States ^[2]CATIE ~ Tropical Agroforestry ~ Turrialba ~ Costa Rica

Cacao (Theobroma cacao L.) has been grown under shade and organically for centuries by the Bribri native population in the Talamanca Region in Costa Rica. However, due to low fertility of soils and a debilitating disease (Moniliophthora roreri (Ciferri) Evans et al.), yields are quite low in comparison to other cacao production areas in the world. Biochar produced from melina (Gmelina melina) waste from timber mills was added in 2011 to the soil in a one-meter radius around cacao trees in these agroforestry systems. Our objectives were to study the effect of biochar applied with and without chicken manure, an organic amendment, on the quality of soils (physical, chemical and biological), cacao production, and the incidence of pod diseases. We studied the effect on two clones produced by CATIE (Centro Agronomico Tropical de Investigacion e Ensenanza) in four farms in the region. Expected results include an improvement in soil physical, chemical, and biological properties with the addition of biochar and chicken manure. We also anticipate an increase in cacao productivity in the long term by reducing disease problems and augmenting fruit production.



S05.03-P -55

USE OF NITROGEN-ENRICHED BIOCHAR AS A SOIL AMENDMENT IN TEMPERATE AGRICULTURE

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Increasing crop yield in temperate soils requires an input of ~10 t ha⁻¹ y⁻¹ of biochar. However, enriching biochar with nitrogen (N) may decrease the annual requirement of biochar addition. The objective of this study was to determine the effect of N-enriched biochar (Char+) compared to biochar-only (Char), urea ammonium nitrate (UAN) only and a no amendment control (Ctrl) on Zea maize shoot biomass and on soil fertility using clay, loam and sandy textured soil. Maize biomass was significantly greater ($p < 0.05$) in the Char+ compared to the control showing an increase of 310 and 112% increase in the sandy and loam textured soils respectively. No difference in plant biomass was observed for the fine textured soil, and no significant difference, for all soil textures was observed, between the Char+ and the UAN treatments. N concentrations in the Char+ and UAN treatments were significantly greater compared to the Char and Ctrl treatments. Mean N uptake (mg/plant) was significantly greater in the Char+ and UAN treatments compared to Char and Ctrl. Levels of Soil organic C were significantly greater in the Char+ and Char treatments in coarse and medium textured soils, but were not significantly different for the fine textured soil, whereas soil N concentrations were significantly different in the coarse textured soil only. Results from this study show that N-enriched biochar can improve plant growth and soil fertility and improve plant N uptake.



W05.01-P - RECYCLING OF URBAN WASTE RESOURCES – POSITIVE AND NEGATIVE IMPACTS ON SOIL QUALITY AND THE ENVIRONMENT

Wednesday 04 July 2012 from 17:00 to 18:30. Room Poster Areas

W05.01-P -1

BASIC EXPERIMENTS ON EFFECTS OF SEWAGE SLUDGE ON EARLY GROWTH OF CROP PLANTS

Brigitta Tóth, Debrecen - Hungary

W05.01-P -2

COPPER SOLUBILITY AND PHYTOAVAILABILITY IN SOILS POLLUTED BY COPPER SMELTERS AS AFFECTED BY APPLICATION OF SEWAGE SLUDGE AND SLUDGE LEACHATES

Anna Karczewska, Wroclaw - Poland

W05.01-P -3

DOES THE SEWAGE-SLUDGE SPREADING HAVE AN IMPACT ON SOIL AND CROP QUALITY ?

Denis Baize, Orleans - France

W05.01-P -4

EFFECTS OF MWR ON SOIL PROPERTIES AND LECTUCCE GROW IN NO-POLLUTED HAPLIC CALCISOLS AND POLLUTED SPOLIC TECHNOSOLS

María Nazaret González-Alcaraz, Cartagena - Spain

W05.01-P -5

EFFECTS OF DIGESTATE APPLICATION ON CHEMICAL PROPERTIES OF SOIL

Miklós Gulyás, Gödöllo - Hungary

W05.01-P -6

FATE OF THIACLOPRID AND CHLORTOLURON IN A CALCAREOUS SOIL IRRIGATED WITH WASTEWATER: A FIELD EXPERIMENT

Peña Aránzazu, Armilla (Granada) - Spain



W05.01-P -7

IMPACT OF AMENDMENT WITH ORGANIC WASTES ON THE PREVALENCE OF HUMAN PATHOGENS AND ANTIBIOTIC RESISTANCE SPREAD IN AGRICULTURAL FIELDS

Sylvie Nazaret, Villeurbanne - France

W05.01-P -8

IMPACTS OF DIFFERENT COMPOST AMENDMENTS ON ECOPHYSIOLOGICAL TRAITS OF MICROBIAL COMMUNITIES AND SEASONAL SUCCESSION IN MEDITERRANEAN SOIL. AN EXPERIMENTAL FIELD STUDY

Annette Berard, Avignon - France

W05.01-P -9

INFLUENCE OF FRESH DE-OILED TWO-PHASE OLIVE MILL WASTE ON A SOIL'S PHYSICAL PROPERTIES

Daniel Becerra Traver, Badajoz - Spain

W05.01-P -10

LEACHABLE TRACE METALS IN URBAN WASTE COMPOSTS AND IN AMENDED SOILS – INFLUENCE OF LENGTH OF COMPOSTING AND TRANSFORMATION WITHIN SOIL

Jérémy Doublet, Limay - France

W05.01-P -11

MODEL CALIBRATION OF C AND N MINERALIZATION DYNAMICS AFTER APPLICATION OF URBAN WASTE PRODUCTS

Martin Preuss Nielsen, Frederiksberg C - Denmark

W05.01-P -12

P LEACHED BY BIODEGRADABLE WASTES

Marta García Albacete, Madrid - Spain

W05.01-P -13

RECYCLING OF URBAN PHOSPHORUS IN THE FORM OF MAP. – FROM THE SEWAGE TO THE FIELD.

Tim Theobald, Potsdam - Germany

W05.01-P -14

RECYCLING URBAN LEAF LITTER AT GUINEO VILLAGE, TABASCO, MEXICO

Esperanza Huerta, Villahermosa, Tabasco - Mexico



W05.01-P -15

RECYCLING URBAN SEWAGE SLUDGE TO ENHANCE VEGETATIVE ESTABLISHMENT IN AN ACID MINE SOIL

Peña Aránzazu, Armilla (Granada) - Spain

W05.01-P -16

SPECTROSCOPIC COMPARISON OF DIGESTATES OBTAINED FROM DIFFERENT ORGANIC SUBSTRATES

Anna Daniela Malerba, Bari - Italy

W05.01-P -17

URBAN AND LIVESTOCK WASTE FROM REUNION ISLAND: CHARACTERIZATION AND MODELLING OF THEIR TRANSFORMATION IN SOIL

Nantenaina Rabetokotany-Rarivoson, Saint Denis - Réunion

W05.01-P -18

USAGE OF DIFFERENT FERTILIZERS IN LONG-TERM AGRICULTURAL FIELD TRIAL CRUCIAL – EFFECT ON LEACHING OF PARTICLES, METALS, DISSOLVED ORGANIC CARBON AND BACTERIA FROM INTACT SOIL CORES

Jonas Duus Stevens Lekfeldt, Copenhagen - Denmark

W05.01-P -19

USE OF COMPOST IN FERTILIZATION OF GOLF GREENS

Carmo Horta, Castelo Branco - Portugal

W05.01-P -20

USING DATA MINING TO PREDICT SOIL QUALITY AFTER APPLICATION OF BIOSOLIDS IN AGRICULTURE

Françoise Watteau, Vandoeuvre-lès-Nancy - France

W05.01-P -21

WATER AND NITROGEN DYNAMICS IN A CULTIVATED SOIL AFTER A LONG TERM OF URBAN COMPOST APPLICATION

Maha Chalhoub, Orleans - France



W05.01-P -1

BASIC EXPERIMENTS ON EFFECTS OF SEWAGE SLUDGE ON EARLY GROWTH OF CROP PLANTS

Tóth Brigitta*^[1], Veres Szilvia^[1], Kovács Béla^[2], Borbélyné Varga Mária^[3], Lévai László^[1]

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*Over-doses of fertilizers in poorly managed cropping systems can result serious environmental problems, such as pollution of groundwater and eutrophication. The increased industrial and agricultural activities produce more and more wastes and by-products. About 400 million metric tons of hazardous wastes are generated each year on the World. The aim of our study was to give results about some effects of sewage sludge on the basic physiological parameters of maize (*Zea mays* L cvs. Norma SC) and sunflower (*Helianthus annuus* L. Arena). Plant-nutrient solution and plant-soil systems were applied. Dry matter accumulation of shoots and roots, relative chlorophyll contents, the contents of elements were measured of the plants that were grown on nutrient solution. The growth (night and day separately) of roots was measured in soil experiment. The sewage sludge contains plenty of essential (e.g. Fe, K, Mg, P, Zn) and toxic elements (e.g. Al, Cr, Sr). Most of these elements are localized in the roots and not transferred into shoots. The dry matter of shoots increased when sewage sludge was added to the nutrient solution. The relative chlorophyll content was measured on 10th, 13th and 15th days of the experiment. The growth of root is more intensive at night than at day. The length of sunflower and maize's root and shoot increased at night and day. Summery, we came to the conclusion that sewage sludge does not have unfavorable effect on the growth and development of maize and sunflower in plant-nutrient solution and in plant-soil systems.*



W05.01-P -2

COPPER SOLUBILITY AND PHYTOAVAILABILITY IN SOILS POLLUTED BY COPPER SMELTERS AS AFFECTED BY APPLICATION OF SEWAGE SLUDGE AND SLUDGE LEACHATES

Karczewska Anna^[1], Galka Bernard^[1], Leszek Gersztyn^[1], Kabala Cezary^[1]

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*Four various soils polluted by copper smelter emissions were examined in a pot experiment with lettuce (*Lactuca sativa* L.) as a testing plant. Cu concentrations in soils were in the range 470-1440 mg/kg. Soils differed in their textures and represented loamy sand, sandy loam and silt loam. Four kinds of sewage sludge, differing in properties and stability, were applied to soils at the rates of 20 and 50 g d.wt./kg. To examine separate effects of Cu mobilization by low molecular complexing compounds, particularly dissolved organic matter DOM, and further immobilization by secondary sorption on sewage sludge solid fraction, parallel treatments with sludge suspension and sludge leachates free of solid phase, were included into experimental design. The results of laboratory extraction tests indicated possible Cu mobilization from polluted soils by sludge leachates, particularly when alkaline sludge produced by anaerobic digestion was used. However, a mobilized fraction of Cu was efficiently adsorbed on sewage sludge solid fraction, and therefore final Cu extractability, as well as its uptake by lettuce from all sewage sludge-treated soils were lower than those in control soils. Operationally defined speciation procedures of Cu in soil solution and in soil solid phase were carried out to illustrate the processes running in soils. The conditions under which Cu mobilization from polluted soils may take place were discussed and checked experimentally.*



W05.01-P -3

DOES THE SEWAGE-SLUDGE SPREADING HAVE AN IMPACT ON SOIL AND CROP QUALITY ?

Baize Denis*^[1]

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The spreading of urban sewage sludge as fertilisers introduces unwanted trace metals into the soil. A survey of numerous studies carried out in France on the impact of sewage-sludge spreading was made. Two kinds of data will be presented: topsoil analyses including data from partial extraction carried out to evaluate the phytoavailable fractions, and plant analyses including wheat grains. Three categories of experiments emerge: During the 1970s and '80s, sludges with a high trace metal content, especially Cd, were spread at a farm close to Bordeaux on sandy soils and close to Paris on silty topsoils. The quantities of applied Cd were enormous (from 3600 to 641000 g/ha). In that case, strong impacts on total Cd contents of topsoil and cereal grains were observed. Sludges containing industrial cadmium were spread on acid soils in Limousin for decades up to 1998. A clear increase in the Cd content of cereal grains was found where the cadmium input was highest (300-600 g/ha). During the 1990s and 2000s, numerous experiments with sewage-sludge applications compatible with the new French regulations were implemented. The amounts of applied Cd were therefore much lower, from 0.6 to 270 g/ha and no impact was detected on the composition of wheat grains. The phrase "sewage-sludge application on farmland" conceals possible huge differences in metal-quantity input. These depend upon the cumulative tonnage applied and the sludge composition that has showed large variations over time and space. The spreading respecting the French regulations had no noticeable impact on soil and cereal-grain concentrations.



W05.01-P -4

**EFFECTS OF MWR ON SOIL PROPERTIES AND LECTUCCE GROW IN NO-POLLUTED
HAPLIC CALCISOLS AND POLLUTED SPOLIC TECHNOSOLS**

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The aim of this work was to study the effects of the addition of municipal waste refuse (MWR) in plant growth and metal uptake and soil properties in a carbonated no contaminated Haplic Calcisol and a no-carbonated metal-contaminated Spolic Technosol. For each type of soil, a pot experiment was development during three months with the following treatments: without plant + without MWR; without plant + with MWR; with plant + without MWR; with plant + with MWR. The species used was Lactuca sativa (lettuce). For each soil, the treatments were distributed in a totally randomized design with three repetition blocks. During the first month the pots were irrigated with a nutritive solution to facilitate plant establishment, and only with water during the second and third month. Biological, chemical, physical-chemical and physical soil parameters were measured at the beginning, in the middle and at the end of the experiment. At the end, plants were removed and weighted and metal concentrations in above and belowground parts determined. MWR improved soils conditions by increasing total and soluble organic carbon, humic substances, total nitrogen, biological activity and aggregate stability. The Haplic Calcisol showed an increase of the total metal contents with the addition of the waste, but this effect was not observed in the Spolic Technosol due to the high metal concentration in this soil. Plants mainly accumulated metals in the roots and the effect of the MWR was negligible. Plant growth in amended treatments were slight higher.



W05.01-P -5

EFFECTS OF DIGESTATE APPLICATION ON CHEMICAL PROPERTIES OF SOIL

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*Following the international trends a great number of biogas plants were opened during the last few years in Hungary. Digestate is the endproduct of the biogas process. However, this endproduct can still be applied as fertilizer. So far we have only limited information about its agricultural applications. Farmers and authorities are very skeptic because feedstocks are very different so the endproduct will be different, too. Different pot experiments were established with two soil types, and the chemical effects of digestate are presented. In the first experiment digestate was used with different rates of nitrogen content (25 kg ha⁻¹N, 50 kg ha⁻¹N, 75 kg ha⁻¹N, 100 kg ha⁻¹N, and control). Digestate and distilled water were added to 200g soil, and homogenized. Rye-grass (*Lolium perenne*) was applied as a test plant. Two weeks later the grass was removed. After drying the soil, ammonium and nitrate concentrations were measured with Parnas-Wagner apparatus. Humus content, pH, salt content and cation exchange capacity were also analyzed. In the second experiment 170 kg ha⁻¹N, 255 kg ha⁻¹N was applied and there was also a control treatment. Nitrogen level limit in Hungary is 170 kg ha⁻¹N yearly. For each pot 25 kg of soil was used. The test plant was maize (*Zea mays*). After 2 months the same parameters were measured. Our results show that after digestate application significant changes in different soil chemical parameters were could not be detected. Treatments had positive effect on nitrate concentration.*



W05.01-P -6

FATE OF THIACTLOPRID AND CHLORTOLURON IN A CALCAREOUS SOIL IRRIGATED WITH WASTEWATER: A FIELD EXPERIMENT

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Pesticides reach the soil when applied for the control of pests. Their environmental fate will depend on their presence in the soil solution where they can be available for crops and microorganisms, but also to leaching to deeper soil zones. The increasing use of urban treated wastewater (TW), a complex matrix containing salts, nutrients and organic compounds, may have a bearing on pesticide behaviour in soil. Therefore, a field assay was carried out in an agricultural area of Granada (southeastern Spain), using a completely randomised design for three treatments, with three replications: irrigation with TW, with well water (WL) and a combination of TW and fertilizer amendment (F+TW). A mixture of commercial formulations of thiacloprid and chlortoluron was applied on bare soil at a rate of 6 L ha⁻¹. Pesticide residues in soil, as well as several biochemical and physicochemical indicators of soil and soil solution were periodically evaluated during two months. For both pesticides irrigation with TW resulted in slower disappearance rates than when soil was under F+TW or WL treatments. Preliminary results show reduced biological activity in the TW plots, which would mean that under TW irrigation the microbial consortia involved in pesticide degradation could be negatively affected



W05.01-P -7

IMPACT OF AMENDMENT WITH ORGANIC WASTES ON THE PREVALENCE OF HUMAN PATHOGENS AND ANTIBIOTIC RESISTANCE SPREAD IN AGRICULTURAL FIELDS

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*Recycling organic wastes is of interest in agriculture and horticulture for improving soil quality, favoring plant development or suppressing plant pathogens. Composting is a procedure that can be used to ensure microbial safety and prevent development of food-borne illness pathogen. Standard limits exist for several pathogens and bio-indicators. However these standards do not take into account human opportunistic pathogens (HOP) and/or antibiotic resistant bacteria potentially present in the original waste or developing during the composting process. These particular populations should be studied since HOP are of increasing concern in human health as they are frequently involved in nosocomial and communautary infections, have high innate or acquired resistance to antibiotics and are known for their environmental ubiquity. Here we present data on the impact of adding various composts of organic wastes in an experimental field on the distribution and diversity of human pathogens and antibiotic resistant genes. Three organic treatments were compared to control, without organic input, and farmyard manure (FYM) treatments. A two consecutive-year study showed that none of the treatments were responsible of the dissemination of the 3 opportunistic species *Pseudomonas aeruginosa*, *Stenotrophomonas maltophilia* and *Burkholderia cenocepacia*. Similarly *Listeria monocytogenes* was absent from amendments and amended soils. On the opposite fecal indicators bacteria (i.e. *Escherichia coli* and *Enterococcus faecalis*) were present in all amendments and in some of the compost amended soils. FYM and FYM amended soils presented the highest contamination levels by *E. faecalis*. Data relatives to the prevalence and diversity of β -lactamase encoding genes will be presented.*



W05.01-P-8

IMPACTS OF DIFFERENT COMPOST AMENDMENTS ON ECOPHYSIOLOGICAL TRAITS OF MICROBIAL COMMUNITIES AND SEASONAL SUCCESSION IN MEDITERRANEAN SOIL. AN EXPERIMENTAL FIELD STUDY

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Production of biosolid wastes such as compost is increasing and waste management becomes more crucial. The amendment of soils with composts is an alternative for improving soil fertility and also for reducing waste disposal costs. In the current Mediterranean context, fewer studies have focused on the interaction of seasonal shifts and organic amendments on soil microbial community. In this work, we studied the impacts of inputs of urban waste composts in situ on the activities of microbial communities under actual Mediterranean climate. The composts were added on 3 plots at the recommended dosage (2 plots were amended with composts, which were not provided from methanisation plant on October 2009 and January 2011, the third plot was amended on October 2010 with compost from methanization plant). Temperature, humidity of soils (control soil and soils amended with compost) and functional diversity of microbial community were monitored along 2 years. The physiological profiles of the microbial communities were performed with the MicroRespTM method. Our results show that different types of compost amendment affected the biomass and catabolic activity of the soil microbial community differently. The higher impacts on microbial communities highlighted by the biomasses and Community Level Physiological Profile measurements in the soil plots amended with not methanized composts, could be due to their more decomposable organic matter than organic matter of the methanized compost. In addition, these changes in the microbial parameters were also affected by seasonal temperature and precipitation.



W05.01-P -9

INFLUENCE OF FRESH DE-OILED TWO-PHASE OLIVE MILL WASTE ON A SOIL'S PHYSICAL PROPERTIES

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Soils in Mediterranean regions are generally characterized by low organic matter content, and are subject to progressive degradation and the consequent deterioration of their workability. Farming practices that increase the soil's organic matter are therefore strongly recommended for Mediterranean agro-ecosystems. Because de-oiled two-phase olive mill waste (DW) has a high organic matter content, its recycling as organic amendment may be particularly interesting as an alternative for its disposal since it would also improve soil quality. The influence was studied of fresh DW amendment on the physical properties of a Luvisol, a typical Mediterranean soil, under field conditions. The soil was amended with DW at rates of 0, 27, and 54 Mg ha⁻¹, dry weight equivalent, for eight years, with the cumulative effect being evaluated in the last year. The bulk density decreased from 1.45 g/cm³ in the control to 1.28 and 1.10 g/cm³ in the amended soils. Compared with the unamended soil, in the amended soils the cumulative volume of the pores and the aggregate stability increased by up to 136% and 69%, respectively. We conclude that the application of fresh DW as an organic amendment to a typical Mediterranean agricultural soil may be an effective management practice in improving the soil's physical properties and consequently its productivity.



W05.01-P -10

**LEACHABLE TRACE METALS IN URBAN WASTE COMPOSTS AND IN AMENDED SOILS –
INFLUENCE OF LENGTH OF COMPOSTING AND TRANSFORMATION WITHIN SOIL**

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Sewage sludge mixed with green waste, municipal solid waste (MSW) originated from mechanical biological treatment, and MSW mixed with green waste were composted over a 12 week period in 170L-reactors. The evolution of the mobility of trace elements and of organic matter during composting was characterized through extractions in EDTA and CaCl₂ solutions and by the evolution of biochemical fractions. Samples from the plough layer of a cultivated luvisol and from the organic wastes after increasing composting time were intimately mixed with a mass ratio compost/soil < 1.3%. The mixtures were maintained at water retention capacity and periodically leached during 2 months. Leachates were analysed for pH, DOC, trace and major cations. Specific extractions were performed on amended soils at the end. During composting, the EDTA fraction of trace metals (in % of total metal content) generally decreased, but could increase in absolute values due to organic matter degradation. The evolution of CaCl₂ fractions varied with the initial mixture and pH variations; but a general trend was a temporary increase, then a decrease. After incorporation in soil, the evolution of Cu and DOC in leachates decreased similarly with time. Green waste addition to MSW in the initial mixture reduced the mobility of Cu. The influence of the duration of composting and of transformation within soil on the mobility of Zn and Cd again interacted with pH variations. Possible connections of this laboratory study with data obtained on long-term field experiments using similar soil, compost types and application rates are discussed.



W05.01-P -11

MODEL CALIBRATION OF C AND N MINERALIZATION DYNAMICS AFTER APPLICATION OF URBAN WASTE PRODUCTS

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Increasing amounts of urban waste are being collected and used for centralized treatment. Composting ensures recycling of nutrients, but requires large areas and is costly. Alternatives include application to arable land either directly (uncomposted) or after short-term composting. This study evaluate C and N-mineralization from four garden waste and eight sewage sludge products and use these data for calibration of the mineralization dynamics of the agroecosystem model Daisy. Long-term impacts to the environment and plant growth can then be simulated and subsequent integrated in life cycle assessment models. Significant differences in C-mineralization rate were observed shortly after starting the incubations, whereas later stages showed less difference in C-mineralization rate. This indicates that there are differences in C-mineralization due to differences in easily decomposable carbon. In the initial phase, most garden waste materials displayed net N-immobilization, but mature compost showed larger N-mineralization than the non-amended control soil. Fresh garden waste showed greatest immobilization and very limited re-mineralization later. Only mature compost has higher accumulated N-mineralization than non-amended soil over the entire period. Most sewage sludges showed N-mineralization and few displayed immobilization in the very beginning. Successful calibration of the agroecosystem model Daisy was done based on the observed differences in C and N-mineralization dynamics of urban wastes and these will provide valuable information for future simulations with Daisy. These simulations can be used to assess whether processing decrease the risk of initial N-immobilization, which may affect crop-N supply negatively after application to arable land.



W05.01-P -12

P LEACHED BY BIODEGRADABLE WASTES

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Sludge's, manures and compost applied to agricultural soils in high quantities and long-term application to increase crop productivity, result in accumulation of soil phosphorous (P). Fertilizers and biodegradable wastes application rates in agriculture are based on nitrogen requirements. This results in a P supply that is in excess of crops needs since the ratio of P t N in waste use to be greater than required by plants (Smith, 1995). Elevated levels of soils P have generated considerable interest due to concerns given the potential risks for P losses in leaching or runoff to surface waters. While surface runoff is an important pathway of phosphorus losses from agricultural lands, significant losses can also occur via leaching through soils. Leaching tests are important for assessing the risk of release of potential pollutants from biodegradable wastes into groundwater or surface water. Percolation tests are frequently used for this purpose. The study was conducted with three different soils mixed with four biodegradable wastes (compost, digestato, sludge and slurry) and an inorganic fertilizer. Each soil was amended with P sources at rates of 100 kg P ha⁻¹. The column test was run in up-flow mode and the leachant was demineralised water (DMW) according to the percolation leaching test CEN/TS 14405 "Characterization of waste-Leaching behavior test- Up-flow percolation test". Leachates were collected and analyzed for dissolved reactive P with a double-beam spectrophotometer at 880nm using the vanadomolybdo-phosphate blue method.



W05.01-P -13

RECYCLING OF URBAN PHOSPHORUS IN THE FORM OF MAP. – FROM THE SEWAGE TO THE FIELD.

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As the natural phosphorus reserves are limited, new approaches need to be tackled, leading to a more sustainable use of this resource. In terms of urban mining, the recovery of phosphorus from e.g. urban wastewaters in the form of magnesium ammonium phosphate (MAP) has frequently been proposed as a mean for its recycling as a fertilizer in agriculture. Pot experiments validating the performance of MAP as a fertilizer, showed an uptake efficiency of phosphorus of 67% and 86% in wheat and maize, respectively. Since data from the field is still lacking the focus of this study is to evaluate MAP for its suitability under field conditions. Three different locations with preferably low available P levels were selected in the rural areas of State Brandenburg in eastern Germany: Biesenthal, Welzow, and Sedlitz (respective DL available P contents: 12, 24, 44 mg kg⁻¹ soil). At Biesenthal solely the fertilizing potential of MAP is subject to the trial. At the two other sites, the fertilizing effect of phosphorus and as well that of nitrogen are being ascertained. Trials are carried out over a total period of 2½ years. The crop rotation for the latter two sites is winter wheat, mustard as catch crop, millet and forage rye. At Biesenthal the current crop is winter rape. First results are expected in May 2012 and will give insight, in how far results obtained from the greenhouse apply to field conditions.



W05.01-P -14

RECYCLING URBAN LEAF LITTER AT GUINEO VILLAGE, TABASCO, MEXICO

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At Tabasco, southeast of Mexico, 60 % of the urban wastes are composed by organic wastes, where vegetable wastes from parks and households constituted 70% of the total organic wastes. Wastes are transported and deposited in landfills producing a constant search of new land for garbage deposition. The objective of this study was to recycle (vermicompost) the urban leaf litter of a co-urban village of the capital of the state. The Guineo Rancheria has 2286 inhabitants, within it household wastes it is possible to find leaf and manure wastes. Leaf litter were collected from the main trees presented in the parks and in the houses, manure was collected from the main farms. A mesocosm experiment was installed. Leaf and manure were composted separately during 2 months before vermicomposting. Then, 5 vermicompost treatments with 4 replicas per treatment were established: a) 50% leaf litter with 50% manure, b) 75% leaf litter with 25% manure, c) 85% leaf litter with 15% manure, d) 25% leaf litter with 75% manure and e) 15% leaf litter with 85% manure. In those treatments where leaf litter was equal or superior of 50% the earthworms died within 30 days, those treatments with <50% of leaf litter produced 178% more earthworms after the experiment (60 days). Organic matter, Total nitrogen, available phosphorus and Near-infrared spectroscopy were analyzed per treatment at the beginning of the experiment and in the final vermicompost.



W05.01-P -15

RECYCLING URBAN SEWAGE SLUDGE TO ENHANCE VEGETATIVE ESTABLISHMENT IN AN ACID MINE SOIL

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Mining activities produce vast areas containing large quantities of wastes from the mineral processing. In order to ecologically treat these degraded soils, an integrated approach should be adopted considering physical, chemical, and biological aspects. Establishment of a vegetation cover must be addressed to mitigate erosion and increase soil productivity as a self-sustaining ecosystem. To do this, addition of urban sewage sludge was tested as an economically and environmentally friendly strategy to improve soil quality of a mine tailing (Nerva district, SW Spain). The substrate, derived from a pyritic mine spoil (Iberian Pyrite Belt), is coarse-textured, extremely acid ($\text{pH} < 3$) and has high potentially toxic metal load. The soil, limed with sugar beet wastes (Carbocal), was then added with various doses of stabilised and composted sewage sludge, and compost of sewage sludge plus pruning wastes. Periodical evaluation of soil biological and physicochemical parameters was performed, and the organic and inorganic chemical composition of the soil solution was characterised. Organic amendments led, among others, to an increase of soil organic carbon and of biological activity. Effects of the amendments on germination and vegetative establishment of different plant species, used in agriculture or in biofuel production, were tested.



W05.01-P -16

SPECTROSCOPIC COMPARISON OF DIGESTATES OBTAINED FROM DIFFERENT ORGANIC SUBSTRATES

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Anaerobic digestion (AD) is an efficient waste-treatment technology in which microorganisms degrade organic matter in absence of oxygen to methane and carbon dioxide (biogas) and the final product, the digestate (D) is characterized by high contents of recalcitrant organic molecules. In this work, FTIR and fluorescence spectroscopy were applied to the characterization of 3 different substrates: a) D1 obtained by the organic fraction of domestic solid wastes and sewage sludge; b) D2 obtained by pig slurry and c) D3 obtained by energy crop, poultry manure, ruminant's stomach residue and agro-industry residues. D1 and D3 show similar FTIR spectra. However, D1 exhibits a higher relative intensity of peaks at 1430 cm⁻¹ and 1034 cm⁻¹ (inorganic substances) whereas D3 shows a number of peaks in the 1550-1400 cm⁻¹ range revealing the heterogeneous chemical nature of fresh biomasses. D2 shows a peak of higher relative intensity at 1620 cm⁻¹ (aromatic C=C double bond) and a number of peaks at 1440, 1390 (COO-, CH₂ and CH₃ groups) and at 1280 cm⁻¹ (amide, ethers). Emission spectra of all D samples feature a unique broad band located at 440 nm; excitation spectra show a maximum at 330 nm for D1 and D2 and at 350 nm for D3. Synchronous-scan excitation spectra of D1 e D2 present a maximum at 330 nm whereas D3 shows a major peak at 380 nm and a secondary peak at 430 nm. Results obtained indicate that the different chemical composition of the fresh organic substrates submitted to AD affect the chemical characteristics of the final products.



W05.01-P -17

URBAN AND LIVESTOCK WASTE FROM REUNION ISLAND: CHARACTERIZATION AND MODELLING OF THEIR TRANSFORMATION IN SOIL

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The objective of this study is to assess the transformations in soil of carbon and nitrogen forms of Exogenous Organic Matters (EOMs): raw materials, mixtures and composts from Reunion Island agricultural and urban waste by using the TAO (Transformation of Added Organic materials) model calibrated on EOMs and substrates of temperate areas. EOMs were studied in terms of chemical and biochemical contents and for their C and N mineralization during incubations in a typical andosol of Colimaçons, Reunion Island. The TAO model was used to predict the transformations of C (very labile, resistant and stable organic C) and N (very labile, resistant and stable organic N, produced and immobilized inorganic N) forms driven by EOMs biochemical data. The C transformations and inorganic N production of most of the tested EOMs are predicted accurately by TAO without any change in calibration formulae. Complementary adjustments using more complete data from laboratory experiments are suggested to correct the tendency to overestimate the C mineralization and the re-mineralization of immobilized N. TAO model appear as a promising tool to optimize the management of urban and livestock waste but complementary fittings have to be submitted in order to suit to the tropical zone application.



W05.01-P -18

**USAGE OF DIFFERENT FERTILIZERS IN LONG-TERM AGRICULTURAL FIELD TRIAL
CRUCIAL – EFFECT ON LEACHING OF PARTICLES, METALS, DISSOLVED ORGANIC
CARBON AND BACTERIA FROM INTACT SOIL CORES**

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In the 'CRUCIAL' long-term agricultural field trial a number of different fertilizer treatments were established in 2003. Among these was an unfertilized control, cattle slurry at a rate corresponding to Danish agricultural practise and cattle manure at an accelerated rate. Treatments with sewage sludge and degassed and subsequently composted organic municipal waste were also included at 'normal' and accelerated rates. Presently there is a factor 2 difference in soil carbon between the accelerated rate of municipal waste compost amendment and the unfertilized control. The gradient in organic matter across the treatments may have profound effects on the formation, size and stability of soil aggregates. This in turn might have implications for the prevalent flow regime in the different soil treatments. In this study we examine whether the different fertilizer treatments have brought about significant differences in the prevalent flow regime of the soil. Further we examine the hypothesis that leaching of dissolved organic matter and bacteria from intact near saturated soil cores in the laboratory is positively correlated to total carbon content of the soil. Finally we investigate if the leaching of metals from intact soil cores is correlated to leaching of DOC and is correlated to the cumulative input of metals from the waste amendments. A counter effect could be that the low organic matter content of the unfertilized treatment yields a greater particulate matter leaching due to a lower aggregate stability.



W05.01-P -19

USE OF COMPOST IN FERTILIZATION OF GOLF GREENS

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*The aim of this study was to contribute to a better knowledge of compost application in golf courses and collect results that allow seeing if these products could be an alternative to the conventional fertilizers usually applied. A germination test was made and a field trial with the duration of four months was set, using a group of putting greens with *Agrostis stolonifera*, where was observed the answer to a compost: sand mix (1:2) topdress. A group of greens with the conventional fertilization was used as a control. It was analyzed the compost phytotoxicity; his influence on some soil properties as: pH value, organic matter content, electrical conductivity, extractable P and K and saturation bases; his influence in the presence/severity of Dollar spot and the putting green playing quality expressed by its speed. The germination test indicates an ideal maturity degree of the compost. The results obtained in the soil properties analysis, with the exception of the extractable K, were always identical or better on the greens treated with the compost. During the time trial there were no signs of the presence of Dollar spot. The green speed in the greens treated with the compost was at first similar to the control group, but after the second compost topdress, the results were better. The compost application in the trial conditions could be an interesting destiny to this product, because in replacing the conventional fertilization in the treated putting greens, they maintained a play quality identical to the ones fertilized conventionally.*



W05.01-P -20

USING DATA MINING TO PREDICT SOIL QUALITY AFTER APPLICATION OF BIOSOLIDS IN AGRICULTURE

Cortet Jérôme^[1], Kocev Dragi^[2], Ducobu Caroline^[1], Džeroski Sašo^[2], Debeljak Marko^[2], Watteau Françoise^{*[1]}, Schwartz Christophe^[1]

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The amount of biosolids recycled in agriculture has steadily increased during the last decades. However, few models are available to predict the accompanying risks, mainly due to the presence of trace element and organic contaminants, and benefits for soil fertility of their application. The paper deals with using data mining to assess the benefits and risks of biosolids application in agriculture. The analyzed data came from a 10-year field experiment in north-east France focusing on the effects of biosolid application and mineral fertilization on soil fertility and contamination. Eight types of biosolids were applied at agriculturally recommended rates according to four applications on several successive crops. Biosolids had a significant effect on soil fertility, causing in particular a persistent increase in plant-available P relative to plots receiving mineral fertilizer. However, soil fertility at seeding and crop management method had bigger effects than biosolid application on soil fertility at harvest, especially soil N content. Levels of trace elements and organic contaminants in soils remained below legal threshold values. Levels of extractable metals correlated more strongly than total metal levels with other factors. Levels of organic contaminants, in particular PAH, were linked to total metal levels in biosolids and treated soil. The study confirmed that biosolid application at rates recommended for agriculture is a safe option for increasing soil fertility. However the quality of the biosolids selected has to be taken into account. The results also indicate the power of data mining in examining links between parameters in complex data sets.



W05.01-P -21

WATER AND NITROGEN DYNAMICS IN A CULTIVATED SOIL AFTER A LONG TERM OF URBAN COMPOST APPLICATION

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^[1]BRGM ~ 45 ~ Orleans ~ France ^[2]INRA ~ 78 ~ Thiverval-Grignon ~ France ^[3]Veolia ~ 78 ~ Limay ~ France

The need of realistic site specific and local studies still exists for developing sustainable urban compost application practices. We conducted a field study to quantify the impact of compost on soil water dynamics, solute transport and nitrogen release. In addition to the monitoring of soil water potential and water content using tensiometers and TDRs, a tracer study was carried out to evaluate the effect of compost application on the transport of non-sorbing conservative solutes in soil. The dynamics of nitrogen was evaluated by sampling destructively the soil to measure its mineral nitrogen content. The deterministic soil-crop model PASTIS was used to simulate the observed water and N dynamics. Compost application affected the soil water properties only in the upper tilled horizon by increasing its water holding capacity and reducing cumulative evaporation under high evaporative demand. This could be explained by the increase in soil organic matter content after 10 years of compost application. Simulated N fluxes showed that the application of urban composts increased nitrogen availability for plants. Compost with high biodegradability presented higher nitrogen release the year following its application, while composts with low biodegradability allowed long term availability of N after several years of compost application. Simulated N fluxes showed the application of organic amendments increased losses of nitrogen, which can be related to cropping practices. This means that, waste compost use in agriculture could be a sustainable practice provided that application is adjusted according to the specific characteristics of compost and management practices.



S06.01-P - GREENHOUSE GAS EMISSIONS FROM SOIL UNDER CHANGING ENVIRONMENTAL CONDITIONS: CONCEPTS, MODELING AND OBSERVATIONS

Wednesday 04 July 2012 from 17:00 to 18:30. Room Poster Areas

S06.01-P -1

AMMONIA AND NITROUS OXIDE EMISSION AFTER FERTILIZATION WITH BIOGAS SLURRY

Ulrike Wolf, Braunschweig - Germany

S06.01-P -2

ARE N₂O EMISSIONS HIGHER IN SOYBEAN CROP AND RESIDUES THAN IN OTHER CROPS?

Miguel Angel Taboada, Hurlingham, Province of Buenos Aires - Argentina

S06.01-P -3

BIOLOGICAL SOIL CRUSTS (BSC) IN THE SAHELIAN ZONE. CAN THEY IMPACT SOIL C AND N CYCLES?

Isabelle Bertrand, Reims - France

S06.01-P -4

C AND N TRACE GAS EXCHANGE FROM TROPICAL ECOSYSTEMS AT MT. KILIMANJARO, TANZANIA

Friederike Gerschlauer, Garmisch-Partenkirchen - Germany

S06.01-P -5

CO₂ EMISSION IN SOILS UNDER SEWAGE SLUDGE AMENDMENT IN AFFORESTED AREAS

Tania Leme De Almeida, São Carlos - Brazil

S06.01-P -6

CHANGES IN NITRIFICATION AND DENITRIFICATION POTENTIALS AFTER COATED UREA APPLICATION AFFECT SOIL N₂O EMISSIONS FROM DIFFERENT SOILS – A 15N TRACER STUDY

Yoshitaka Uchida, Tsukuba - Japan



S06.01-P -7

COMPARISON OF SOIL CO₂ EMISSIONS BETWEEN ARABLE LAND AND SHORT ROTATION CROPS FOR BIOMASS

Chiara Ferré, Milan - Italy

S06.01-P -8

DAILY VARIATIONS OF CO₂ FLUXES IN HISTIC AND TURBIC CRYOSOLS FROM SALLUIT, NUNAVIK (QC, CANADA)

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Rachel Helliwell, Aberdeen - United Kingdom

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Jesper Riis Christiansen, Copenhagen - Denmark

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VALIDATION TO DAYCENT SOIL MODEL FROM EDDY COVARIANCE MEASUREMENTS.

Lorenzo Brilli, Firenze - Italy

S06.01-P -1

AMMONIA AND NITROUS OXIDE EMISSION AFTER FERTILIZATION WITH BIOGAS SLURRY

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The number of biogas plants in Germany is strongly increasing due to the promotion of biogas production within the German Renewable Energy Source Act. Most biogas slurries are valuable N fertilizers due to the accumulation of ammonium during digestion. However, they may also cause environmentally harmful gaseous N emissions such as ammonia (NH₃) or nitrous oxide (N₂O). There is little knowledge on the effect of these new fertilizers on NH₃ volatilization and N₂O emission and how in particular N₂O emissions can be reduced by different fertilizing strategies. The objectives of this study were a) to quantify NH₃ volatilization and N₂O emission from a maize field fertilized with biogas slurry (from maize residues) or mineral nitrogen (calcium nitrate) and b) to determine the effect of a nitrification inhibitor (Piadin) on emissions from the treatment fertilized with biogas slurry. A fertilization experiment (replicated field plots) was established in April 2011. NH₃ volatilization was determined with passive samplers (acid traps) directly after fertilization, N₂O emission was measured weekly for one year with soil chambers. Cumulative N₂O-N losses for 188 days (until harvest) were highest following application of biogas slurry (1766 g ha⁻¹) followed by the treatment biogas slurry + Piadin (399 g ha⁻¹) and the application of mineral fertilizer (358 g ha⁻¹). High NH₃-N emissions occurred following the application of biogas slurry (24-25 kg ha⁻¹). The results show the high potential of biogas slurry to cause emissions of N₂O and NH₃ and they suggest that the addition of Piadin can reduce N₂O losses.



S06.01-P -2

ARE N₂O EMISSIONS HIGHER IN SOYBEAN CROP AND RESIDUES THAN IN OHER CROPS?

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Are N₂O emissions higher in soybean crop and residues than in oher crops? Abstract. Nitrous oxide (N₂O) is produced in soils by microbial processes affected by several factors, including nitrogen availability, water filled porosity, crop type and the quality of their residues. In order to assess N₂O emissions in N fixing (soybean) and non fixing (wheat and maize) crops and their residues, three field lots under different crops were sampled five times from November 2009 to December 2010. Due the low topsoil temperatures (< 10°C), N₂O emissions were almost null during winter periods. The N₂O emission rates were significantly higher in vegetative (V5) maize than in wheat crop next to harvest. This was attributed to the higher concentration of nitrates in recently fertilized maize crop. Concerning the residues, N₂O emission rates were higher ($p < 0.05$) in double cropped soybean that in maize. This was also associated with higher nitrate concentration, derived from decomposition of N-rich soybean residues. N₂O emission rates were higher ($p < 0.1$) in double cropped soybean than in maize next to harvest. Present results do not allow identifying the factors causing high N₂O emissions. They can be attributed to the biological fixation of nitrogen by soybean and / or by the belowground rhizodeposition of organic compounds. These results show that N₂O emission rates were highly variable in the studied soils: they were almost null during winter and occur as pulses during the rest of the year.



S06.01-P -3

BIOLOGICAL SOIL CRUSTS (BSC) IN THE SAHELIAN ZONE. CAN THEY IMPACT SOIL C AND N CYCLES?

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Biological soil crusts are considered as major source of soil organic carbon in semiarid ecosystems. However, while the ability of these crusts to fix atmospheric C and N under low moisture and high temperature is well understood, only few studies dealt with the turnover of the fixed C and N in soils. The aim of this study was to assess the quantitative impact of BSC on C and N cycles in soils from the Sahelian zone. Biological crusts and soils were sampled in February 2009 along a climatic gradient and on diverse land use's plots (cultivated, fenced and not fenced fallows) in Western Niger. BSC and soil profiles samples were characterized before incubation for their C and N contents, particle size, C biomass, mineral N, sugar monomers contents and microbial diversity. C and N fluxes of mineralization and fixation were measured by incubating biological crusts at 28 °C in dark and light conditions. Higher C and N content and C biomass were found in superficial BSC samples compared to depth samples. Within BSC we demonstrated that C fixed under light conditions by autotrophic biomass, which fluxes ranged from 7,51 to 24,65 $\mu\text{C}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ was mainly under a polysaccharide form. Mineralization fluxes measurements showed that the polysaccharides materials are partly consumed under dark conditions, corresponding to fluxes from 2,95 to 5,88 $\mu\text{C}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ in average. However, the net balance seems to be positive and its impact on soil C and N content in Sahelian soils will be further discussed.



S06.01-P -4

C AND N TRACE GAS EXCHANGE FROM TROPICAL ECOSYSTEMS AT MT. KILIMANJARO, TANZANIA

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In a rapidly changing world understanding of natural ecosystems response to human perturbations such as land use and climate changes as well as habitat destruction is crucial with respect to sustainability of ecosystem services. The changes in terrestrial ecosystems due to shifts in climate and modifications in land use occur in many dimensions, and include changes in the biogeochemical cycles of C and N and associated greenhouse gas (GHG) exchange. In contrast to the global importance of tropical ecosystems studies of impacts of climate and land use change on C and N nutrient turnover and GHG exchange are still scarce, in particular for Africa. In the framework of the DFG funded Kili research unit we have investigated nitrogen cycling and GHG exchange (N₂O, CH₄ and CO₂) at selected ecosystems around Mt. Kilimanjaro, Tanzania. We will present results for tropical forests in two different altitudes, homegarden (extensive agro-forestry), coffee plantation (intensive agro-forestry) and savanna ecosystems. Thereby we used a combined approach consisting of a laboratory parameterization experiment (2 temperature and moisture levels) for GHG exchange, static chamber measurements and characterization of N cycling using ¹⁵N stable isotope techniques. The magnitude of GHG emissions were highly variable in space and time and were strongly influenced by environmental and climatic conditions, like soil texture, substrate availability and changes in soil moisture as well as temperature. Furthermore, significant differences in fluxes and nutrient turnover were found across natural and managed ecosystems.



S06.01-P -5

C02 EMISSION IN SOILS UNDER SEWAGE SLUDGE AMENDMENT IN AFFORESTED AREAS

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Main objective was evaluating effect of sewage sludge (SS) amendment in CO₂ emissions in soils with different characteristics. Experimental areas were established in 2008 with eucalyptus plantation, with and without SS amendment in two different soils, one sandy and other with more clay (16-20%). Analysis of CO₂ emissions realized in 2011 showed that for sandy soils, with and without SS amendment, practically there were not differences, with mean value of 3.75 $\mu\text{mol m}^{-2} \text{s}^{-1}$. For soils with more clay (16-20%) values of CO₂ emissions were different with, 5.59 $\mu\text{mol m}^{-2} \text{s}^{-1}$ to area with SS amendment, in comparison to 4.13 $\mu\text{mol m}^{-2} \text{s}^{-1}$ to area without SS amendment. These results of CO₂ emissions were consistent with changes in soil carbon content in these different areas, mainly with a noticeable decrease in soil organic carbon in clay soil under SS amendment. Also data of laser-induced fluorescence (LIF) spectroscopy indicated increase of relative carbon compounds stability in the remaining soil organic carbon. This correlation between LIF data and CO₂ emissions suggested that only more stable soil carbon compounds were not decomposed by probably increase in microorganism activity in areas under SS amendment in clay soil.



S06.01-P -6

CHANGES IN NITRIFICATION AND DENITRIFICATION POTENTIALS AFTER COATED UREA APPLICATION AFFECT SOIL N₂O EMISSIONS FROM DIFFERENT SOILS – A 15N TRACER STUDY

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Nitrous oxide (N₂O) is emitted from fertilized agricultural soils. Using coated urea, N₂O emissions maybe reduced, because it slowly releases nitrogen substrates for N₂O producers, but the efficiency of coated urea, with regards to the reduction of N₂O emissions, varied among soil types. An incubation study was performed using two soils, well-drained Andosol (A) and poor-drained Fluvisol (F). Urea (U) or coated urea (CU) was applied on the soils and N₂O fluxes were measured for 1 month. A stable isotope technique was used to determine N₂O production via nitrification and denitrification at; before fertilizer application, 1 week and 1 month after fertilizer application. Nitrous oxide emissions from A_CU were 26% lower than those from A_U. For Fluvisol, coated urea did not reduce N₂O emissions. For A_U and A_CU, nitrification was the major source of N₂O throughout the experiment, and the contribution of nitrification to N₂O emissions increased over time. For F_U, nitrification and denitrification equally contributed to N₂O emissions and the fertilizer had no effect. However, for F_CU, the contribution of nitrification to N₂O emissions increased over time. Thus, the increase of nitrification derived N₂O emissions in F_CU was the reason that F_CU could not reduce soil N₂O emissions when compared to F_U. The efficiency of coated urea, as a N₂O mitigation option, is influenced by soil types.



S06.01-P -7

COMPARISON OF SOIL CO₂ EMISSIONS BETWEEN ARABLE LAND AND SHORT ROTATION CROPS FOR BIOMASS

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The objectives of this study were the investigation of the effects of conversion of arable land to short rotation crops (SRC) and the comparison of different agricultural practices on soil respiration. The experimental site is located at Casale Monferrato (Piedmont, Italy), on alluvial soils near the Po river. It was managed similarly until 2009, then the area was subdivided in 4 parts: a maize field, an alfalfa field, and two poplar SRC (high and very high density). A pedological survey was carried out to characterize surface and subsurface spatial distribution of soil properties. The mean SOC (\pm SD) was $0.76 \pm 0.13\%$ in the 0-60 cm depth, with significant differences in vertical distribution between investigated fields: probably because of soil management, the alfalfa field showed a higher SOC value ($1.1 \pm 0.2\%$) in the 0-15 cm layer, while the remaining fields exhibited a uniform vertical distribution ($0.80 \pm 0.15\%$) in the ploughed layer (0-35 cm). The CO₂ fluxes were monitored (April 2010-November 2011) using an infrared gas analyzer equipped with a dynamic chamber. At the same time soil surface temperature and soil water content were measured. Because of differences in SOC and soil temperature, the comparison between land uses showed the following soil respiration rates: alfalfa 4.1 ± 1.5 , maize 3.6 ± 2.4 , high density SRC 3.0 ± 1.3 , very high density SRC 3.0 ± 1.3 $\mu\text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1}$. Although in the very high density SRC soil CO₂ fluxes were not affected by agricultural practices, differences in soil respiration rates between row and inter-row were found.



S06.01-P -8

DAILY VARIATIONS OF CO₂ FLUXES IN HISTIC AND TURBIC CRYOSOLS FROM SALLUIT, NUNAVIK (QC, CANADA)

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Cryosols in tundra ecosystems contain large stocks of organic carbon. Global warming could induce an Arctic ecosystems positive feedback on global C release. Instrumentation was installed in Salluit (Nunavik; 62°14'N, 75°38'W) to monitor accurately Cryosols respiration. Two experimental sites were set up: a Histic Cryosol (H site) in a polygonal peatland; a Turbic Cryosol reductaquit (M site) on post-glacial marine clays. At each site, surface temperature was monitored hourly and soil respiration (SR) was measured at 10:00 AM, 3:00 and 8:00 PM every second day with a respiration chamber linked to an IRGA, from mid July to end of August 2010. Average SR in H (0.96 $\mu\text{molCO}_2\cdot\text{m}^{-2}\cdot\text{s}^{-1}$) was lower than in M (1.67 $\mu\text{molCO}_2\cdot\text{m}^{-2}\cdot\text{s}^{-1}$). SR variations at H and M sites follow the same seasonal trend, highly correlated with the surface temperature. The Q₁₀ coefficient is usually used to compare respiration activity among different ecosystems. We found at both sites the highest Q₁₀ value in the evening (H: 7.68; M: 11.07) while it is the lowest in the morning (H: 4.67; M: 2.91). In afternoon at H and M sites Q₁₀ is resp. 5.34 and 3.75. The SR variation due to a given temperature amplitude will be more important, in increasing order, from morning to evening. These daily differences in Q₁₀ could be explained either by the soil heat transfer within the profile that provides deeper favourable conditions for microbial and plant activities in the evening than in the morning or by the enhancement of the autotrophic respiration at twilight.



S06.01-P -9

DEVELOPMENT AND REGIONAL APPLICATION OF SIMPLE MODELS FOR SOIL GREENHOUSE GAS FLUXES

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We developed simple models, which were termed SG models, for soil CO₂ efflux, CH₄ uptake, and N₂O efflux in forest soils (Hashimoto et al. 2011, Ecological Modelling). We described each gas flux in terms of three functions: soil physiochemical properties (C/N ratio for CO₂ and N₂O, bulk density for CH₄; 0–5-cm soil layer), water-filled pore space (WFPS, 5-cm depth) and soil temperature (5-cm depth). Multi-site data, which were gathered monthly in Japanese forests over 3 years, were used for model calibration (36 sites, $n = 768$ in total for each gas flux). We used Bayesian calibration for optimization of the models. Then we estimated climate-driven changes in CO₂ emission, CH₄ uptake, and N₂O emission fluxes in Japanese forests from 1980 to 2009 using the models (Hashimoto et al. 2011, Scientific Reports). Our study reveals that the soil greenhouse gas (GHG) fluxes in Japanese forests have been increasing over the past 30 years at the rate of 0.31 Tg C yr⁻² for CO₂ (0.23 % yr⁻¹, relative to the average from 1980 to 2009), 0.40 Gg C yr⁻² for CH₄ (0.44 % yr⁻¹), and 0.0052 Gg N yr⁻² for N₂O (0.27 % yr⁻¹). Our estimates also show large interannual variations in soil GHG fluxes. We are now planning to apply the models globally.



S06.01-P -10

EFFECT OF PEAT PROPERTIES ON THE EMISSIONS OF N₂O AND CO₂

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Drainage of pristine peatlands is followed by increased emissions of nitrous oxide (N₂O) and carbon dioxide (CO₂) because of enhanced mineralization of the surface peat. The emissions are further enhanced due to liming, fertilisation and ploughing especially if the peat soil is used for arable agriculture. Cultivated organic soils are the largest single source of greenhouse gases in the agricultural sector in Finland. Only about 10% of the agricultural fields in Finland are peat soils but they cause 60% of the N₂O and CO₂ emissions caused by agriculture. Increasing the accuracy of the emission estimates requires information on the effect of different background factors on the emissions. We selected six peatland sites and studied the potential denitrification activity in six samples with a declining trend in the organic carbon content along a transect within each site. The field fluxes of N₂O and CO₂ were also monitored for one year on the same transect on three of the sites. The rates of potential denitrification in the soil samples correlated strongly with the total C and N, DOC and pH of the soil. However, the fluxes of N₂O and CO₂ on the field correlated poorly with the measured background variables. The results indicate that these peat properties can determine the potential for N₂O production but additional background variables like depth of the ground water are needed to estimate the actual field fluxes.



S06.01-P -11

EFFECT OF WEATHER CONDITIONS ON N₂O EMISSION PATTERNS DURING WINTER CEREAL CULTIVATION IN TWO DIFFERENT CLIMATIC REGIONS

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Nitrous oxide (N₂O) is a powerful greenhouse gas (GHG) and agriculture was the major source of emission in France and Italy during 2009 (> 69%). N₂O soil production is related to N fertiliser applications and residue management interacting with soil moisture. Here, steady state chambers and gas chromatograph were used to estimate the effect of winter cereal cultivation on N₂O emissions in two rainfed trials located in different climatic regions. In the Paris region (France), the innovative cropping systems with specific constraints (ICC) trial was established in 2008, in a silty-loam soil, with two systems: Environmental friendly (PHEP) and 50% GHG emission reduction (50%GHG). In this trial, N₂O was monitored during barley cultivation from 2009 to 2011. In Central Italy, the conventional versus integrated management agricultural systems (CIMAS) trial was established in 1992, in a clay-loam and N₂O emissions from durum wheat cultivation were monitored during 2010-2011 season. The results showed a strong effect of the lack of rainfall after N fertiliser applications on soil N₂O emissions. Actually, no differences were observed between cropping systems in both trials when soil moisture was below 0.4 m³ m⁻³. At this soil moisture content, N₂O emissions were close to soil background emissions (<10 N₂O-N g ha⁻¹ d⁻¹). These results suggested that under long-lasting dry conditions crop management has a limited influence on soil N₂O emissions.



S06.01-P -12

EVALUATING SPATIAL AND TEMPORAL VARIATION IN GWP AT A REGIONAL SCALE IN IKUSHUNBETSU RIVER WATERSHED, HOKKAIDO JAPAN

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In order to identify effects of land use, soil type, temperature and land management on the soil-atmosphere exchange of GHG in agricultural field, CO₂ from soil organic matter decomposition (SOMD), N₂O and CH₄ fluxes in 17 representative sites were measured. Global warming potential (GWP) at regional scale in 2005, 2007 and 2009 was estimated by sum of SOMD-C application, N₂O and CH₄ emissions by CO₂ equivalence. SOMD was described as $SOMD [kg\ C\ ha^{-1}\ yr^{-1}] = -63 \times TC [g\ kg^{-1}] - 111 \times TN [g\ kg^{-1}] - 50 \times (silt+clay) [\%] + 253 \times \text{average } 5\ cm\ soil\ temperature\ (^{\circ}C) + 3524 (P < 0.05)$. Estimated SOMD demonstrated high spatial variations, with CV ranging 752 to 2439%. Within same climate region, silt + clay was primary factor for explaining spatial variation of SOMD ($P < 0.05$). Soil temperature and soil moisture could explain 66-90% of temporal variation in SOMD, wet and warm climate in 2007 may have enhanced SOMD. N fertilizer application was determining factor for N₂O flux than soil properties, illustrating moderate three years average spatial variability (CV: 96%). Mean annual temperature explained temporal variation in N₂O emission better than annual precipitation. Spatial variation in CH₄ was caused by land use change and land management, a proper reduction of straw application could lower CH₄ in paddy fields. CVs of GWP ranged from 105 to 198%. Temperature greatly affected temporal variation of GHG emission. Large spatial variation of GHG emission was observed due to variation of soil property and land management.



S06.01-P -13

FUMIGATION-CO₂-INJECTION (FCI)-BAPS: A NEW METHOD TO MEASURE GROSS NITRIFICATION RATES IN CALCAREOUS SOILS

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Nitrification has been identified to substantially contribute to overall N₂O emissions from soil. The knowledge of gross-nitrification rates is therefore essential for estimating the contribution of N₂O from nitrification to the total GHG-inventory. The easy, isotope-free, and non-destructive Barometric Process Separation (BaPS) technique, after Ingwersen et al. (1999), makes it possible to measure gross-nitrification and respiration rates in oxic soils based on changes in total, O₂ and CO₂ pressure in a gastight incubation system. Until now, the accuracy of the method has been demonstrated with well-aerated acidic to weakly acidic soils. In calcareous soils, the dissolution of CO₂ in the soil solution causes mismatches in the system's gas balance, which leads to errors in process separation. Modeling the dissolution process with a thermodynamical chemical reaction equation is not practicable because of insufficient accuracy. Instead, we propose a novel method, the Fumigation-CO₂-Injection-BaPS (FCI-BaPS). The dissolution process is determined experimentally in that a subsample sterilized by chloroform fumigation is incubated in the BaPS-apparatus and known CO₂ amounts are injected into the system while CO₂ partial pressure is monitored. After each injection, the amount of CO₂ transferred to the soil solution is computed from mass balance. The paired information on CO₂ and CO₂aq is used to derive a regression equation which gives ?CO₂aq as a function of the CO₂ partial pressure. This equation can then be used with the BaPS method. Results of FCI-BaPS measurements for five soils are presented and compared to results obtained by standard methods (e.g. 15N pool-dilution technique).



S06.01-P -14

GREENHOUSE GAS BUDGETS OF FOREST SOILS, BASED ON SOIL MONITORING DATA

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Soils of temperate forests are discussed as relevant sources or sinks for greenhouse gases (GHG). CO₂, CH₄ and N₂O are the most important GHG-components exchanged between soils and atmosphere. Since Germany and other states have opted for consideration of GHG-budgets of forest soils in the Kyoto protocol, a sound data basis on GHG-fluxes is required. We developed a diffusive gas sampling technique, which allowed for monitoring GHG-concentrations in the soil atmosphere at 6 Level II spruce sites at 0 cm (below humus layer), 5 cm and 10 cm depths in the mineral soil. Fortnightly data series are available from 1998 to 2011 in the spruce- and from 2010 to 2011 in 5 beech stands at the same locations. GHG-fluxes are calculated through the linear-gradient-method with the three measuring depths. CO₂ fluxes ranged between 1.14 - 4.74 MG ha⁻¹ a⁻¹, N₂O-N between 0.05 – 0.83 kg ha⁻¹ a⁻¹, and CH₄ between -0.64 - -5.59 kg ha⁻¹ a⁻¹, the latter indicating the investigated forest soils being a sink for CH₄. Effects of tree species spruce and beech as well as soil protective liming on GHG-fluxes will be discussed. Spatial patterns of C-sequestration in forest soils will be presented for CO₂ by comparing carbon contents stocks from the soil surveys of 1992 and 2007 in the state of Baden-Württemberg (SW Germany). This evaluation resulted in an averaged C-loss of 0.6 MG ha⁻¹ a⁻¹, which corresponds to a source-strength of 2.2 MG ha⁻¹ a⁻¹ CO₂, which is roughly the average at the Level II sites.



S06.01-P -15

GREENHOUSE GAS EMISSIONS FROM ACID SULPHATE SOILS

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There are 1000–2000 km² of acid sulphate soils in the coast of Finland that originate from the anoxic basins in the former Baltic Sea where sulfate reducing bacteria converted sulphate to sulphides in bottom sediments. Some of these soils are drained and used as agricultural fields. When exposed to oxygen, sulphides oxidize to sulphuric acid that makes the soil extremely acid (pH 2.5–4), and mobilizes high quantities of metals like Al, Cd, Co, Ni and Zn. To elucidate management practices to lower the metal loads and increase pH in the drainage water, a demonstration field (18.5 ha) with three different drainage practices was established in Söderfjärden, near Vaasa in Western Finland in 2010. The treatments were: 1) ordinary subsurface drainage, 2) elevated groundwater level via controlled drainage system, and 3) controlled drainage system with additional pumping of water during dry periods. There is some indication that acid sulfate soils could be remarkable sources of greenhouse gases, especially nitrous oxide. We measured the fluxes of nitrous oxide and carbon dioxide in the field experiment in 2010–2011. Fluxes of nitrous oxide were high compared to mineral soils in general and high even compared to organic soils. Fluxes of carbon dioxide were not especially high compared to other soil types. The results will be presented in relation to the water table level, soil moisture, temperature, pH and concentration of nitrate in the soil and drainage water.



S06.01-P -16

IMPACT OF CULTIVATION ON N₂O EMISSIONS AFTER NATIVE FOREST CLEARING WITH CHOP AND MULCH METHOD IN FRENCH GUIANA

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*In French Guiana, primary forest currently covers 96% of the surface area. High population growth, estimated to double by 2030, is accompanied by deforestation, especially for agricultural production. This land-use change makes it necessary to establish a global evaluation method. Experiments were conducted to (i) assess the impact of cultivation on N₂O emissions, and (ii) determine agronomical techniques with lower environmental impacts. In 2008, an innovative method ("chop and mulch") was used to cut down primary forest at the experimental site. The mulch was then incorporated to 15 cm soil surface depth after lime amendment. The experiment was conducted 17 months after deforestation on soil cultivated over a 1-year period. It consisted in (i) N₂O flux measurements obtained through the non-steady-state chambers technique, and (ii) studying the determinism of the N₂O fluxes by measuring ancillary soil variables and through regression analysis. Measurements were made for four land uses: (1) tropical rain forest (considered a reference ecosystem), (2) grassland (*Brachiaria ruziziensis*), and fertilized soybean/maize crop rotation either with (3) conventional tillage or (4) no tillage. We observed that N₂O fluxes for grassland were significantly lower than those for cropland. No significant difference was observed between the two agricultural practices (with or without tillage). N₂O emissions in the forest were not significantly different from those for the three other land uses. N₂O emissions from grassland and cropland were related to NO₃ content, whereas N₂O emissions from the forest appeared to be determined by soil Water Filled Pore Space (WFPS).*



S06.01-P -17

IMPACT OF FOREST DISTURBANCE ON SOIL RESPIRATION IN ORGANIC SOILS ON CALCAREOUS BEDROCK

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Stand-replacing windthrow events are serious disturbance regimes in mountain forest ecosystems. The blown over tree layer can alter environmental factors, such as soil temperature (T_s), soil moisture (M_s), root activity as well as availability and quality of the organic substrate. This can have significant effects on soil respiration (R_s), its temperature sensitivity and on the whole soil carbon balance in general. On Folic Histosols and Rendzic Leptosols developed on calcareous bedrock, an increase of carbon mineralization may contribute to vast humus losses and therefore to pronounced site degradation. In the present study we try to quantify disturbance-driven changes in R_s for a montane mountain forest located in the Northern Limestone Alps. Hence, R_s , T_s and M_s were measured biweekly within a 12 ha research site in 2010. The site includes a disturbed area affected by windthrow events in 2007 and 2009 respectively, and a mature spruce - fir - beech stand. In terms of a geostatistical analysis the measurement locations were arranged in an optimized sample design. Despite a statistically insignificant difference in R_s between the strata, a disturbance driven increase of the mineralization rate is likely because of the typically high contribution of root respiration within the stand. A geostatistical analysis detected a high spatial autocorrelation of R_s within a range of 10 m. A rough annual extrapolation showed an emitted carbon amount of 4300 kg C ha⁻¹ for both windthrow areas. This value corresponds to approximately 7 % of the soil organic carbon stocks of this site.



S06.01-P -18

IMPROVEMENT OF TECHNIQUES FOR MEASURING GREENHOUSE GAS FLUXES FROM AGRICULTURAL SOILS IN JAPAN

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Mitigation of greenhouse gas (GHG) emissions in agricultural sector could be achieved through improved management practices. Uncertainty about the complex biological and ecological processes involved in GHG emissions and carbon storage in agricultural soils, currently limits our ability to evaluate the persistence of mitigation practices. This requires creating standardized protocols and improving chamber methods for GHG flux measurements, so as to cover the issues relating to the spatial and temporal variations in fluxes. Here we summarize the chamber methods and the related techniques for measuring GHG fluxes from agricultural soils in Japan. We also report the development of automatic chamber methods for measuring CO₂ and non-CO₂ (e.g. CH₄ and/or N₂O) fluxes, based on non-steady-state or steady-state flow-through mechanism. We propose a protocol for evaluating GHGs flux especially concerning linking N₂O emission to decomposed CO₂ from soil organic carbon and residue/manure inputs. We use this protocol to estimate the sequestration of soil carbon and the trade-off with N₂O emission in relation to long-term manure input, and discuss the preliminary results of first year. Finally, we briefly introduce the on-going projects on evaluating GHGs emissions and mitigation techniques in Japan.



S06.01-P -19

INFLUENCE OF SOIL WATER STATUS AND COMPACTION ON N₂O AND N₂ EMISSIONS FROM SYNTHETIC URINE.

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Up to 80% of total annual N₂O emissions from urine patches result from a small number of large emission events. Denitrification when soils are wet is the major process leading to N₂O production and soil water status is a key determinant of these emissions. The aim of this research was to better understand how soil physical characteristics and changing soil water status regulate N₂O emissions. This knowledge will be used to develop practical tools for predicting when there is greatest risk of N₂O emissions from urine patches. We conducted a laboratory experiment to quantify N₂O and N₂ emissions during three saturation-drainage cycles (from 0 to -10 kPa tension) from repacked soil cores compacted at pressures of 0, 220kPa & 400kPa that had been treated with or without 15N-labeled synthetic urine applied at 600 kgN ha⁻¹ (enrichment of 50 atom%). Daily gas fluxes of N₂O, N₂ and CO₂ were quantified using mini-headspace chambers placed over the cores. Soils sampled prior to each cycle and on completion of the experiment were analysed for mineral-N, dissolved organic-C and pH. N₂O emissions were low until the third saturation-drainage cycle, with total emissions highest in the 220kPa compaction treatment. N₂ was being emitted by 7d, with total emissions highest in the 400kPa treatment. Maximum N₂O and N₂ emissions occurred close to saturation and declined as soils drained to -10 kPa. Emissions and relationships to soil water tension and content, air-filled porosity and the forms and availability of N and C will be discussed.



S06.01-P -20

INFLUENCES OF FOREST MANAGEMENT ON SOIL CARBON STOCKS IN SISTEMA CENTRAL (SPAIN)

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*Forest management practices change soil environmental conditions, influencing both the inputs of carbon to the soil and the conditions for organic matter decomposition; thus, forest management clearly influences the soil C cycle. In a global change perspective, the potential mitigation role of forest ecosystems is a criterion to be considered by forest managers. We present a study located in Scots pine (*Pinus sylvestris* L.) forests from Central Spain, under two different management practices (uniform and group shelterwood, respectively). We worked on the hypothesis that both different forest management practices and forest age influence both soil CO₂ emissions and stocks, as a result of the different C inputs to the soil (from aboveground litter and rhizodeposition) and the different meteorological conditions (i.e. soil temperature and soil moisture) under each forest type. Soil C stocks results for the whole soil profile are presented. Soil CO₂ efflux rates, temperature and moisture manual measurements presented here range from July 2009 to June 2012. Measurements were carried out fortnightly at plots installed in the youngest, middle and oldest artificial age class (thus covering the whole rotation period) for each forest. First results show a strong seasonal pattern for CO₂ soil production rates. Rates in summer were mainly controlled by soil moisture, but not by temperature, whereas the opposite trend (strong temperature dependence) was found in periods not limited by drought. This suggests that alterations of summer water regimes in Mediterranean ecosystems may imply greater influence on the soil C cycle than changes in temperatures only.*



S06.01-P -21

INTERCALATION OF CARBON DIOXIDE IN A SMECTITE CLAY

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Due to current awareness of global warming and the challenges related to carbon capture and sequestration, the interactions between clays and CO₂ are attracting attention in the scientific community. A recent molecular dynamics study by Cygan et al. shows the possibility of intercalation and retention of CO₂ in smectites at 37 °C and 200 bar. This has led the authors to suggest that clay minerals may prove suitable for carbon capture and carbon dioxide sequestration. We show from x-ray diffraction measurements that gaseous CO₂ intercalates into the interlayer space of the synthetic smectite clay Na-fluorohectorite at conditions not too far from ambient. The mean interlayer repetition distance of the clay when CO₂ is intercalated is found to be 12.5 Å for the conditions 20 °C and 15 bar. The dynamics of the process is observed to be dependent on the pressure, with a higher intercalation rate at increased pressure. The rate of intercalation at the studied conditions is found to be several orders of magnitude slower than the intercalation rate of water or humidity at ambient pressure and temperature. The conditions studied are different from most of the simulations in the literature related to geological storage, but demonstrating intercalation at less extreme conditions could prove very useful in understanding the processes involved



S06.01-P -22

IRRIGATION AND MANAGEMENT PRACTICES INFLUENCE ON SOIL GREENHOUSE GAS EMISSIONS

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The effects of irrigation, tillage, crop rotation, and N fertilization on soil CO₂, N₂O, and CH₄ emissions were studied in a sandy loam soil from March to November, 2008 to 2010 in western North Dakota, USA. Treatments were two irrigation systems (irrigated and non-irrigated) and five management practices [no-tilled malt barley with N fertilization (NTBFN), no-tilled malt barley with no N fertilization (NTBON), no-tilled malt barley-pea with N fertilization (NTB-PN), conventional-tilled malt barley with N fertilization (CTBFN), and conventional-tilled malt barley with no N fertilization (CTBON)]. The CO₂ and N₂O fluxes increased following a substantial precipitation and/or irrigation during increased temperature during the summer. During this period, both CO₂ and N₂O fluxes varied with irrigation but were greater in CTBFN and NTBFN than in CTBON and NTBON. While total CO₂ flux from March to November was greater with non-irrigation than with irrigation, reverse trend occurred with total N₂O flux in 2008. Total CO₂ and N₂O fluxes were greater in CTBFN than in CTBON and NTBON in 2009 and 2010. Tillage increased N₂O flux compared with no-tillage in 2010 and N fertilization increased CO₂ and N₂O fluxes compared with no N fertilization in 2009 and 2010.



S06.01-P -23

LARGE N₂O EMISSION FROM N-SATURATED SUBTROPICAL FOREST, SOUTHWEST CHINA

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N-saturated forests in subtropical China are significant N sinks, despite low forest growth rates [Larssen et al., 2011]. In a forested headwater catchment at Tieshanping (TSP), Chongqing, SW China, with 4 g N m⁻² a⁻¹ atmogenic deposition (60% as NH₄⁺-N; Chen & Mulder, 2007) and leaching of only 0.6 g N m⁻² a⁻¹ (NO₃⁻-N) [Larssen et al., 2011], we applied state-of-the-art field and laboratory methodologies to investigate the nature of the N sinks. The study included the determination of spatiotemporal patterns of N₂O emission and laboratory incubations for nitrification and denitrification characteristics and their gaseous product stoichiometries. Emission of N₂O occurred predominantly during the wet summer and was driven mainly by rain episodes. Rates of denitrification and N₂O emission were particularly large in organic surface horizons of soils on the hill slope and smaller in the colluvium-derived soils of the groundwater discharge zone. Lab experiments confirmed that the difference was primarily due to smaller contents of organic matter in the latter. The spatial pattern of potential denitrification was consistent with NO₃⁻ concentration profiles. Laboratory experiments confirmed that low-pH soils on the hill slope gave rise to relatively high N₂O/N₂ product ratios, explaining some of the variation in N₂O emission fluxes. Estimated annual N₂O emission for 2009-2010, a relatively dry year, was as high as 0.4 g N m⁻², equivalent to appr. 10% of the annual N input. To close the N budget of the watershed, a field ¹⁵N labelling experiment was conducted to assess total gaseous losses including N₂.



S06.01-P -24

LONG TERM CO₂ ENRICHMENT IN A TEMPERATE GRASSLAND INCREASES SOIL RESPIRATION DURING LATE AUTUMN AND WINTER

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Soil respiration, a major component in the global carbon cycle (Schlesinger, 1977), imposes a potential positive feedback to elevated atmospheric CO₂ (eCO₂) concentration (King et al., 2004). However, analyses reflecting seasonal variability of soil CO₂ fluxes under long term eCO₂ and taking winter respiratory CO₂ losses from soil into account are very limited. Here we specifically present seasonal dynamics of soil respiration under long term eCO₂. The study site was the Giessen Free Air Carbon dioxide Enrichment (GiFACE) experiment. Since 1998, CO₂ enrichment (+20%) was applied in three plots, all-year-round during daylight hours. Three control plots were maintained at ambient atmospheric CO₂ levels. The vegetation is a wet grassland (*Arrhenatheretum elatioris* Br.-Bl.). We defined five seasons per year, in respect to management practices and phenological cycles. For a period of three years, soil respiration rates were weekly measured from vegetation-free subplots using the Li-Cor 8100 system. We applied linear mixed-effects models to test for a CO₂ effect within the defined seasons. Our results show a pronounced pattern of soil CO₂ increases during winter dormancy and late autumn. However, during spring time and summer, a period characterized by above-ground plant production, no significant change in soil respiration was observed at the GiFACE. King, J.S., Hanson, P.J., Bernhardt, E., DeAngelis, P., Norby, R.J., Pregitzer, K.S., 2004. A multiyear synthesis of soil respiration responses to elevated atmospheric CO₂ from four forest FACE experiments. *Global Change Biol.* 10, 1027-1042. Schlesinger, 1977. Carbon balance in terrestrial detritus. *Annual review of ecology and systematics* 8, 51-81.



S06.01-P -25

MANAGEMENT EFFECTS BIOLOGICAL AND PHYSICAL CONTROLS ON SOIL CARBON SEQUESTRATION

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Soil carbon sequestration is a viable short-term option to mitigate increased atmospheric CO₂. In agriculture, strategies to increase the soil carbon (C) sink include no-tillage, cover crops, and improved crop rotation. The objective of this study was to determine the influence of different tillage systems on SOC, soil aggregation and aggregate associated C in two different soil types: Oxisol (Brazil), and Mollisol (USA). Long-term tillage experiments included tillage (T) and no-tillage (NT). A native grassland site was included for comparison purposes. Water-stable aggregates (WSA) were separated using a wet-sieving method. Total C was determined by dry combustion. Cultivation reduced the mass of macroaggregates and the associated C; however NT, regardless of soil type, tended to be more similar to the native grassland sites. Agroecosystems reduced TOC, regardless of soil type, compared to the native grassland. This effect followed: Mollisol > Oxisol. This loss of C and N was associated with the decrease in the mass of macroaggregates and lower C concentrations of the aggregates. Macroaggregation was related to TOC and microbial biomass in the Mollisol, suggesting a biological role as the principal mechanism of C protection in these soils. The relationship between TOC and large macroaggregates showed lower values for the Oxisol, indicating that in these soils TOC has a complementary role in macroaggregation. A shift from native grassland to an agroecosystem decreased fungal biomass, but this decrease was less pronounced under NT.



S06.01-P -26

MEASUREMENTS AND MODELING OF THE MOLECULAR HYDROGEN FLUX FROM EUROPEAN SOILS

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Although hydrogen is rarely mentioned as a greenhouse gas, it is expected that massive releases of this gas into the atmosphere, associated with future hydrogen economy, may lead to longer residence time of atmospheric CH₄ and associated enhancement of the greenhouse effect. The global budget of atmospheric hydrogen is not well constrained. In particular, little is known about strength and spatio-temporal variability of H₂ uptake by soils which constitutes the most important sink for atmospheric hydrogen. The field measurements were performed between March 2008 and June 2011. The hydrogen flux into the soil (or out of the soil) was measured using the closed static enclosure technique. The results are interpreted in the context of seasonal changes of local climate and physical parameters of the soil (temperature, moisture content). It is apparent that H₂ flux reveals distinct seasonal fluctuations. Reduced fluxes are recorded during winter months (ca. 5 – 10 $\mu\text{mol h}^{-1} \text{m}^{-2}$). The H₂ flux gradually increases towards the summer, with maximum values in the order of 30-35 $\mu\text{mol h}^{-1} \text{m}^{-2}$ reached in August. Uptake rates of molecular hydrogen measured on the experimental site were modeled using 2-D diffusion equation with assigned sink term. The measured hydrogen flux densities could be reproduced by the model only if significant reduction of the soil moisture content in the uppermost centimeter of the soil is postulated. This finding has important implications for parameterization of H₂ uptake rates for modeling of the global H₂ budget. The work was partly financed from Polish national grant N N305 400939.



S06.01-P -27

METHANE PRODUCTION AND CONSUMPTION IN LOESS SOIL AS AFFECTED BY SLOPE POSITION

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Methane (CH₄) and carbon dioxide (CO₂) are known to act as greenhouse gases, and their concentrations in the atmosphere increase. CH₄ and CO₂ production, and CH₄ consumption in a loess soils collected from the summit (Top), back slope (Middle), and slope bottom (Bottom) positions were assessed in the laboratory. Soils were incubated under conditions which occur in the agricultural soils, i.e. relatively short-term flooding periods with initially ambient O₂ concentrations for CH₄ production, while CH₄ addition to wet soils with for methane oxidation. None of the soils tested in this study emitted a significant amount of CH₄. The Middle and Bottom soils, especially at the depth of 20-40 cm, were a consistent sink of methane. Soils collected at different slope positions significantly differed in their methanogenic, methanotrophic and respiration activities. In comparison with the Top position (as reference soil), methane production and both CO₂ production and O₂ consumption under flooding were significantly stimulated in the soil from the Middle slope position ($P < 0.001$), while they were reduced in the Bottom soil (not significantly, by 6 to 57%). All upper soils (0-20 cm) completely oxidized the added methane (5 kPa) during 9-11 days of incubation. Soils collected from the 20-40 cm at the Middle and Bottom slope positions, however, consumed significantly more CH₄ than the Top soil ($P < 0.001$).



S06.01-P -28

N₂O EMISSION FACTORS FROM N-FERTILIZER UREA IN COTTON AND CORN IN THE BRAZILIAN SAVANNA

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Nitrous oxide (N₂O) is a trace gas, considered a major cause of global warming. In agricultural soils the nitrogen supply, necessary to crops, is indicated as the main responsible for the formation of this gas. This study aim to determine the N₂O emissions and estimate emission factors from N-fertilizer urea use in soil with corn and cotton crops growing in the environmental conditions of Brazilian Savanna, one of the biggest grain and fiber producers in the world. The experiment was carried out in Mato Grosso State, (Brazil) on a clayed Oxisol. The treatments, arranged in the form of randomized blocks, were composed by the nitrogen source urea in three doses: 50%, 100% and 200% of the normally applied 50 kg N ha⁻¹ and 60 kg N ha⁻¹ for cotton and corn, respectively, in coverage. N₂O emission factor calculated according to N-source applied was 0.35% and 0.33% for cotton and corn, respectively. These emission factors were much lower than the standard 1% proposed by the IPCC (2006). In this case, the estimated emission of N₂O in the area responsible for producing 3.5 (i. e. 70%) and 29.4 million tonnes (i. e. 50%) of Brazilian cotton and corn, respectively, in the 2010/2011 harvest may be overestimated. Information obtained in this study characterize the need for refining the data presented in the inventory of GHG emissions. Thus, we suggest more research related to the responses of emission factors for different locations in different soil and climatic conditions and management of nitrogen fertilizers adopted.



S06.01-P -29

N₂O EMISSION FROM SOIL DUE TO ADDITION OF URINE OF LIVESTOCK IN EXTENSIVE SYSTEM

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Pasture expansion in Brazil has shown an increase in 4.5% per year, and a total cattle herd of about 200 millions in 2010. Associated to animal husbandry there are emissions of N₂O (nitrous oxide) and other gases to the atmosphere. The Intergovernmental Panel on Climate Change (IPCC, 2007) identified a N₂O emission flux and an emission factor for cattle urine in to the soil in subtropical conditions. However, it is necessary to determine specific emission factors that reflect the reality of Brazilian tropical conditions. Therefore, the main goal of this research is to estimate N₂O emissions due the addition of cattle urine to soil in extensive livestock system. The research has been conducting in a pasture area at University of São Paulo, Brazil. Nitrous oxide was sampled in the field (0, 5, 10 and 20 minutes of retention), using static chambers and analyzed using a chromatograph Shimadzu. Complementary determinations were performed in the field, i.e., temperature, soil moisture, N content in soil. Preliminary results showed N₂O emissions ranging from 4.3 to 6.5 kg N-N₂O animal-1 year-1 under extensive pasture in dry season. Based on this work we intend to determine a N₂O emission factor for urine in tropical conditions, and thus contribute to the Brazilian inventory of greenhouse gas emissions.



S06.01-P -30

N₂O EMISSIONS BY SOILS IN RELATION TO SOIL WATER DYNAMICS

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Soils are an important source of the greenhouse gas N₂O. High N₂O emissions by soils are generally observed in wet conditions, favorable to anoxic volumes in soils and microbial denitrification. We studied soils N₂O emissions by soils submitted to wetting/drying cycles in a range of water contents close to the water saturation. The study was performed in laboratory on undisturbed soil samples of a gleyic luvisol with exceeding nitrate contents and placed in controlled water contents during wetting/drying cycles. During N₂O fluxes measurements, soil samples were enclosed in airtight systems connected to an infrared spectrometer (Megatec 46i). At the end of the measurement periods, the soil structure was characterized by mercury porosimetry. N₂O fluxes increased during the wetting phase. Small pores, less than 350µm, were observed to play an important role in this increase. We observed the highest N₂O emission when the drying step was just started. Then fluxes rapidly decreased as the soil was drying. For similar soil water contents, N₂O fluxes were different according to the dynamics of the soil water content i.e. during the wetting and the drying steps. This result suggests that models of N₂O emission could probably be improved by considering this hysteresis phenomenon.



S06.01-P -31

NITROUS OXIDE AND METHANE EXCHANGE IN DIFFERENT ECOSYSTEM TYPES IN NORTH-WESTERN GERMANY

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Soils are important global sinks and sources for CH₄ and N₂O. The release of these gases from the soils to the atmosphere or contrary adsorption from the atmosphere to the soils is controlled by different soil properties. Within in the COMTESS (Sustainable coastal land management: Trade-offs in ecosystem services) project we investigate the soil source and sink functioning for CH₄ and N₂O of different landscape units. In pursuing these objectives fluxes of N₂O and CH₄ are measured biweekly with the closed-chamber method in different ecosystem types at the North Sea coastline in Germany. The ecosystems show significant differences in respect of salinity, soil moisture, groundwater level, land use and vegetation. According to these differences the fluxes of CH₄ and N₂O differ over a wide range. Due to the continuous sampling of gas fluxes on 24 plots and the determination of chemical and physical soil properties we will get a wide database to estimate changes in greenhouse gas emissions under changing environmental conditions. By summer next year a nearly one year investigation campaign will be completed. Results will be presented in this session.



S06.01-P -32

NITROUS OXIDE DYNAMICS IN ALLUVIAL SOIL-GRAVEL VADOSE MATERIAL FOLLOWING NITRATE LEACHING

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Production of N₂O from denitrification of leached NO₃ in deeper subsoils may contribute to greenhouse gas warming if this gas is later emitted above-ground. However, subsoil N₂O production and transport processes are poorly quantified. In this field study, we monitored NO₃, Br and N₂O, CO₂ and O₂ concentrations in alluvial soil-gravel matrix vadose material to a depth of 7 m over a 32-month period following the application of nitrogen (400 kg ha⁻¹ as NH₄NO₃) and Br to potatoes followed by a second application (400 kg ha⁻¹ as NH₄NO₃) to ryegrass. Our sampling system consisted of an array of ceramic cups to sample soil solution and permeable silicone tubing chambers to sample soil gases. Soil N₂O concentrations increased following fertiliser application. Subsoil N₂O concentrations increased rapidly following rainfall and irrigation. Within days of NO₃ leaching below 1 m, high concentrations of N₂O, NO₃ and Br were observed at 7 m. Based on N₂O flux estimates and NO₃-N to Br ratios, almost all of the net N₂O production occurred in the subsoil above the gravel material (1 m depth). In the gravel matrix the NO₃-N to Br ratio did not change. Based on N to Br ratios, and NO₃ leaching estimates from drainage amounts and leachate NO₃ concentrations, 5 to 10% of the fertiliser and soil N appears to have been denitrified. There may have been localised net N₂O production between 1 m and 7 m but this contribution to the total amount of N₂O produced in the profile was small.



S06.01-P -33

PRODUCTION AND CONSUMPTION OF NO_x GASES IN SOILS OF EUROPEAN PART OF RUSSIA

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On the basis of long-term monitoring of N-containing greenhouse gases emission from soils of different ecosystems estimated of annual and seasonal fluxes of NO_x from the main soil types of European part of Russian Federation. It was found that the emission of NO_x gases from basic types of soils in Russia is carried out mainly in the form of N₂O, because of the limited ways of biological consumption. Other gaseous products (NO, NO_x) is easily assimilated by the microbial and plant biomass. Therefore, the intensity of the emission of NO_x gases from the soil usually did not exceed 20-27 µg N-NO/m² day. Among the environmental factors affecting the formation and absorption of N-containing greenhouse gases in soils, are soil moisture and organic matter content. The most intensive release of NO_x occurs when changing the moisture regime of soils (draining – wetting) due to increasing role of nitrifying bacteria in the formation of gaseous nitrogen oxides (NO and N₂O). It was concluded that low diversity bacterial complex in podzolic soil causes increased increases NO/N₂O ratio in products of denitrification. In the agricultural soils emission of greenhouse gases increases in a dose of nitrogen fertilizers, reaching the maximum level by using mineral fertilizer in the ammonium and amide forms, which is determined by the significant contribution of nitrifying bacteria in the formation of NO and N₂O.



S06.01-P -34

REDUCTION OF N₂O-EMISSION BY PYRACLOSTROBIN

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To mitigate the input of agriculture on global warming, a major task is the development of agents that reduce the production of greenhouse gas emissions, particularly nitrous oxide emissions, from soil. The fungicide pyraclostrobin (F500®) from BASF was tested at the University of Hohenheim on its N₂O-emission reduction potential. In addition, changes in biomass were studied after a spray application of pyraclostrobin to maize. A greenhouse study was carried out with wheat and maize using soil taken from the Ah horizon of an agricultural Cambisol. The pots were fertilized with 15 kg ha⁻¹ NH₄15NO₃. Three treatments were conducted 1) no further addition (Control, NF), 2) spray application of 250 g ha⁻¹ pyraclostrobin (NF+F500), 3) spray application of 250 g ha⁻¹ NI (NF+NI), (NI=commercial nitrification inhibitor). Gas samples were taken from all pots two times a week (11 times in total) using a closed-chamber system for the determination of N₂O emissions and the isotopic ratio of 15N/14N of N₂O. Soil samples were taken weekly for total N content. N₂O-emissions, isotopic ratio of 15N/14N of N₂O and N content in the soil had similar patterns over the same time in all treatments. During the first 5 days after the application, N₂O-emissions increased in all treatments due to fertilization. From day 5 to 25, cumulated N₂O-emissions in NF+F500 and in NF+NI were significantly lower ($p < 0.05$) than in the NF treatment. Overall, pyraclostrobin reduced N₂O-emissions from soil. In addition, pyraclostrobin enhanced plant biomass of maize up to 10 %.



S06.01-P -35

RELEVANCE OF DIRECT ORGANIC N-OXIDATION AS SOURCE OF NITROUS GASES (NO AND N₂O)

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Forest soils exhibit a variety of complex biochemical N reactions in which nitric oxide (NO) and nitrous oxide (N₂O) can be produced by coexisting processes which differently respond to environmental conditions. In general two biochemical processes, (i) oxidation of ammonia (nitrification) and (ii) reduction of nitrate (denitrification), are well-known to act as the major sources of nitrous gases. Besides the inorganic nitrogen substrates, also soil organic N compounds (Norg) have recently been reported to be oxidized and transformed into N₂O. During the last years triplet ¹⁵N-tracer experiments (TTE) have been developed and applied to allow a source-related quantification of N species which are simultaneously produced via the three known pathways. The influence of two different oxygen levels (21 and 2 vol.% O₂) on the NO- and N₂O-release of soil samples from 5 different Basque forest sites (Pine, New Plantation, Young pine, Young beech, Beech) was investigated. From each stand 9 soil samples were incubated: 3 treatments with ¹⁵N tracer in the pools NH₄⁺, NO₃⁻, and NH₄⁺ and NO₃⁻, respectively. The experiments have revealed that under oxic condition N₂O-production based on Norg was the dominant source. Under limited O₂-availability, the relative fraction of the Norg-pool strongly decreased, while the absolute N₂O-release from Norg increased concomitantly. In accordance with other studies, denitrification was the dominant process of soil N₂O release under limited O₂-availability (2 vol.% O₂). Concerning NO-emission, denitrification was the main source for both O₂-conditions.



S06.01-P -36

RESPIRATION OF OLD (C3) AND NEW (C4) CARBON IN A SWEDISH LONG-TERM FIELD EXPERIMENT USING ^{13}C CO₂ CAVITY RING-DOWN SPECTROSCOPY MEASUREMENTS

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We studied carbon dioxide (CO₂) fluxes in the Ultuna Long-Term Continuous Soil Organic Matter Experiment in Sweden, which was started in 1956 for studying the effects of different N fertilizers and organic amendments on crop production and soil fertility. This experiment has been cultivated with maize since 2000 introducing a distinct shift in the $\delta^{13}\text{C}$ -signature in the soil, which earlier had only received carbon inputs from C₃ plants. Measurements of CO₂ evolution and $\delta^{13}\text{C}$ signatures were conducted repeatedly in situ with the aim to estimate the contribution of new (C₄) and old (C₃) C to the total CO₂-flux throughout the growing season, and to evaluate the sensitivity of C pools of different origins and qualities to variations in environmental conditions. A bare fallow treatment was used as a control.



S06.01-P -37

RESPONSE OF SOIL WATERS TO CHANGES IN CLIMATE, NITROGEN DEPOSITION AND LAND MANAGEMENT IN AN ALPINE HEATHLAND

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This study assesses the interactive effects of N additions (0 and 10 kg Nha⁻¹yr⁻¹), simulated accidental fire, and climate change on soil solution chemistry. Results are presented from a 5 year experiment on a Calluna-dominated low-alpine heathland in the Scottish Highlands. Open top polycarbonate chambers (OTC) resulted in slightly drier conditions with average soil moisture of 0.556±0.003% for the control and 0.482±0.003% within the climate chambers. Temperature differences between plots with and without OTC's followed a diurnal cycle on most days with a maximum differential during the mid afternoon (1.6°C) and a minimum in the early morning close (~0°C). The main treatment effects were predominantly driven by the N treatment and to a lesser extent the burning and warming (OTC) treatments. Inorganic N, dissolved organic carbon and PO₄ in soil solution increased significantly in response to the N treatment. The nitrogen treatment also resulted in significantly higher SO₄ concentrations (26.8±1.61 µeq l⁻¹) compared to those plots without the N treatment (24.83±0.1.60 µeq l⁻¹) which is contrary to a previous study which focussed on a 50 kg ha⁻¹yr⁻¹ treatment. The OTC's resulted in statistically significant higher concentrations of SO₄ (28.14±1.83 and 23.50±1.38), and NH₄ (3.83±.67 and 2.65±0.43) compared to plots without the OTCs, and the burning treatment mirrored these results. These findings have serious implications for water quality particularly in areas where the recovery from the effects of acidification has been marginal. There is clear evidence that modest N loading and subtle changes in temperature alter biogeochemical cycling in sensitive habitats.



S06.01-P -38

SEASONAL DYNAMICS OF SOIL RESPIRATION IN SILVER BIRCH PLANTATIONS IN FREE AIR HUMIDITY MANIPULATION EXPERIMENT: A FAHM STUDY

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Soil respiration plays a critical role in regulation atmospheric CO₂ concentration. Water vapour concentration in the atmosphere, next to CO₂ and other greenhouse gases, is an important factor influencing global climate warming which in turn interacts with global and regional precipitation regimes. Hence, it is important to understand the processes controlling the CO₂ efflux between the forest soil and the atmosphere in changing climate. Our aim was to examine how manipulated humidity and other abiotic and biotic factors affect seasonal dynamics of soil respiration in silver birch (*Betula pendula* Roth) plantations. Soil respiration was monitored monthly from May to October, in 2008 and 2009 in three control and in three misting plots; soil temperature and soil moisture were measured simultaneously. Fine root and rhizome biomass of understorey was measured by soil cores. Soil microbial biomass and basal respiration were measured using Oxitop®, WTW. Soil respiration showed a typical seasonal pattern following the changes in soil temperature. Over two years soil temperature explained 56-75% of the variance of soil respiration. Significant differences between control and misting plots were revealed only in 2009; soil respiration was higher in control plots. The temperature sensitivity was greater in the control plots. In 2009 fine root and rhizome biomass of understorey was higher in misting than in control plots, however, photosynthetically active biomass was smaller in misting treatments. No difference was found in soil microbial biomass between control and misting plots, however, basal respiration was a fifth higher in misting than in control plots.



S06.01-P -39

SEASONAL VARIABILITY OF SOIL CO₂ FLUX AND ITS CARBON ISOTOPE COMPOSITION IN KRAKOW URBAN AREA, SOUTHERN POLAND

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Attempts to quantify the role of urban areas in the global carbon budget have been so far focused mainly on quantifying anthropogenic emissions of carbon dioxide. Studies related to biogenic CO₂ emissions were focusing mostly on characterization of soil CO₂ fluxes for different ecosystems. The presented work was aimed at assessing the impact of urban areas on atmospheric levels of CO₂ and to characterize carbon isotope signature of biogenic CO₂ fluxes on areas with varying degree of different anthropogenic impact. The soil CO₂ flux and its carbon isotope signature were measured on monthly basis during the period from July 2009 to October 2011. The measurements were performed at two locations within the metropolitan area of Krakow, representing different level of anthropogenic influence. Additionally, measurements of small-scale spatial variability of the soil CO₂ flux were performed at one site. The soil CO₂ flux was measured using a closed-chamber system coupled with Vaisala CARBOCAP sensor. The “Keeling plot” approach was applied to calculate carbon isotope signature of the biogenic CO₂ flux. The soil CO₂ flux at both sites reveals strong seasonal variation, as a consequence of natural biospheric activity cycle. The differences in the measured CO₂ flux between measurement sites were not correlated with the presumed degree of anthropogenic influence. During winter the differences between sites were negligible. No seasonal variability of carbon isotopic signature of soil CO₂ indicates that fossil-fuel CO₂ present in urban environment did not left measurable imprint on the carbon isotopic composition of soil CO₂ flux at the investigated sites.



S06.01-P -40

SIMULATION OF GREENHOUSE GASES AND SOIL ORGANIC CARBON STOCK CHANGES IN IRISH CROPLAND USING THE ECOSSE MODEL

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Agriculture and associated land-use changes contribute about one-third of global greenhouse gas emissions to the atmosphere. To enhance the value of national inventories, Ireland is considering the adoption of a process-based model. The ECOSSE model can simulate C and N emissions with limited data. In arable fields receiving different N rates, the modelled trends in N₂O fluxes are consistent with the measured values. The total difference between measured and modelled N₂O fluxes is large due to the impact of a few unexpected measurements. In the fertilized fields, significant correlation ($r=0.54-0.60$) between modelled and measured N₂O fluxes is observed, with RMSE of 18.6-20.8 g N ha⁻¹ d⁻¹. At N rates of 70-79 and 140-159 kg ha⁻¹, the sum of the measured N₂O losses taken over the crop-growth period amounted to 0.41 and 0.50% of the applied fertiliser, respectively. The simulated values taken on the measurement dates only were higher (0.69 and 1.11%), but this could be due to missed emissions associated with the sporadic timing of measurements. The simulated annual losses were closer to the summed measurements at 0.49 and 0.62% of applied N. The model estimated heterotrophic respiration of 4.0 t C ha⁻¹ yr⁻¹ and negligible CH₄ emission, which is consistent with values measured in a nearby field. The modelled SOC content showed an average loss of 1.06 t C ha⁻¹ yr⁻¹. Results imply that the model can reliably be used but further work is needed to fully determine the uncertainty in the estimates across land-use and soil types.



S06.01-P -41

SOIL CO₂ FLUX AND DECOMPOSITION FROM SOIL DISTURBANCE TREATMENTS AFTER CLEAR-CUTTING

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Soil disturbance, such as soil mixing, double humus layer and bare mineral soil, are common disturbances both after site preparation and removal of stumps during stump harvest. Wheel ruts and compaction of soil are other kinds of soil disturbance, caused by heavy machinery, where the risk for compaction increases when roots, stumps and branches have been harvested. Boreal forest soils contain much more carbon than the standing forest biomass. A disturbance of the soil can affect decomposition and therefore both the size of the soil carbon stock and CO₂ emissions to atmosphere. Soil-surface CO₂ flux (R_s) and decomposition of roots and needles were followed over three years in five treatments of different soil disturbance in a clear-cut in central Sweden. The treatments included heavy mixing of humus layer and mineral soil (M), exposed mineral soil (E), double humus layer (H), compaction (CM), and control (C). Each treatment was replicated four times. On each plot (2x2 m), measurements of decomposition and R_s were performed four times. Litter-bags containing needle litter and fresh roots (6 mm diameter) from pine were incubated in the plots in May 2009 to follow the decomposition rates. The litterbags were incubated in or on the soil, where the roots and needle litter would have been if they had been exposed to the treatment. Litterbags were collected in May and October from 2009 through 2011. Measurements of R_s were conducted in situ, together with temperature and moisture, two to four weeks apart.



S06.01-P -42

SOIL GREENHOUSE GAS FLUXES UNDER CONDITIONS OF CLIMATE-INDUCED DROUGHT AND HEAVY RAIN FROM AGRICULTURAL SOILS IN THE PANNONIAN AREA

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IPCC models for the development of the precipitation in the Pannonian area in Austria predict increasing drought periods due to an overall reduction of precipitation. The remaining amount of precipitation is thought to be concentrated to a few heavy rain falls. However, there is a lack of understanding of how altered precipitation and thus soil moisture regime affect changes in greenhouse gas (GHG) emissions and underlying processes. The objective of the present study is, therefore, to determine the effects of climate-induced droughts and heavy rain on GHG fluxes (CO₂, N₂O and CH₄). For this purpose, the GHG fluxes from three soils typical of the Pannonian area have been determined biweekly in a field trial with controlled irrigation using the closed-chamber method since spring 2011. The field trial is located at the lysimeter facility Hirschstetten, Austria, which consists of 18 backfilled gravitation lysimeters (six replicates per soil type). Three replicates of each soil type (calcic chernozem, calcareous phaeozem and gleyic phaeozem) are watered according to the precipitation pattern predicted for the period from 2071 to 2100 simulating drought periods and heavy rain events (variant D). The remaining nine lysimeters (control; variant C) are irrigated with respect to the 30 year mean of rainfall (amount and distribution) in Großenzersdorf, Marchfeld, Austria. First results of the field measurements indicate higher N₂O and CO₂ fluxes and increased CH₄ uptake rates in variant D compared to the control. No differences between the three soil types have been detected so far.



S06.01-P -43

SOME ASPECTS OF THE SPATIAL VARIABILITY OF N₂O EMISSIONS FROM AN AGRICULTURAL SOIL IN CENTRAL FRANCE

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Soil N₂O flux are affected by several soil variables such as temperature, water content and available mineral nitrogen and labile organic carbon. The complex interactions between these factors as well as soil heterogeneity result in large spatial variations in soil N₂O fluxes. Developing methodologies for quick spatial sampling of N₂O fluxes is thus of concern to improve our understanding of the variables controlling the heterogeneity of emissions. The main objective of this paper is to assess in a case study the spatial variability of N₂O fluxes at local and plot scales, to define methods for measuring the spatial variability of N₂O fluxes, determining its control factors and modelling it. A campaign was carried out in March 2011 in the Faux-Perche region in Central France. The plot had a gentle slope (1.6%) with hydromorphic loamy soils under winter barley. Soil N₂O fluxes were measured during two 1-day campaigns using a laboratory-built quantum cascade laser spectrometer coupled to a "fast box", i.e. a mobile closed chamber without base. During the first day, fluxes were measured in 7x4 points (150m along the main slope x 12m). On the second day, 48 measurements were made in a small area (2.4x3.2m) at the footslope to sample most (77%) of the selected surface. This sampling methodology enabled to study the spatial variability and control factors of emissions. No pattern was observed at the local scale but at the plot scale, fluxes showed a clear pattern along the main slope, related to soil moisture, nitrogen and carbon patterns.



S06.01-P -44

SUBTERRANEAN CO₂ FLUCTUATIONS UNDER DIFFERENT METEOROLOGICAL DRIVERS

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The subterranean CO₂ reservoir may play a key role in the global C cycle, but remains poorly characterized. In the vadose zone, CO₂ is stored in subterranean spaces, fluctuating from 0.04 to 13% by volume. Such CO₂ is ventilated to the atmosphere, affecting regional carbon budgets. Here we study how the vadose zone acts as a source or sink of CO₂, depending on the intensity of different atmospheric processes. We analyze continuous measurements of subterranean CO₂ molar fraction using GMP-343 sensors (Vaisala, Finland) in two carbonate ecosystems situated in Southeast Spain: (A) Llano de los Juanes in Sierra de Gádor and (B) Balsa Blanca in Cabo de Gata-Níjar Natural Park. At both sites, subterranean CO₂ storage changes according to different atmospheric drivers. Site A has two sensors, one in the soil (0.25 m) and another in a hole bored into bedrock (7 m). For both, high CO₂ fluctuations coincide with high turbulent wind speeds (friction velocities). Soil CO₂ accumulates (sink) during calm days but is released to the atmosphere (source) during windy days. Site B has sensors buried at 0.15, 0.5 and 1.5 m. Only the shallow sensor is affected by high friction velocities. However all sensors show fluctuations in CO₂ that correspond to varying atmospheric pressure. With increasing pressure, CO₂ is stored in the soil (sink) however with decreasing atmospheric pressure it is released to the atmosphere (source). These changes in the CO₂ can explained only by the ascension of deep subterranean air, richer in CO₂.



S06.01-P -45

THE IMPACT OF LAND MANAGEMENT TO THE EMISSION OF GREENHOUSE GASES

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Organic soils are the main source of Greenhouse Gases (GHG) outside the energy industry. At the same time organic soils represent various uncertainties into the global GHG-inventory. In this paper we estimate the impact of the common regional land management to the full GHG-balance of a Fibric Histosol and a Gleysol by determining the fluxes of carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O) in the region 'Upper Rhine Valley'(South-West Germany). The GHG-fluxes of the year 2010 were measured biweekly using the dynamic and the static chamber method. The highest annual CO₂-fluxes were measured on the forest - Fibric Histosol site with 624 kg C m⁻² y⁻¹ and on the conventional tillage - Fibric Histosol with 390 kg C m⁻² y⁻¹. In contrast to the tillage sites with 2,6 kg CH₄-C ha⁻¹ y⁻¹ the extensive used grasslands as well as the forest site typify with CH₄-fluxes of -0,4 to -2,3 kg CH₄-C ha⁻¹ y⁻¹ a methane sink of the landscape. The comparison of the tillages with the grasslands and the forest site shows, that the GHG-emission of the tillage - Gleysol exceeds all of them with 11,8 kg N₂O-N ha⁻¹ y⁻¹. The lowest annual N₂O-fluxes were measured on the grassland sites with 0,7 kg N₂O-N ha⁻¹ y⁻¹ on the Fibric Histosol and 0,7 kg N₂O-N ha⁻¹ y⁻¹ on the Gleysol. The findings suggest that anthropogenic used organic soils are important contributors to the overall terrestrial ecosystem GHG-flux.



S06.01-P -46

THE ROLE OF INTERNAL GAS TRANSPORT IN *JUNCUS EFFUSUS* FOR METHANE EMISSIONS FROM DRAINED PEATLANDS

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*Aerenchymatous plants adapted to waterlogged conditions often invade permanent grasslands with shallow groundwater. Aerenchymatous plants can transport methane from the soil to the atmosphere through their internal air-filled lacunae. A recent study monitoring greenhouse gas fluxes from agricultural peat soils in Denmark found consistently high methane emissions throughout the year from plots in grazed grasslands where tussocks of *Juncus effusus* were present. To investigate this further, we measured methane fluxes from four paired plots, with and without *J. effusus*, at three grassland sites on peat. Soil methane concentration profiles and water table depth were also recorded, and the tussocks of *J. effusus* were characterized during a growth season. In a related laboratory study experiment we quantified methane uptake and transport in *J. effusus*. We found evidence for methane production above the water table at all three sites. A diffusion barrier near the peat surface was apparent at one site where methane fluxes from plots with *J. effusus* were also higher, but in general at all sites seasonal dynamics in methane flux were more important than the presence of *J. effusus*. Laboratory experiments identified root tips and lateral roots as sites for methane uptake by the plants, whereas aboveground morphology was not important in controlling rates of transport. We conclude that aerenchymatous plants can affect methane emissions from poorly drained grasslands used by agriculture, but their importance depends on soil conditions at very local scale.*



S06.01-P -47

TREE SPECIES AND LAND-USE CHANGE EFFECTS ON CH₄ OXIDATION IN SOIL

Christiansen Jesper Riis^[1], G. Bárcena Teresa^[1]

^[1]University of Copenhagen ~ Forest & Landscape ~ Copenhagen ~ Denmark

Microbial activity drives methane oxidation in soils removing this strong greenhouse gas from the atmosphere. Agricultural practices can decrease or completely inhibit CH₄ oxidation in soils while afforestation of former cropland has been shown to increase the CH₄ oxidation capacity adding to the mitigation potential of this major land use change. However, knowledge on tree species effects on CH₄ oxidation in afforested soils is scarce. We performed an incubation experiment to study the CH₄ oxidation capacity of the top mineral soil for sites representing the transition from agriculture to afforestation based on monoculture stands of three tree species: pedunculate oak, European larch and Norway spruce at two age levels (1-2 and 4 decades). CH₄ oxidation in early stages after afforestation did not differ between tree species or from the agricultural soil. At later stages CH₄ oxidation capacity diverged under the different tree species. Spruce maintained the same potential as all the youngest stands, whereas the capacity in oak and larch stands increased. An earlier field study at the same site concluded that differences in CH₄ uptake could not be attributed solely to observed changes in soil physical characteristics, such as bulk density and water content during stand development. We hypothesize that the observed changes in CH₄ oxidation capacity instead are caused by different development of the soil methanotrophic community under the three tree species. Moreover, we aim to characterize the diversity and abundance of the methanotrophic community by molecular analyses and relate these data to the observed CH₄ oxidation rates.



S06.01-P -48

VALIDATION TO DAYCENT SOIL MODEL FROM EDDY COVARIANCE MEASUREMENTS.

Brilli Lorenzo^{*[1]}, Lugato Emanuele^[2], Gioli Beniamino^[2], Ferrise Roberto^[1], Bindi Marco^[1]

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It is widely accepted that the human perturbation of carbon (C) and nitrogen (N) cycles, underpins of much of long-term climate change (Canadell C.J. et Al., 2011). In this context, agriculture plays an important role as it can influence climate change through the release of GHGs (CO₂, CH₄ and N₂O) into the atmosphere, or it can contribute to their reduction by adopting strategies aimed at sequestering C into the soil and reducing N₂O emissions. With the widespread application of eddy covariance technology, long-term records of C fluxes between plants and atmosphere are becoming easily available. Up to now, most of the studies on C exchange were focused on forest ecosystems, while only few studies have been focused on long-term agro-ecosystems such as olive trees. However, the role that this crop can play in C sequestration cannot be neglected, especially in Italy where its cultivation is very widespread. Starting from these consideration, 2 years of eddy covariance measures were used to quantify the net ecosystem CO₂ exchange (NEE) of an olive orchard situated in Follonica (Tuscany; 42°55'N/10°45'E). Despite NEE showed positive values in correspondence to tillage events, the cumulated NEE indicated that olive orchard is a net C sink to 3,2 Mg/C ha⁻¹. NEE measures were coupled with site specific data (soil, climate, management, etc.) to calibrate the biogeochemistry model DayCent. The results suggested that the model could become a reliable tool for estimating the influences of agronomic management, soil and climatic on GHG emissions from olive orchards in Italy.



S06.02-P - SUSTAINABLE AGROECOSYSTEMS IN CLIMATE CHANGE MITIGATION

Monday 02 July 2012 from 17:00 to 18:30. Room Poster Areas

S06.02-P -1

RESPONSE OF SPRING WHEAT YIELDS TO CLIMATE VARIABILITY AND CHANGE

Elena Pivovarov, Barnaul - Russian Federation

S06.02-P -2

13C OF RESPIRED CO₂ FROM SOIL AND RESIDUE MIXTURES IN A COMPLEX AGROECOSYSTEM

Amanda Bichel, Waterloo - Canada

S06.02-P -3

DEVELOPMENT OF A SOIL HEALTH INDEX (SHI) BASED ON THE ECOLOGICAL SOIL FUNCTIONS FOR ORGANIC CARBON STABILIZATION. APPLICATION OF SHI TO DIFFERENT CROPPING SYSTEMS FOR VEGETABLES IN NORTHEAST ITALY.

Andrea Ferrarini, Venice - Italy

S06.02-P -4

ECOLOGICAL RESOURCES IN AGRICULTURAL FARMS: A CASE STUDY OF AGROECOSYSTEMS IN ALBANIA

Hysen Mankolli, Tirana - Albania

S06.02-P -5

FACTORS INFLUENCING THE NUTRIENT SIGNATURE OF POTATO CULTIVARS

Serge-Étienne Parent, Québec - Canada

S06.02-P -6

GIS DATA BASE AND METHODOLOGY FOR ESTIMATING IMPACTS OF CLIMATE CHANGE ON SOIL TEMPERATURE AND RELATED RISKS FOR AUSTRIAN AGRICULTURE

Erwin Murer, Petzenkirchen - Austria

S06.02-P -7

INFLUENCE OF INCREASES SOIL TEMPERATURE ON COMMUNITY STRUCTURE OF FUSARIUM SP. AND THE CORRESPONDING ANTAGONISTS

Jean Charles Munch, Neuherberg - Germany



S06.02-P -8

METHANE EFFLUX IN FLOODED SOIL IS AFFECTED BY RICE CULTIVARS

Leandro Souza Da Silva, Santa Maria - Brazil

S06.02-P -9

*ORGANIC CARBON ACCUMULATION IN VERTISOLS OF LOMBARDY (NORTHERN ITALY)
MANAGED UNDER CONSERVATION AGRICULTURE PRACTICES*

Stefano Brenna, Milan - Italy

S06.02-P -10

*SOIL BULK DENSITY EVALUATED BY X-RAY MICROTOMOGRAPHY FOR CARBON STOCKS
QUANTIFICATION*

Aline Segnini, São Carlos - Brazil

S06.02-P -11

SOIL NITROGEN TRANSFORMATIONS IN COMPLEX AGROECOSYSTEMS

Meaghan Wilton, Waterloo - Canada

S06.02-P -12

SOIL RESPIRATION AND QUALITY IN A REHABILITATED RIPARIAN ZONE

Maren Oelbermann, Waterloo - Canada

S06.02-P -13

USING ECO-CLIMATIC DIAGRAMS TO CREATE A MODEL FOR FORECASTING

Suleyman Sahin Ince, Bari - Italy



S06.02-P -1

RESPONSE OF SPRING WHEAT YIELDS TO CLIMATE VARIABILITY AND CHANGE

Pivovarova Elena^{*[1]}, Andresen Jeffrey^[2], Garkusha Aleksey^[3], Usenko Sergey^[3]

^[1]Altai State Agricultural university ~ Soil Science and Agrochemistry ~ Barnaul ~ Russian Federation ^[2]Michigan State University ~ Geography ~ East-Lansing ~ United States ^[3]Altai Research Institute of Agriculture ~ soil science ~ Barnaul ~ Russian Federation

The Altai Region of Russia ranks among the top five agricultural regions and produces about 40% of grain in the West-Siberian region. The most important crop, spring wheat, is produced on about 2.5 million hectares (68-70% of the total grain crops). One current concern in the Region is climatic variability and change and the potential resulting impacts on spring wheat. Analysis of climatological data from Altai during the past 50 years (1961-2010) suggests that mean temperatures during the May-September growing season have increased by 3.2°C, which was largely associated with warming during May and June. There were also changes in the seasonality of temperature, with increases of the duration of frost-free period by an average of 3 weeks. No significant trends were observed for growing season precipitation totals over the same period. In a statistical analysis of observed wheat yields, meteorological variables were found to be of relatively greater importance than technological variables. Highest yields (3.0-3.5 t/ha range) were associated with May daily average temperature of 13-14°C, and with June daily average temperatures from 16-17°C. Temperatures during the second half of the growing season were more weakly associated with yield. Growing season precipitation is a limiting factor throughout the whole growing season, with monthly optimum values varying from 40 to 100 mm per month. Highest wheat yields were associated with bare fallow and peas as preceding cropping options. The effects of fertility, basic tillage type, and level and type of pest control on yield were relatively small.



S06.02-P -2

13C OF RESPIRED CO₂ FROM SOIL AND RESIDUE MIXTURES IN A COMPLEX AGROECOSYSTEM

Bichel Amanda*^[1], Oelbermann Maren^[1]

^[1]University of Waterloo ~ Environmental and Resource Studies ~ Waterloo ~ Canada

With a growing population, it becomes increasingly important to sustainably produce food while reducing anthropogenic greenhouse gases. One example of a sustainable practice is intercropping, where two or more crops are grown on the same land area at the same time. This is considered to be a sustainable alternative to conventional practices as it promotes increases in diversity, nutrient retention, carbon sequestration and decreases in erosion and greenhouse gas emissions. Common intercropping practice is integrating legume and non-legume crops, such as soybean and maize. The intent of this study is to determine how effective C3 (soybean) and C4 (maize) plants are at sequestering carbon in intercropping systems. More specifically, it will compare characteristics of monocropped to intercropped soil by measuring changes in carbon and nitrogen dynamics using the $\delta^{13}\text{C}$ natural abundance method. However, little has been studied on soil organic matter dynamics within temperate intercropping systems. Soil samples were collected in the Argentine Pampa from four field treatments: sole maize, sole soybean, 1:2 and 2:3 (rows of maize:rows of soybean) and are being used in a six month long incubation. The objectives of this study are to quantify: i) $\delta^{13}\text{C}$ contribution from C3 and C4 plants to soil organic carbon, ii) microbial biomass and community structure, iii) carbon and nitrogen dynamics, and iv) greenhouse emissions from the soil. This study will contribute to knowledge of long-term carbon sequestration processes in complex agroecosystems, mitigate greenhouse gases and encourage utilization of sustainable cropping practices.



S06.02-P -3

DEVELOPMENT OF A SOIL HEALTH INDEX (SHI) BASED ON THE ECOLOGICAL SOIL FUNCTIONS FOR ORGANIC CARBON STABILIZATION. APPLICATION OF SHI TO DIFFERENT CROPPING SYSTEMS FOR VEGETABLES IN NORTHEAST ITALY.

Ferrarini Andrea^{*[1]}, Bini Claudio^[1]

^[1]University of Venice ~ Department of Environmental Sciences ~ Venice ~ Italy

There is a pressing need for quantitative soil health assessment to assist the sustainable management of agricultural soils, as it supports important ecosystem functions. The objective of this research was: 1) to develop a weighted Soil Health Index (SHI) based on soil functions with particular interest to carbon stabilization process; 2) to apply this method to vegetable production in agricultural areas of northeast Italy. We developed a Soil Health Index (SHI) based on the performance of six weighted soil functions (SF) (Biodiversity, Water movement and availability, Filtering and Buffering, Nutrient Cycling, Physical stability and support, Resistance and Resilience of SOC in aggregate-size classes). For each SF we selected from literature a Minimum Data Set (MDS) of physical, chemical and biological soil health indicators (total 18). SHI was evaluated at four agricultural sites involving different vegetable cropping systems (2 sites with organic farming, one in open field and the second on permanent raised beds, and two sites with conventional farming) within the floodplain of Venice area. Although all four management systems received high total soil health scores, the organic farming sites scored significantly higher ($p < 0.1$) than the conventional systems. The soil ecosystems with organic farming completely fulfills soil functions as biodiversity, nutrient cycling (biochemical transformations of C and N) and resilience and resistance function at a score near 1. Results indicated that the Soil Health Index proved an effective framework for evaluating the overall effects of different cropping practices on soil functions involved in organic carbon stabilization.



S06.02-P -4

ECOLOGICAL RESOURCES IN AGRICULTURAL FARMS: A CASE STUDY OF AGROECOSYSTEMS IN ALBANIA

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^[2]3Selcuk University, Engineering Faculty, 42003 KONYA-TÜRKIYE ~ Environmental Engineering Department ~ Konya ~ Turkey ^[3]2MIT Massachusetts Institute of Technology Cambridge, Massachusetts 02139, USA **echnology Cambridge, Massachusetts 02139, USA ** ~ Energy Engineering Department ~ Torino ~ Italy ^[4]3Selcuk University, Engineering Faculty, 42003 KONYA-TÜRKIYE ~ Environmental Engineering Department ~ Konya ~ Turkey

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Agro-ecological resources receive special attention in the effectiveness of the agricultural farm. Based on such, statistical methods and analysis of the study area Kashar, Tirane agro ecological resources, the central area of Albania, for the period 2009-2011 show that: Terrestrial ecological resources have a significant problem and a tendency to decrease in area; The case of converting the agricultural land in urban land is a serious threat to the farmers in the area; The eco kinetic resources present a priority in the area, especially those of solar lighting and precipitation; Resources of natural and cultivated flora should be revaluated because it results as an area of floristic resources of a special genetic and economic importance; The financial effectiveness of such productive resources may be higher because of the nearness with local urban markets; The growth of greenhouse-covered areas is a priority because it is simulated by the solar energy source; Models of agricultural layering are an important source of technology that takes priority. Effective opportunities to use environmental resources are numerous. They can become more efficient through simulating scientific, technological, economic and environmental coordination. Key words: agro-ecological resources, agricultural farms, production, technology



S06.02-P -5

FACTORS INFLUENCING THE NUTRIENT SIGNATURE OF POTATO CULTIVARS

Parent Serge-Étienne*^[1], Parent Léon-Étienne^[1]

^[1]Université Laval ~ Department of Soils and Agrifood Engineering ~ Québec ~ Canada

*Plant nutrient signature is influenced by genetics, soil and climatic variation, and physiological age at sampling time. However, comparisons between nutrient signatures are intrinsically biased, possibly leading to wrong inferences. Most biases can be avoided using adequate data transformation of compositional data, i.e. multivariate, inherently not normally distributed, scale-dependent and self-redundant. For example, a ternary K-Ca-Mg diagram made of 3 constrained nutrients has two degrees of freedom for modeling purposes. Isometric log-ratio transformations, that reduce D-part compositional vectors to D-1 orthogonal balances of components, can avoid numerical and physiological biases due to analysis of raw or simply log-transformed concentrations. The effect of physiological age on nutrient concentrations is minimized using proper balances. Our objective was to test the influence of annual and spatial variations on the nutrient signature of potato (*Solanum tuberosum* L.) cultivars. Our dataset comprised around 6300 compositional vectors of analytical data of the first mature leaf from top surveyed in southern Quebec across 40 cultivars, 4 physiological ages, 19 soil types, 14 locations and 24 years. We computed 3 ilr values by balancing N and P against K, N against P, and Ca against Mg. Discriminant analyses across cultivars, physiological age, soil type, location, and year showed overlapping nutrient signatures at the population level. However, means differed significantly between factor levels as shown by Tukey tests. The effect of yearly climatic conditions and soil type was relatively small on nutrient signature, indicating that the nutrient signature of potato cultivars was robust across a gradient of climate change.*



S06.02-P -6

**GIS DATA BASE AND METHODOLOGY FOR ESTIMATING IMPACTS OF CLIMATE CHANGE
ON SOIL TEMPERATURE AND RELATED RISKS FOR AUSTRIAN AGRICULTURE**

Murer Erwin^[1], Eitzinger Josef^[2], Krammer Carmen^[2]

^[1]Federal Agency for Water Management ~ Land use and land management ~ Petzenkirchen ~ Austria ^[2]University of Natural Resources and Life Sciences ~ Institut for Meteorologie ~ Vienna ~ Austria

The aim of the project is to develop a GIS data base, based on the Austrian digital soil map, which includes relevant developed soil physical properties for soil temperature simulations for the agricultural soils in Austria. Further, several soil temperature simulation approaches will be tested and compared, where the most suitable approach for GIS implementation will be calibrated and implemented in a GIS for agricultural soils. The established high spatial resolution data base will be a very important input source for impact models dealing with processes where the soil temperature regime plays a crucial role (dynamics of soil nitrogen, organic matter, soil chemical processes; Greenhouse gas emissions from soils; crop root growth and limitations; pest, diseases and weed development and risks, etc.). The application will be demonstrated for important pests at selected target regions. The CLIMSOIL project will improve the GIS data base of Austrian agricultural soils for a better simulation of soil temperatures based on the resolution of the Austrian digital soil map. This will help to better analyse soil temperature depending processes and phenomena such as pest development in the context of climate change.



S06.02-P -7

INFLUENCE OF INCREASES SOIL TEMPERATURE ON COMMUNITY STRUCTURE OF FUSARIUM SP. AND THE CORRESPONDING ANTAGONISTS

Astrid Bauer^[1], Karin Pritsch^[2], Munch Jean Charles^{*[2]}, Michael Schlöter^[1]

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Based IPCC models, climatic change will result in many regions of central Europe in increased temperatures in soil. However the consequences of warmer soil temperatures on microbial life in soil are poorly understood. Mainly questions addressing the influence on complex interactions pattern between plant – plant pathogens and the corresponding antagonists, which have the potential to act as natural biocontrol agents have not been studied so far. Therefore we focussed in our study on the consequences of increased soil temperature on phytopathogenic fungi of genus Fusarium, which are one of the most important pathogens on cereals worldwide, resulting in reduced crop quality and yield due to the contamination with different mycotoxins. Most of those mycotoxins are highly toxic to mammals and thermally stable. In addition we investigated response pattern of increased soil temperature of selected antagonists, including different Trichoderma species. Also questions related to changes in plant fitness and immune response have been addressed. Soils were taken from a lysimeter study where different soil types were incubated at ambient as well as with increased soil temperature (+3 °C) for more than 10 years and cultivated with summer wheat cultivar "Tybalt". Samples were analysed using realtime PCR for selected Fusarium species and T-RFLP for diversity of Fusaria in soil samples. Additionally expression of the keygene tri5 of an important mycotoxin was analysed. In the presentation first data from this study will be presented and discussed.



S06.02-P -8

METHANE EFFLUX IN FLOODED SOIL IS AFFECTED BY RICE CULTIVARS

Da Silva Leandro Souza^{*[1]}, Moterle Diovane Friere^[2], De Oliveira João Marcelo Santos^[3]

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Flooded rice crops contribute to soil methane emission because of anaerobic conditions after flooding. However, plants can affect methane emission from soil to atmosphere because: a) root exudates are subtracts to methane production, b) plant aerenchyma favors methane flux from soil to atmosphere, and c) oxygen in roots can improve methane oxidation to carbon dioxide. Thus, there is a soil methane efflux potential depending on morphological and physiological characteristics of the rice cultivar and it can be used to mitigate methane emission by flooded rice crops. Six plants of 19 rice cultivars (Avaxi, Inov CL, Arize QM 1003, BRS Querência, BRS Atalanta, BRS Taim, BRS Bojuru, Irga 422 CL, Irga 421, Irga 424, EPAGRI 108, SCS Tio Taka, SCS114, SCS 116 Satori, IAS Formosa, Bluebelle, Carnaroli, Koshihikari and Farroupilha) were cultivated in a greenhouse experiment using PVC containers with 7 kg of a lowland soil (Albaqualf). Methane emission evaluation was performed using a PVC chamber that was attached at the top of the container. The air samples were taken weekly after flooding on set, by sampling the air inside the chamber with a polyethylene syringe (20 mL), in four time intervals of five minutes each, and then analyzed by chromatography. The methane efflux dynamics were similar for all cultivars, but the cumulative emissions were different (range from 8.5 to 26.2 g m⁻²) and related to rice shoot dry matter production and plant height. Short plant rice cultivars with high yield can be used to produce rice with low methane emission.



S06.02-P -9

**ORGANIC CARBON ACCUMULATION IN VERTISOLS OF LOMBARDY (NORTHERN ITALY)
MANAGED UNDER CONSERVATION AGRICULTURE PRACTICES**

Brenna Stefano^{*[1]}, Rocca Alberto^[1], Sciaccaluga Marco^[1], Grandi Mauro^[2]

^[1]ERSAF Regional Agency for Agriculture and Forests of Lombardy ~ Regional Soil Service ~ Milan ~ Italy ^[2]AIGACOS ~ Italian Association for Conservative Land and Soil Management ~ Milan ~ Italy

Soil is the main organic carbon reservoir in the terrestrial ecosystems and represents the largest carbon sink over which we can have control. Soil organic carbon (SOC) is strongly responsive to modification through farming practices so that in many agricultural areas soils, that have declined their organic matter content over the past decades because of intensive exploitation, show a considerable capacity to regain a large amount of carbon under C saving management regime. SOC stored in the upper 30 cm of the Lombardy soils is about 130 millions of tons. Nevertheless, this pool is varying according to bioclimatic conditions, soil types and land use. SOC is low in particular on the Po Plain, where cropland shows a mean content of 57 t/ha. Thus, a research and technology transfer project (called "AgriCO2ltura") has been started to assess the capacity of Conservation Agriculture practices to draw carbon from the atmosphere into soils. Study sites have been indentified under different pedoclimatic conditions to compare long time zero tillage managed soils with conventional ploughed soils to accumulate and store carbon by acting as effective carbon sinks. The data achieved in the first area studied, characterised by clay soils with vertic features (Vertisols or Vertic Cambisols) and mean annual rainfall ranging from 750 to 850 mm/year, show SOC stored is higher than under traditional tillage agriculture by 46%. Field investigations will continue on coarser soils, in order to get data supporting the development of measures enhancing the carbon sink function of agricultural soils.



S06.02-P -10

SOIL BULK DENSITY EVALUATED BY X-RAY MICROTOMOGRAPHY FOR CARBON STOCKS QUANTIFICATION

Segnini Aline*^[1], Vaz Carlos M.p.^[1], Guastali Mathias D.^[2], Lasso Paulo R. O.^[1], Posadas Adolfo^[3], Cássaro Fabio A. M.^[4], Bernardi Alberto C. De Campos^[5], Milori Débora M. B. P.^[1], Martin Neto Ladislau^[1]

^[1]Embrapa Instrumentation ~ ~ São Carlos ~ Brazil ^[2]Centro Universitário Central Paulista (UNICEP) ~ ~ São Carlos ~ Brazil ^[3]Potato International Center ~ ~ Lima ~ Peru ^[4]Universidade Estadual de Ponta Grossa ~ ~ Ponta Grossa ~ Brazil ^[5]Embrapa, Southeast Cattle Research Center ~ ~ São Carlos ~ Brazil

Soil carbon stocks are important data for agriculture and environmental studies. Total carbon and soil bulk density are used for soil carbon stocks determinations and the bulk density has been traditionally determined by gravimetric methods. X-ray microtomography (micro-CT) has become advantageous to provide high resolution cross-sections images of an object, that later can be used to recreate a virtual 3D-model of the object. With wide application, the technique may be useful in the development of methodologies for evaluation of soil properties such as soil bulk density. However, beam hardening and the polychromatic nature of the used x-rays make it difficult to directly quantify the soil bulk density. In parts, this difficulty is avoided by filtering the emitted X-ray radiation of the micro-CT equipment using metallic filters. The objective of this study was to use microtomographic images to estimate the soil bulk density of three soils with different textures (clay, sand clay loam and loamy sand), collected at 0-10 and 10-30 cm depths. The obtained results were compared with bulk density values determined by the gravimetric method in oven dried (2 days at 105 °C) undisturbed soil samples (100cm³). Undisturbed soil samples were imaged with the SkyScan 1172 Micro-CT system using a copper-aluminum filter. Linear attenuation coefficients correlated linearly with the soil bulk density for each soil and the angular coefficient were associated with the mass attenuation coefficients. Such parameters are related to soil structure and can be very usefully in soil dynamic studies and soil carbon sequestration evaluations.



S06.02-P -11

SOIL NITROGEN TRANSFORMATIONS IN COMPLEX AGROECOSYSTEMS

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Land use change for agricultural production has contributed to the accumulation of greenhouse gases (GHG) and has negatively impacted soil nutrient dynamics. Nitrous oxide (N₂O) is a potent GHG produced simultaneously by nitrification and denitrification and is thus enhanced by anthropogenic nitrogen inputs. Utilizing stable isotopic ¹⁵N and ¹⁸O techniques allows nitrification and denitrification to be distinguished and for N₂O sources to be identified in various soil management practices. Research is currently conducted on corn-soybean monocropping and intercropping systems in the temperate climate region of the Argentine Pampa. The objective of this study is to compare each cropping system by obtaining carbon dioxide, methane, and nitrous oxide fluxes and by quantifying the nitrogen transformations using stable isotope N₂O partitioning techniques. Results from this research will be the first to use stable isotope techniques to investigate and compare nitrogen transformations in complex agroecosystems. Additionally, data collected will be related to baseline data since 2007 from the same research site. It is imperative to monitor changes of carbon and nitrogen dynamics in intercropping and monocropping systems to elucidate further differences between the treatments and to develop cropping strategies to mitigate GHG emissions.



S06.02-P -12

SOIL RESPIRATION AND QUALITY IN A REHABILITATED RIPARIAN ZONE

Raimbault Beverly^[1], Oelbermann Maren^{*[1]}, Gordon Andrew^[2]

^[1]University of Waterloo ~ Environment and Resource Studies ~ Waterloo ~ Canada ^[2]University of Guelph ~ School of Environmental Sciences ~ Guelph ~ Canada

The replanting of riparian zones with forest vegetation can improve water quality and may decrease CO₂ emissions. The objectives of this study were to quantify the effect of riparian rehabilitation after 25-years of tree planting (RH) on soil biophysical characteristics compared to a grass-forb riparian zone (GF) and a natural (undisturbed) forested riparian zone (NF). Total litter input (g m⁻²) from herbaceous vegetation and annual litterfall resulted was greatest in the GF, followed by the RH and NF riparian zones. Biomass carbon (C) and nitrogen (N) followed the same pattern. Soil bulk density was greatest ($p < 0.05$) in the RH. However, hydraulic conductivity, soil organic C (SOC), soil total N and the C/N ratio were significantly lower in the RH riparian zone. Soil CO₂ production rates were not significantly different between the three riparian zones. Soil CO₂ production rates were significantly negatively correlated with soil C/N and positively correlated with soil pH and litter input in all riparian zones. Soil CO₂ production rates were positively correlated with soil temperature ($r = 0.32$) and negatively correlated with soil moisture ($r = -0.48$). Of the three riparian zones, the NF exhibited the least amount of seasonal fluctuation for soil CO₂ production rates, soil moisture and temperature. Results from this study suggested that the RH riparian zone has not yet reached equilibrium with respect to soil characteristics and organic matter inputs after 25 years of rehabilitation.



S06.02-P -13

USING ECO-CLIMATIC DIAGRAMMS TO CREATE A MODEL FOR FORECASTING

Ince Suleyman Sahin^{*[1]}, Porcelli Francesco^[2], Verrastro Vincenzo^[3]

^[1]Università degli studi della Basilicata ~ DITEC ~ Bari ~ Italy ^[2]Università degli studi di Bari ~ Di.Pro.Ve ~ Bari ~ Italy

^[3]Istituto Agronomico Mediterraneo di Bari ~ Organic Department ~ Bari ~ Italy

Climate (from Ancient Greek klima) is commonly defined as the weather averaged over a long period of time, however climatology is the scientific study of climates. Wladimir Koppen published the first climate classification in 1868. Afterwards, Walter et al., (1976) divided the world in nine climatic zones. According climate classification, Walter Heinrich (1978) was created climate-diagrams and they became a model for forecasting. Today the idea of mapping and collecting climatic graphs of all the meteorological stations are accessible in a specific area and to compare different climatic regions in the world, in which vegetation is similar to one another. Values of climate-diagram maps are; mean annual temperature and precipitation, mean monthly temperature and precipitation, mean daily minimum temperatures of individual months and the absolute monthly minima, for stations in the tropics often also the mean daily maximum of the warmest month, the absolute maximum and the mean daily variation of temperature. For this purpose, GIS (Geographical Information System) will be used in finding the similarities between regions. This will show, the effects of climate on soil and plant relations (such as fertility, growth mechanism... etc.). In addition, the model will be used for taking strategic decisions for long term planning such as: selection of crops and livestock, forest species introduction and moreover scheduling agricultural operations such as; planting and pest control. Keywords: Climate, GIS, Climate-Diagram and Mapping



S06.03-P - SOIL FUNCTIONS IN A CHANGING CLIMATE - RECENT INSIGHTS FROM FIELD EXPERIMENTS

Tuesday 03 July 2012 from 17:00 to 18:30. Room Poster Areas

S06.03-P -1

AFFORESTATION AS A WATER-SAVING ALTERNATIVE LAND USE FOR SALINE CROPLANDS IN THE LOWER REACHES OF THE AMU DARYA RIVER, CENTRAL ASIA

Tilman Schachtsiek, Bonn - Germany

S06.03-P -2

CHANGES IN EXTRACTABLE ZN, CU, K AND NA AS AFFECTED BY SILICON, SALINITY AND WATERLOGGING IN A SANDY LOAM SOIL

Jahanshah Saleh, Tabriz - Iran, Islamic Republic of

S06.03-P -3

CONSEQUENCES OF THE COMBINATION OF FREQUENT WILDFIRES AND DRYING-REWETTING EVENTS ON THE SOIL MICROBIAL FUNCTIONS IN A MEDITERRANEAN AREA

René Guéron, Reims - France

S06.03-P -4

DETERMINING HALOPHYTES ECOLOGICAL DRIVERS IN TIDAL WETLAND SOILS FOR SUSTAINABLE PRODUCTION IN ABANDONED SALTPANS

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Andrew Baker, Adelaide - Australia



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AFFORESTATION AS A WATER-SAVING ALTERNATIVE LAND USE FOR SALINE CROPLANDS IN THE LOWER REACHES OF THE AMU DARYA RIVER, CENTRAL ASIA

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Soil salinization in the lower reaches of the Amu Darya River, Central Asia, resulting from shallow, saline groundwater tables reduces cropland productivity and, in the absence of reclamation leaching, leads to land abandonment. Climate change is predicted to decrease the irrigation water availability in the region, underlining the need for water saving land reclamation practices. Certain tree species are more salt tolerant than annual crops grown in the area and after initial irrigation could rely on groundwater alone. Thus, afforesting abandoned croplands with well-adapted tree species could save water while providing marketable products and sequestering carbon. To study tree species suitability for afforestation, experimental plantations of six species were established on two deserted cropping sites. Both sites showed soil nutrient deficiency, high soil salinity (10-12 dS m⁻¹) and saline groundwater (2-5 dS m⁻¹), but differed in soil texture (silty loam: site1 and loamy sand: site2) and depth to the groundwater table, fluctuating between 0.6 and >2.8m (site1) and 0.2 and 1.4m (site2). Tree survival and carbon sequestered in biomass were assessed during two years following afforestation. Under deficit irrigation (~150mm yr⁻¹), four of the six species showed survival rates ranging from 85- 90% (site1) and 32-76% (site2). Higher survival rates were observed on silty loam with deeper groundwater. *Elaeagnus angustifolia* was most promising, combining the highest survival rates (76-90%) with highest biomass increments of 2533 and 1033kg ha⁻¹yr⁻¹ hence most carbon sequestered. *Populus euphratica* and *Salix nigra* showed survival rates <20%, proving their limited suitability for saline afforestation.



S06.03-P -2

CHANGES IN EXTRACTABLE ZN, CU, K AND NA AS AFFECTED BY SILICON, SALINITY AND WATERLOGGING IN A SANDY LOAM SOIL

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Effects of silicon, salinity and soil moisture on changes of extractable Zn, Cu, K and Na concentrations were studied on a sandy loam calcareous soil in a laboratory experiment. The experiment was arranged as factorial based on completely randomized design with three replications. Treatments consisted of silicon (8 and 200 mg kg⁻¹ soil), salinity (0.46 dS m⁻¹, 8 dS m⁻¹ as NaCl, 8 dS m⁻¹ as salts combination), soil moisture regime (-20 kPa, waterlogged) and incubation time (0, 7, 30 and 45 days). Determination of acetic acid extractable Zn, Cu, K and Na was carried out after 0, 7, 30 and 45 days. Waterlogging caused a significant decrease in Zn and Cu and an increase in K concentrations, but no change was observed in Na content. Soil salinity decreased extractable Zn and Cu, showing no significant difference between mixed-salts and single-salt treatments. In contrast, salinity enhanced acetic acid extractable K and Na levels. Increase in K concentration was statistically higher in mixed-salts treatments, whereas higher Na content was observed in NaCl treated soils. Silicon addition did not affect soil extractable Cu, K and Na, but decreased Zn concentration. It was concluded that Zn and Cu fertilizers should be applied in sufficient amounts to waterlogged and/or saline soils to prevent their deficiencies in plants. Furthermore, K over-fertilization must be avoided in waterlogged soils, because of high concentrations of potassium under such conditions. Decreasing effect of silicon fertilization on soil extractable Zn should also be considered for accurate fertilizer recommendations.



S06.03-P -3

CONSEQUENCES OF THE COMBINATION OF FREQUENT WILDFIRES AND DRYING-REWETTING EVENTS ON THE SOIL MICROBIAL FUNCTIONS IN A MEDITERRANEAN AREA

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Mediterranean basin is expected to suffer the largest due to climate change. Recently, Mediterranean climate has been marked by a significant decrease in precipitations in summer and an increase in extreme events such as heat waves and drought favouring wildfire frequency. Frequent wildfires affect post-fire recovery of soil microbial activities and, consequently affect some ecosystem processes such as turn-over of SOM, nutrient availability, soil C storage and also plant productivity. The purpose of this study was to assess the stability (i.e. resistance and resilience) to 1 and 4 successive drying and rewetting cycles (D/RW) of broad (basal and substrate induced respiration, alkaline phosphomonoesterase and FDA hydrolases) and narrow processes (catabolic profiles and cellulase activities) driven by soil microbes when soils have previously suffered from frequent wildfires with both short and long time since fire. At resistance time, we found that a single D/RW cycle increased the soil microbial respiration by mechanism of apparent priming effect mainly attributed to a loss of 20% microbial active biomass. Contrariwise, 4 D/RW immediately brought back this activity at the initial state with a significant loss of catabolic capabilities. This loss was revealed by a significant change in catabolic profiles simultaneously with a decrease in almost all C-substrate utilisation, especially in frequent and recent wildfire regime. The stimulation of alkaline phosphomonoesterase both at short and long term indicated an increase in phosphorus demand for soil microbial communities in frequent wildfire regime when submitted to 4 D/RW cycles.



S06.03-P -4

DETERMINING HALOPHYTES ECOLOGICAL DRIVERS IN TIDAL WETLAND SOILS FOR SUSTAINABLE PRODUCTION IN ABANDONED SALTPANS

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Reserva Natural de Castro Marim e Vila Real de Santo António (RNSCMVRSa) is a natural reserve located over alluvial soils, including the tidal area of lowland Guadiana River (SE Portugal). Tidal marsh ecosystems present great ecological importance but have suffered intense anthropic disturbance, namely hydrologic alterations and vegetation removal to gain soils for agriculture and salt intensive production. On the other side, traditional salt production has been declining so that many saltpans are currently abandoned in the RNSCMVRSa area. This study aimed to characterize the halophyte flora ecology in the RNSCMVRSa tidal marsh in order to implement, afterward, a sustainable cultivation of autochthonous halophyte plants, with economic value, in the abandoned saltpans and degraded rangelands. This project will promote the environmental requalification, will provide an economic alternative for local populations, and will allow the reduction of unregulated harvest of halophyte plant populations. Field sampling strategy included a preliminary survey of local vegetation diversity aiming at identifying potential target species. A second step addressed an abiotic/biotic characterization of halophyte target species natural habitat in order to elucidate the main ecological drivers of their presence and abundance. Water level monitoring, chemical analysis of soil and water, and floristic inventories of plant communities were realised during a whole year cycle. Among the surveyed flora, eight autochthonous halophyte species with economical potentialities (human and animal feed, pharmacy) were identified. These species display different life forms, phenology and habitat preferences allowing their cultivation in soils with different degree and frequency of salinity and water saturation.



S06.03-P -5

EFFECT OF LAND USE ON SOIL NUTRIENTS

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To understand impacts of climate and land use changes on biodiversity and accompanying ecosystem stability and services at the Mt. Kilimanjaro, detailed information about the soil nutrient status and fluxes are needed. Therefore, main nutrients and typomorph elements (C, N, P, K, Mg, Fe, etc.) as well as the cation exchange capacity and soil pH will be quantitatively described on pedon depending on land use (natural vs. agricultural ecosystems) and climate (altitude gradient). Total and available pools of the elements will be quantified in litter and soil for different dominant ecosystems (e.g. maize fields, coffee plantations, lower montane forests, homegardens). The linkage between soil nutrient status and input via litter in the respective ecosystems will be investigated. Nutrient contents of the different land use type will be compared with the conversion of natural ecosystems to agriculture as well as to the changing plant diversity. A comparison of all investigated ecosystems should provide a better understanding about the change from natural to agricultural land as well as further land degradation.



S06.03-P -6

EFFECTS OF A 13-MONTH EXPERIMENTAL DROUGHT ON THE PARTITIONING OF NUTRIENT AND ORGANIC MATTER FLUXES IN A COCOA AGROFOREST IN CENTRAL SULAWESI, INDONESIA

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*The effects of drought disturbances on water-bound nutrient transport and replenishment and consequently on the functions and services of agro-forestry ecosystems in the perhumid tropics are still imperfectly understood. To test the impact of a 13-month drought on the throughfall and leaf litter fluxes, availability and soil stocks of C, N and P compounds, a replicated throughfall exclusion experiment was performed in a cocoa (*Theobroma cacao* L.) agro-forestry system in Central Sulawesi, Indonesia. Under control conditions input fluxes of dissolved C, N and P species with throughfall amounted to 6, 25 and 61% (or 208, 42.6 and 14.6 kg ha⁻¹ a⁻¹, respectively) of the above-ground litter plus throughfall input. The rain reduction by about 80%, realized by the installation of large roofs beneath the canopy, exhibited a drastic change in the partitioning of these input fluxes to the ground to 2, 8 and 26 % (or 48 kg C, 9.6 kg N and 2.6 kg P ha⁻¹ a⁻¹, respectively). Under drought conditions, the mean turnover time for the litter layer increased from 0.7 to 1.2 years accompanied by an increase of C, N and P pools stored in the litter layer. However, corresponding topsoil pools diminished over time, likely due to the reduced matter input with throughfall and diminished amounts of litter leachates. In the subsoil no drought-induced effects on element soil stocks became notable. The significance of throughfall fluxes for the re-distribution of water-bound nutrients pinpoints the vulnerability of this element pathway towards altered climatic conditions especially droughts.*



S06.03-P -7

ELEVATED CO₂ AND WARMING ALTER THE SOIL MICROBIAL COMMUNITY'S ABILITY TO DECOMPOSE LITTER

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Global change could alter ecosystem nutrient cycling in terrestrial environments by altering litter quality and soil microbial function, both of which are important in determining decomposition rates. However, no experimental work has investigated global changes, such as elevated CO₂ and warming, influence the two main controllers of decomposition rate, namely litter quality and microbial function independently. We conducted reciprocal transplant experiments using a native grassland community that has been subjected to both elevated CO₂ and warming to separate the effect of manipulations-induced changes in litter quality from changes in the soil microbial community on litter decomposition. We found that the manipulation-induced changes in soil microbial function had far greater influence on litter decomposition, irrespective of litter source. Experimental effects on litter quality were slight compared to the changes in microbial community function. We concluded that changes in the soil microbial function are likely to have a pronounced impact on litter decomposition in this grassland community under global change with consequences for ecosystem C storage and nutrient cycling.



S06.03-P -8

FUTURE CLIMATE IMPACTS ON WATER DYNAMICS OF YOUNG MINE SITE

AFFORESTATIONS-MODELLING REGIONAL LEVEL EFFECTS IN EASTERN GERMANY

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The Lusatian Lignite District is one of the most climate-sensitive regions in Central Europe. A negative climatic water balance, a very low water availability of sandy rec-lamation soils, weather episodes with annual precipitation <400 mm and warm summer intermezzos cause increment depressions and ecosystem destabilization. It is now to consider the effects of climate alterations on future soil moisture conditions and ecosystem hydrology. At regionalization global climate scenarios the downscaling models WETTREG, COSMO-CLM and REMO are used. After retrospective validation of model runs current and future water budgets of young Scots pine and Sessile oak stands are simulated. Towards the end of 21st century a significant increase in annual mean temperature by 2.4 °C to 3.4 °C and an extension of vegetation period by 33 days is predicted. In the worst case scenario there is a reduction of annual rainfall up to (-30 %). On the other hand, annual precipitation shifts by trend from the vegetation period into the winter half year. Changing climate has strong impacts on soil and ecosystem water balance. Thus, mean evapotranspiration of pine stockings increases in the remote future, expected deep percolation decreases. For oak forests lower evapotranspiration and interception are estimated, so that ground water recharge remains higher. Since boreal Scots pine comes out quite heat-sensitive, we suppose a high vulnerability to climate change. Stand conversion to site-adapted and more heat-tolerant Sessile oak mixed forests will probably enhance ecosystem stability but also reduce pressure on water-shed due to higher soil water fluxes.



S06.03-P -9

GENESIS AND AMELIORATION OF SODA-SALTED SOILS

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The soda-salted soils are widely spread on Earth. The genesis of these soils is caused by underground alkaline waters from the foothills of Caucasus, by natural and artificial desalting of territory as well. An alkalinity of soda-salted soils is caused for 80-95% by carbonates, 10-15% by organic soil substances, 3-5% by sulfates and depends on nature of carbonate calcium equilibrium (CCE). The nature of CCE determines the soda-resistance of soil. The samples of soils deferred one from another on hydrological regime mode, humus content, absorbed ions composition, salting type were studied. Thermodynamic approach and corresponding coefficients to determine the influence of CCE on soda-salted soil and "supersaturation" of soil with soda were proposed. In solonetz soil the product of CaCO_3 solubility in situ $S \sim 5 \cdot 10^{-8} \dots 5 \cdot 10^{-6}$ is much higher than thermodynamic product of CaCO_3 solubility $S_0 = 4,8 \cdot 10^{-9}$. Real soil solution is seemed to be "supersaturated" with CaCO_3 . It was revealed that degree of "supersaturated" is caused by: ion association – 3,3-48,8 times; high value $\mu=0,8-1,2$ of highly mineralized soil solution of solonetz – 15-30 times; ion complex with organic matter – 1,5-1,98 times. Thus soil solution of steppe solonetz is not "oversaturated" with CaCO_3 indeed. But under excessive humidifying conditions of soda formation in soil appears to be real. Essence and stability of CCE is the key to understand genesis of soil soda in every special biogeochemical conditions of soil formation.



S06.03-P -10

IS FUNCTIONAL DIVERSITY OF SOIL FUNGI MORE LINKED TO ABOVE-GROUND VEGETATION OR TO SOIL PHYSICOCHEMICAL PROPERTIES?

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Plant species composition is currently changing in grasslands due to anthropogenic drivers such as land management, pollution or climate change. These above-ground changes may affect below-ground soil microbial communities through modifications in litter quality and root exudates. Below-ground fungi drive key ecological processes, playing an important role in nutrient uptake by plants. Thus, links between above and below-ground communities is not only of ecological interest, but also economic (i.e., grass production). This study focuses on the functional diversity and activity of soil fungi in temperate grasslands and their relationship with both vegetal and soil physicochemical properties. To this aim, we carried out repeated grid samplings in a temperate grassland of Urdaibai Biosphere Reserve (Basque Country, Spain). In each square, we quantified in situ the plant species richness and grass production. For soil analyses, composite samples (0-10 cm depth) were taken from each square and their texture, humidity, chemical (pH, OM, CEC, N, P, K, Ca) and fungal properties (from Biolog FF PlatesR) were determined in the laboratory. Contrary to that we a priori expected, functional diversity of soil fungi was negatively correlated with plant diversity. It is due to the fact that, in general terms, potential activity and functional diversity of soil fungi appeared to be linked to soil fertility, while most fertile-productive plots were dominated by a minor number of vigorous plant species. In fact, plant diversity showed significant negative correlations with grass production and, concomitantly, soil fertility parameters (OM, N, K, Ca and humidity).



S06.03-P -11

MONITORING DROUGHT EFFECTS ON SOIL STRUCTURE AND HYDROLOGICAL SOIL FUNCTIONS

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Soil structure responds to changing climate (in particular drought) conditions, mainly due to shrinkage and fracturing of soil aggregates. Soil structure is also closely linked to the activity of soil microbiota and plant roots, which modify pathways along roots, water repellence and organic matter of soils. This study gives an overview of our drought experiments, in which we test the following hypotheses: (i) drought causes a change in soil structure, which affects hydrological soil functions (water infiltration, uptake and redistribution); (ii) changes in rooting patterns and microbial community composition, in response to drought, influence the hydrological soil functions. We established adaptive roofing systems which allow a flexible reduction of the precipitation in order to achieve the long-term minimum precipitation of a site. The effects of the imposed drought on soil structure and hydrological soil functions are monitored in repeated measuring/sampling campaigns over a period of three years. We present first measurements of the various experiments, which we designed for analyzing pore architecture and related flow and transport behaviour. These experiments include sprinkling experiments with a dye tracer, a combination of inflow-outflow experiments with stable isotope (2H , 18O) enriched water and computed tomography at soil monoliths ($\sim 70\text{ l}$) and multi-step outflow experiments at 100 ml soil cores. Finally, we sketch our idea how to relate the observed temporal changes of soil structure and hydrological soil functions to the observed dynamics of hydrometeorological site conditions, soil moisture and desiccation as well as changes in rooting patterns, herb layer and soil microbiotic communities.



S06.03-P -12

NITROGEN AND MICROBIAL DYNAMICS IN TWO PORTUGUESE FLOODED RICE SOILS

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*Rice is the most important food crop in the world and staple for more than half of the global population. Portugal is the fourth largest European rice producer, contributing to the 5.3% of the total production, and is the first rice consumer per capita. The cultivation of rice in Europe is mainly by flooding. The water logging helps to control soil temperature, weeds and crop pests. The anaerobic conditions in these soils influence residue and nutrient management, mainly nitrogen (N). In 2011, we evaluated the soil dynamics of N and microbial activity in two contrasting paddy rice open fields at Salvaterra de Magos (central Portugal). We also evaluated the influence of increased atmospheric carbon dioxide concentration and temperature in open chambers. Nitrate was significantly higher in the lighter soil, whereas in the heaviest soil, the inorganic N was only significantly higher in the higher-temperature-chambers. Soil mineral N increased significantly after flooding to the grain filling stage. Soil pH was significantly higher in textured soil (pH=5.90) and increased during the growth cycle by 0.27 units, but did not vary with depth (pH=5.85). Surface water in open fields contained in general residual amounts of inorganic N. The anaerobic condition potentially promoted some nitrification in the 0-15 cm layer after 5. A significant model ($R^2=0.66$, $p=0.01$, $n=72$) was obtained for the potential N mineralization using the Levenberg-Marquardt algorithm [$N_{min}=66.14 * (1-e^{-0.28t})$]. Dehydrogenase and β -galactosidase activity increased immediately after residue incorporation in soil and water logging, and decreased thereafter until the end of flooding.*



S06.03-P -13

PREDICTION OF THE EFFECTS OF CLIMATE CHANGE ON THE SOIL SALINITY OF AN IRRIGATED AREA UNDER MEDITERRANEAN CONDITIONS

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Soil salinization in irrigated areas is a degradation process that harms both crop productivity and environment. According to current predictions the climate change in the Mediterranean region will be accompanied by changes in the precipitation patterns and increases in the average temperatures. These new conditions could affect the soil salt build-up due to a decrease in the salt leaching ability of rainfall and because of an increase of the evapotranspiration. Regional simulations of the effects of climate change on soil salinity are necessary. The process-based model SALTIRSOIL was fully integrated within a Geographical Information System-GIS framework to simulate the salinity of an irrigation district 20 thousand ha wide in SE Mediterranean Spain. Four scenarios were simulated: i) present climate conditions, ii) climate change featured by a different precipitation pattern and higher temperatures than nowadays, iii) same conditions than in scenario ii but with 10% increase in the irrigation rates, iv) same conditions than scenario ii but with 20% increase. The soil average electrical conductivity (EC25) increased 14% in the climate change scenario (ii) regarding the present climatic conditions (i). Nevertheless an increase of 20% in the irrigation rates could practically offset the effects of climate change on soil salinity. In those areas irrigated with low saline water ($EC_{25} < 1.3 \text{ dS m}^{-1}$) the soil salinity did not significantly increased under the climate change conditions. The GIS-SALTIRSOIL is a useful tool to assess the effects of water quality and present and future climate conditions on the soil salinity of large areas.



S06.03-P -14

ROADSIDES IN URBAN AREAS OR IN THE OPEN LANDSCAPE ARE SECONDARY HABITATS

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The most important species of road verges is Weeping alkali grass (*Puccinellia distans*), which was found along all class roads in the Czech Republic. It forms lines of 0.25-0.35m width close to the asphalt edges and to the median stripe. It is annual halophyte species that has peak of vegetation in June. Then, these mono-species lines are modified by the new dominant species in August. Mainly, they are Large crabgrass (*Digitaria sanguinalis*) or Smooth crabgrass (*D. ischaemum*) in the open landscape and in the cities. Roadside species, growing in same places with Weeping alkali grass, are likely to be salt tolerant. This hypothesis began to be tested in a targeted greenhouse experiments in salt soil condition (NaCl concentration 0%, 0.12%, 0.25%, 0.50%, 0.99%, and 1.96%). The experiment confirmed the successful growth and development of Large crabgrass and Barnyard grass (*Echinochloa crus-galli*) in soil contaminated with salt (NaCl 0.12%). The growth inhibitive effect was found in soil with NaCl concentration more than 0.12%, but both species were able to produce flowers and seeds. The verges closes to the asphalt part of the roads, although contaminated by a spreading of the salt, are a suitable habitat for occurrence of these species and their spreading into agriculture landscape. This research was supported by grants OC10032 and LD11040. Author has been in cooperation with the COST Actions FA0901 and TU0902 .



S06.03-P -15

SOIL CARBON STOCKS IN THE FOREST SECTOR OF JAPAN AND THEIR DETERMINING FACTORS

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To evaluate the carbon balance in forest lands, carbon stock in soil pool should be clarified. We thus determined soil carbon stocks (0-30 cm depth) in 2,404 plots over the forest sector in Japan. A 0.1-ha circular plots were set in one fifth of the 4 km × 4km-grid points over the forest area. In each survey plot, gravel content was estimated by visual judgment, and soil samples for chemical analysis and for bulk density were sampled at 0-5, 5-15, 15-30 cm depths with four replicates. Soil carbon concentrations were measured by combustion method. Soil carbon stock was high in the plots around volcanic area, but low in Setonaikai area, where the organic matter had been removed in an anthropogenic way. This indicates that volcanic ash content and anthropogenic disturbance influence the carbon accumulation in forest soil. Moreover, we confirmed that soil carbon stock was varied with geographical characteristics: soil carbon stock increased with altitude and decreased with inclination.



S06.03-P -16

SOIL INORGANIC CARBON STOCK OF ITALY

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Calcium carbonate forms the largest part of soil inorganic carbon that influences CO₂ fluxes. Pedogenetic calcium carbonate may constitute a significant part of the total stock, in relation to the dynamic of the soil forming factors. This paper presents a model to evaluate the CaCO₃ stock using a national soil geodatabase. Estimation of inorganic carbon storage and spatial predictors of CaCO₃ are presented for the whole Italian territory at different depth, with spatial resolution of 1 km. Four separated multiple linear regression (MLR) models were worked out to determine the most powerful set of predictors for the occurrence of soil CaCO₃ content. They were related to site features (climatic regions, morphology, geology and land use), temperature and its derivatives, precipitation and its derivatives, and soil physical characteristics (texture and hydrological group). The final model resumed the four linear models and the resultant map was used as a trend surface. The evident spatial dependence of the residuals suggested the use of regression kriging as best spatialization technique to create a prediction map. The model explained 40% and 41% of total variance for the 0-50 cm and 50-100 cm depth respectively. In particular, the climatic variables explained 14% of variance for 0-50 cm and 17% for 50-100 cm. The amount of CaCO₃ accumulation was mainly driven by seasonal rainfall variations and by soil hydrological group, followed by geology, land use, and precipitation - evapotranspiration balance. The model allowed an estimation of the calcium carbonate content of Italian soils at the year 2080.



S06.03-P -17

**TEMPERATURE EFFECTS ON VARIOUS FOREST LITTER DURING THEIR DECOMPOSITION
ALONG MOUNTAIN ELEVATION GRADIENT.**

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Temperature is one of the most important factors affecting soil organic matter decomposition processes. Mountain areas with vertical gradients of temperature and precipitation provide an opportunity to observe climate changes similar to those observed at various latitudes and may serve as an approximation for climatic changes. The aim of the study is to estimate the effect of such changes on the decomposition processes of litter originating from stands at three altitudes (600, 900, 1200 m a.s.l.) in the Beskidy Mts in southern Poland, incubated at each of these altitudes in litter-bags. The experiment was established during the fall 2011 and some preliminary results are presented here, including comparisons of decomposition rates, changes in chemical composition and organic matter thermal sensitivity as well as their microbial characteristics (activity, biomass, functional and taxonomical diversity) measured in laboratory. We expect, that changes in organic matter thermal sensitivity and their microbial characteristics will strongly depend on initial litter features and climatic conditions (elevation) (see Niklinska and Klimek 2007; Klimek and Niklinska 2010; Niklinska and Klimek 2011). The study is founded by the Polish State Committee for Scientific Research (Grant 0594/B/P01/2011/40).



S06.03-P -18

TEMPORAL VARIATIONS IN RE-FLOODED ACID SULFATE SOIL ENVIRONMENTS AROUND LAKES ALEXANDRINA AND ALBERT, SOUTH AUSTRALIA

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Recent prolonged drought in south-eastern Australia caused significant drying of wetlands in the Murray-Darling Basin, including the RAMSAR listed Lakes Alexandrina and Albert at the lower end of the Basin. A combination of decreasing water levels and gently sloping near-shore lake beds caused large expanses of subaqueous acid sulfate soils (ASS) to be exposed. The resultant formation of sulfuric material ($\text{pH} < 4$) and strongly acidic surface mineral efflorescences, led to serious concerns over water quality, ecological and public health issues. From early 2010, increased rainfall and inflows to the Basin caused the inundation of these sulfuric soil materials that had formed along the previously dried margins of the Lakes. The impact on surface water pH over most of the Lakes was not significant, but locally (> 200 ha), rewetting of ASS led to severe surface water acidification ($\text{pH} < 3$) and metal release. Inundation promoted the onset of reducing conditions in shallow soil materials over much of the Lake margins, but sub-surface soils at depth have remained strongly acidic in many areas. Where reducing conditions do occur, sulfate reduction has been important in generating alkalinity and leading to the formation of sulfide minerals that will help to increase soil pH and reduce metal concentrations previously released during the drying phases. The recovery of the soils is variable reflecting a range of soil and hydrological conditions, however, complete recovery is expected to take several years, and the impacts on soil ecology are not yet well understood.



S06.04-P - LYSIMETER RESEARCH AND CLIMATE CHANGE

Tuesday 03 July 2012 from 17:00 to 18:30. Room Poster Areas

S06.04-P -1

3RD GENERATION LYSIMETER TECHNIQUES: THE LYSIMETER-FIELD INTERFACE

Georg Von Unold, Munich - Germany

S06.04-P -2

APPLICATION OF THE MODEL MIKE SHE AT THE LYSIMETER WAGNA

Christian Reszler, Graz - Austria

S06.04-P -3

COMPARISON OF CALCULATED ET₀ TO MEASURED ET USING PRECISION LYSIMETERS

Fank Johann, Graz - Austria

S06.04-P -4

COMPARISON OF THE SIMULATION MODELS CANDY AND STOTRASIM ON LYSIMETER-SCALE

Johannes C. Draxler, Graz - Austria

S06.04-P -5

CONNECTION OF LYSIMETER MEASUREMENT WITH CATCHMENT MANAGEMENT IN THE MIYUN RESERVOIR NEAR BEIJING, CHINA

Ralph Meissner, Falkenberg - Germany

S06.04-P -6

DESIGN AND ASSESSMENT OF PAN LYSIMETERS TO MONITOR INFILTRATIONS THROUGH A MUNICIPAL SOLID WASTE FACILITY COVER

Serge-Étienne Parent, Québec - Canada

S06.04-P -7

HYDRAULIC PROPERTIES OF GRAVEL INVESTIGATED ON AN INDOOR LYSIMETER

Franz Feichtinger, Petzenkirchen - Austria



S06.04-P -8

INVERSE MODELLING OF WATER FLOW AND ROOT WATER UPTAKE IN LYSIMETERS

Henrike Schelle, Braunschweig - Germany

S06.04-P -9

LYSIMETER AS A COMPONENT OF AN INTEGRATIVE APPROACH TO SIMULATE GLOBAL WARMING IMPACT ON GRASSLAND

Markus Herndl, Irdning - Austria

S06.04-P -10

LYSIMETER EXPERIMENTS TO INVESTIGATE THE FATE OF CHLORIDAZON IN LEACHATE SAMPLES

Andrea Fuhrmann, Vienna - Austria

S06.04-P -11

MEASURING WATER CHANGES IN THE SOIL WITH AUTOMATED MICROLYSIMETERS

Olga Ucles, Almeria - Spain

S06.04-P -12

NITRATE LEACHING IN AGRICULTURAL SOILS WITH AND WITHOUT IRRIGATION, DURING DRY SUMMERS

Christiane Vögeli Albisser, Zürich - Switzerland

S06.04-P -13

ON THE EVALUATION OF PRECISION LYSIMETER MASS DATA

Fank Johann, Graz - Austria

S06.04-P -14

OVERALL SOIL QUALITY AND CROP YIELD POTENTIAL OF LYSIMETER SITES

Lothar Müller, Müncheberg - Germany

S06.04-P -15

RESPONSE OF FOREST SOIL C AND N TO A SNOW MANIPULATION EXPERIMENT IN THE NORTH-WESTERN ITALIAN ALPS

Davide Viglietti, Grugliasco (TO) - Italy



S06.04-P -16

SMOOTHING NOISY WEIGHING DATA OF A LYSIMETER WITH A LEVER-ARM-COUNTER-BALANCE WEIGHING SYSTEM

Reinhard Nolz, Vienna - Austria

S06.04-P -17

SURVEY OF WATER BALANCE COMPONENTS AS DETERMINED ON SELECTED LYSIMETER SITES IN AUSTRIA

Peter Cepuder, Vienna - Austria

S06.04-P -18

SUSTAINED STIMULATION OF SOIL RESPIRATION AND CO₂ RELEASE AFTER 10 YEARS OF EXPERIMENTAL WARMING

Jean Charles Munch, Neuherberg - Germany

S06.04-P -19

THE FUTURE OF ALPINE FARMING - WATER BALANCE AND GLOBAL CHANGE

Georg Leitinger, Innsbruck - Austria

S06.04-P -20

UPSCALING UNCERTAINTIES DUE TO INSUFFICIENT SOIL DEPTH INFORMATION FOR MODELLING GROUNDWATER RECHARGE AND NITROGEN LEACHING

Gernot Klammler, Graz - Austria

S06.04-P -21

USING AUTOMATIC SMALL LYSIMETER SYSTEMS TO MEASURE CLIMATE CHANGE INDUCED DROUGHT EFFECTS ON ALPINE GRASSLANDS

Nikolaus Obojes, Bolzano - Italy



S06.04-P -1

3RD GENERATION LYSIMETER TECHNIQUES: THE LYSIMETER-FIELD INTERFACE

Von Unold Georg^{*[1]}, Georg Leitinger^[2], Nikolaus Obojes^[3], Thomas Puetz^[4], Johann Fank^[5], Ralf Kiese^[6], Klaus Butterbach-Bahl^[7], Markus Herndl^[8]

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Reflecting the true field situation is one major issue of Field Lysimeter design & construction. As the Lysimeter is a biosphere field extract & representative, it must fit to the field in its hydrologic, soil specific, agronomic, microbial and microclimatic behavior. Due to mass balance applications the weighing system must not be interfered by the field or any field work & maintenance. The paper shows the technical design of the interface Lysimeter/Surrounding field and its thermodynamics to fulfill these requirements.



S06.04-P -2

APPLICATION OF THE MODEL MIKE SHE AT THE LYSIMETER WAGNA

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This study presents the application and test of the widely used model MIKE SHE at the Lysimeter in Wagna in Southern Styria (Austria). The model contains physical based algorithms for the representation of evapotranspiration and water movement in the unsaturated zone. For the calculation in the unsaturated zone the one-dimensional Richards-Equation and the Van Genuchten-Mualem approach is used. At the Lysimeter comprehensive data of vegetation, i.e. cultivation, types and soil hydraulic properties are available to parameterise the model. Aim of the study is to test the water movement simulation in the unsaturated zone and the evaporation and transpiration modules by a comparison with measured groundwater recharge rates and measured soil water contents in different soil depths. A sensitivity study of the modules and parameters is performed to select certain parameters for calibration at the point scale. Also, with the parameterised model the solute transport module is tested using the data of a tracer experiment (Bromide). Calibration results are promising. However, particularly in the gravel zone the dynamics of both water content and recharge can hardly be reproduced by one individual parameter set. This indicates a complex pore system consisting of different flow paths (e.g. system of matrix flow and macropore flow) at the Lysimeter, which can not be represented by the used approach.



S06.04-P -3

COMPARISON OF CALCULATED ET₀ TO MEASURED ET USING PRECISION LYSIMETERS

Johann Fank*^[1]

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A monolithic precision lysimeter is used to measure evapotranspiration at a reference site in Wagna (Austria). The lysimeter has a surface of 1 m² and a depth of 1 m. The precision load cells on the concrete fundament measure the lysimeters mass with a resolution of 35 g. The lower boundary condition of the lysimeter is realized as a suction cup rake. The soil water tension measured in 0.9 m below surface in the undisturbed soil profile is transferred via an automatic controlled vacuum pump to the suction cups. The lysimeters surface is cultivated by grassland which is cut during the vegetation period once a week to a length of 12 cm – as the reference height of the FAO-Penman-Monteith equation. The mass of the lysimeter and of the seepage water container is registered with a time interval of 1 minute. Beside the lysimeter a standard weather station has been installed where temperature, relative humidity, radiation and wind velocity are measured in a standard height of 2 m. In this poster measured grass evapotranspiration is compared to calculated reference evapotranspiration using different formulas (FAO-Penman-Monteith, Talyer-Priestly, Blaney-Criddle) on a daily basis as well as using different time steps for calculation. Results show a very exact representation of real ET in water stress free periods using Penman-Monteith equation.



S06.04-P -4

COMPARISON OF THE SIMULATION MODELS CANDY AND STOTRASIM ON LYSIMETER-SCALE

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Normally, nitrogen inputs into groundwater from diffuse agriculture sources are high in Austria. Which alternative land-use structures are possible in water protected areas to safeguard quality standard of groundwater resources? To answer this question, we investigate the effects of land-use change on water balance and nitrogen leaching with different soil water and solute transport models. Thus, there will be an evaluation of two software tools for modelling in unsaturated zone: Darcy model STOTRASIM versus capacity model CANDY. On the one hand, STOTRASIM calculates nitrogen dynamics of agriculturally used soils. The main focus of STOTRASIM is set on nitrogen leaching into groundwater. Only nitrate is solubilised, other nitrogen metabolized in nitrate-turnover and nitrate transport is linked to water movement. On the other hand, CANDY calculates nitrate-N leaching from root zone, describes relevant soil processes with different sub modules for soil temperature, soil water, crop growth and a model of organic matter turnover including three conceptional pools of organic material. Therefore, evaluation will happen at lysimeters in Wagna, Austria. For verification on lysimeter-scale, data of two high-precision lysimeters, high quality data of soil physics, extensive weather data and long-time seepage water records are used. In addition, we compare all required input data for regional modelling of site specific agricultural management practices, which are important for model decision. So, the aim of the study is to show limitations of these models and which model is giving a better overview of prevailing processes of water balance and nitrogen transport under local circumstances.



S06.04-P -5

CONNECTION OF LYSIMETER MEASUREMENT WITH CATCHMENT MANAGEMENT IN THE MIYUN RESERVOIR NEAR BEIJING, CHINA

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The Miyun reservoir is the main drinking water supply source for the Beijing agglomeration. It suffers from increasing water quantity and quality problems caused by a relatively high population density, inadequate land use, over-fertilization, excessive livestock breeding and uncontrolled disposal of wastes in the catchment. The aim of the running project is the development and implementation of a scientific based management system for non-point source pollution control in the Miyun basin. The presentation describes the bottom up research strategy and focus to the connection between lysimeter observations with hydrological investigations at plot and small catchment scale. In detail - the installation of a lysimeter station in the Miyun catchment and its management will be explained. First results regarding the behaviour of water balance parameters during the investigation period and groundwater recharge will be shown. Hydrological networks in the plot and catchment scale deliver additional information on the surface runoff. There is strong evidence for the dominance of very high rates of evapotranspiration that trigger the overall water balance. Additionally, episodically percolation and surface runoff generation occur. The combination of surface and subsurface flow pathways in small sub-catchments will be done with the process-based model IWAN (Integrated Winter Erosion And Nutrient Load Model). For the calculation of runoff, sediment and nutrient transport in the entire catchment the Web GIS based model STOFFBILANZ will be applied. This approach forms a basis to test different mitigation options and to develop a sustainable management system for the Miyun reservoir



S06.04-P -6

DESIGN AND ASSESSMENT OF PAN LYSIMETERS TO MONITOR INFILTRATIONS THROUGH A MUNICIPAL SOLID WASTE FACILITY COVER

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Pan (or zero-tension) lysimeters are often used as a practical and cost-effective device to collect infiltrations for sake of water qualitative and quantitative measurements. Their design must be adequately addressed, especially where quantitative measurements are aimed. Indeed, it is well known that the height of the walls of the pan must be sufficient to allow, for a targeted infiltration rate, the development of non-negative water pressure at its base, i.e. a necessary condition to evacuate water from the pan to the collecting device. If this condition is not met, one should expect to collect smaller amounts of water compared to the actual flow through its surrounding. We used existing techniques to design six lysimeters, which were subsequently installed to monitor infiltrations through a 300 m² experimental cover with capillary barrier effect placed over a municipal solid waste facility. Tensiometers were placed at the bottom of a lysimeter installed into a sand layer. Using data collected through four years, we measured, most of the time, non-negative water pressures at the base of the pan. These data provided an empirical support to the evidence for construct validity of the lysimeter design techniques in terms of wall-height.



S06.04-P -7

HYDRAULIC PROPERTIES OF GRAVEL INVESTIGATED ON AN INDOOR LYSIMETER

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Knowledge of groundwater recharge from seepage water is essential for sustainable ground-water management. If the groundwater table is far below the land surface and the area has been formed by quaternary sediments, seepage water from precipitation may have to pass long distances through gravelly material. In such a case noticeable mismatches between re-sults of modelling groundwater recharge and corresponding measurements became apparent. Therefore a large scale indoor lysimeter experiment was started to investigate water dynamics and flow behaviour of gravelly material. A cylindrical column of gravel was taken from a gravel pit in the field as an undisturbed monolith. The surface area of this column is half a square meter (diameter 80 cm) and its height is four meters. An experimental setup was built to monitor the vertical water fluxes inside the column in high spatial and temporal resolution, using different types of measuring devices. In total the column was equipped with 20 TDR – probes, 20 tensiometers and 10 sensors for soil temperature. The amounts of water inflow, outflow and storage are recorded continuously with balances. This equipment has been used to study a multistep–outflow experiment and percolation experiments with different flow rates. Processing the measured data using the software HYDRUS-1D yielded the characteris-tics of water retention and hydraulic conductivity of the gravel as a result of these experi-ments. Based on these characteristics, solute transport and turn-over rates in such gravelly material can be studied for climate change scenarios, what will be done in the near future.



S06.04-P -8

INVERSE MODELLING OF WATER FLOW AND ROOT WATER UPTAKE IN LYSIMETERS

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The correct quantification of variably saturated water flow in soils and thereby also solute transport relies on the accurate identification of soil hydraulic properties. One way to derive adequate effective properties is their estimation from field observations under atmospheric boundary conditions at the system of interest by inverse modelling. For this purpose, weighable lysimeters are powerful test systems, because the boundary fluxes (precipitation, actual evapotranspiration, deep percolation) can be determined very precisely. In this work we examine whether it is possible to identify soil hydraulic functions and root distribution parameters simultaneously by inverse simulation of soil water flow in monolithic lysimeters under atmospheric boundary conditions using the Richards equation. We analyze the amount of information needed for the identification of unique parameters, and investigate the magnitude of their uncertainties, dependent on the information content given by the data. First, we examine synthetic data sets for different scenarios and instrumentation campaigns using atmospheric boundary conditions as measured at the lysimeter station in Wagna, Austria. Then the effective soil hydraulic properties of the grass-reference lysimeter in Wagna are determined. The results show that for homogeneous profiles cumulative outflow and profile-averaged water content data contain enough system information to allow the simultaneous estimation of soil hydraulic and root-distribution parameters. In contrast, for soil profiles consisting of two layers, this is only possible, if additionally matric potential measurements from both layers are available. The effective water dynamics in the grass-reference lysimeter in Wagna could be described quite well by an effective parameterization.



S06.04-P -9

LYSIMETER AS A COMPONENT OF AN INTEGRATIVE APPROACH TO SIMULATE GLOBAL WARMING IMPACT ON GRASSLAND

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Climate change projections suggest a substantially increase of atmospheric CO₂ concentrations and warming of the Earth's surface during the next decades. Field experiments which investigate combined effects of elevated atmospheric CO₂ and warming in grassland are rare and in most cases information are based on computer simulation models. At AREC Raumberg-Gumpenstein in 2010 a technical experimental concept was developed, which enables testing combined effects of warming and elevated CO₂. The warming treatments will be realized by means of an infrared heating system, elevated CO₂ will be achieved by an adapted miniFACE system. To measure the effects of the two factors in the soil, lysimeters will be used. The experimental setup was established in a field experiment using a response surface approach, as based on a range of combinations of three levels of temperature (ambient, + 1.5°, +3°C) and CO₂ (ambient, +150, +300 ppm) on a total number of 24 independent plots. One factor combination thereby will be examined on six lysimeters to get information about water and nutrient fluxes under expected future conditions. This technical experimental concept permits a comprehensive evaluation of consequences to global warming and will allow future interdisciplinary projects within the range of climatic consequences research. Finally, the obtained results should help to develop adjustment strategies for grassland management under future climatic conditions.



S06.04-P -10

LYSIMETER EXPERIMENTS TO INVESTIGATE THE FATE OF CHLORIDAZON IN LEACHATE SAMPLES

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Pesticides are widely present in the environment, including water, soil and food, as a result of agricultural application to protect plants from diseases, weeds and insect damage. In this study, a lysimeter experiment was conducted to investigate the environmental behaviour of chloridazon and its main metabolites (chloridazon-desphenyl and chloridazon-methyl-desphenyl). Chloridazon, a selective herbicide widely used in sugar beet crops, was applied pre-emerge in April 2010 on the lysimeter surfaces in form of the commercial product Pyramin WG. The applied pesticide amount was in agreement to agricultural practice. The experiment was carried out at the research station in Wagna (Styria, Austria). Different lysimeter systems, a weighable monolithic field lysimeter and a non-weighable backfill gravitation lysimeter, were used. Leachate from the bottom of the lysimeters has been collected due to natural precipitation and analysed using liquid chromatography tandem mass spectrometry (LC-MS/MS) which provides low detection limits. The first appearance of chloridazon and its metabolites was determined in the leachate 19 weeks after the application. Results show that transformation of chloridazon to chloridazon-desphenyl and chloridazon-methyl-desphenyl took place. Chloridazon was detected in concentrations up to 0.3 µg/L. The most relevant degradation product is chloridazon-desphenyl which was found at high concentration levels up to 12 µg/L. In contrast chloridazon-methyl-desphenyl was measured at lower concentrations up to 1 µg/L. This study indicates that the selected pesticide, especially its metabolites, is relevant for groundwater contamination.



S06.04-P -11

MEASURING WATER CHANGES IN THE SOIL WITH AUTOMATED MICROLYSIMETERS

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We present an automated weighing microlysimeter capable of measuring evaporation and dewfall condensation in field conditions in semiarid SE Spain. It consists on a modified design from Heusinkveld et al. (2006) using a single point aluminium load cell (model 1022, 3 kg rated capacity, Vishay Tedea-Huntleigh, Switzerland). The microlysimeter had a resolution of 0.01 g under laboratory conditions, the total error was 0.02% of the rated output and there was internal temperature range compensation. The lysimeter was designed to minimize the remaining temperature dependence, i.e. it was built with aluminium and Polyspan materials and a waterproof cover. The sampling cup was made with PVC with 0.152 m of diameter and 0.060 m deep and it was capped at the bottom with a Teflon cup. The weighing microlysimeter was buried in the field and the surface of the sampling cup was level with the surrounding surface. Measurements of soil surface temperatures inside and outside a microlysimeter showed that surfaces properties were not modified between the microlysimeter and the surroundings. Changes in mass and temperatures were monitored and storage in a data-logger. Field calibrations using standard loads were made once a week. The microlysimeter was tested in the field to monitor water condensation and evaporation on different surface covers (physical soil crusts, biological soil crusts and stones).



S06.04-P -12

NITRATE LEACHING IN AGRICULTURAL SOILS WITH AND WITHOUT IRRIGATION, DURING DRY SUMMERS

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The hot summer of 2003 showed what weather conditions – according to climate forecasts – are increasingly to be expected in future. High temperatures combined with long dry spells during the main growing season will also make irrigation increasingly necessary in Switzerland. By examining the extent to which nitrates leach into the groundwater supply, this study aims to determine whether (inappropriate) irrigation or lack of irrigation during a dry spell can increase nitrate leaching. Twelve roofed and weighable lysimeters with a surface area of 3.14 m² and two different soils types are available for three cultivation periods (2010-2012) to answer this question. Both soils are typical Swiss agricultural soils, a sandy cambisol on brash and a cambisol on moraine clay. Each cultivation period is dedicated to an agricultural crop, beginning with maize, and continued with potatoes in 2011, and followed with vegetable in the third cultivation period. All lysimeters are subject to simulated drought similar to 2003. Method 1 allows no additional watering. The crops of method 2 and 3 were treated with two different irrigation intensities (optimum and excessive watering), of two repetitions each being tested in parallel on both soils in each case. Preliminary results show reduced nitrate concentrations in the seepage water when watering an optimal volume in comparison with no irrigation, whereas excessive watering generate no reduction of nitrate concentrations in the seepage water but increased the total annual load because of the increasing seepage water amount.



S06.04-P -13

ON THE EVALUATION OF PRECISION LYSIMETER MASS DATA

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A large weighable lysimeter is the best method for obtaining reliable data about seepage-water quantity and quality. In connection with the additional recording of the amount of percolating water and precipitation a weighing lysimeter permits the quantification of the water balance of the soil column. Beside standard Lysimeter data evaluation - precise measurement of dew, fog, and rime is possible using a high-precision lysimeter. Due to these characteristics, lysimeters are an excellent tool to derive or calibrate water and solute transport models for unsaturated zone simulation and to predict the effects of climate change on groundwater recharge and solute transport into the groundwater. Based on the precision field lysimeters at the agricultural research station in Wagna (Austria) different methods for evaluating precision lysimeter mass data are compared. Standard lysimeter evaluation transfers the errors in measurement of precipitation to the resulting amount of evapotranspiration. The amount of seepage water is recorded separately, the time series of the lysimeter mass represents the other parts of the water balance equation: increasing mass shows precipitation amount, decreasing mass is the effect of evapotranspiration, the mass difference in the evaluation period indicates the change of stored water volume. The analysis of precipitation, evapotranspiration and the change of stored water volume from the time series of the lysimeter mass depend on a filter parameter that integrates random noise. It can be shown, that the filter parameter is sensitive to any unique Lysimeter, to the time steps for evaluation, and to external sources (vegetation, wind) respectively.



S06.04-P -14

OVERALL SOIL QUALITY AND CROP YIELD POTENTIAL OF LYSIMETER SITES

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Results of lysimeter experiments like soil water and solute balances are depending on crop yields. Crop yield potentials may be constraint by soil, climate and other factors. Favourable natural conditions of agricultural land have potentials for higher crop yields and better efficiency of water and nutrients by crops. Land of good agricultural quality is less prone to negative impacts of agriculture on the environment. We present a conception for the quantification of agricultural soil quality and resulting crop yield potentials of small grain cereals. The Muencheberg Soil Quality Rating is the methodical basis of this approach. It is based on crop yield relevant soil indicators. Examples of the application for lysimeters and other experimental sites will be demonstrated. Many of them belong to the European Lysimeter Platform. Differences in agricultural soil quality both between locations and single lysimeters have been quantified. Results provide assessments of the similarity and ranking of lysimeters concerning site-specific limitations of crop yield potentials. The depth of rooting zone and the effective soil water balance in the vegetation period are crucial indicators of overall soil quality. The majority of lysimeters under study had very high and high soil quality and crop yield potentials within a global scale. Water use efficiency of small grain cereals was significantly higher on soils of better quality. Key words: Lysimeter, agricultural land, crop yield potential, indicators, Muencheberg Soil Quality Rating



S06.04-P -15

RESPONSE OF FOREST SOIL C AND N TO A SNOW MANIPULATION EXPERIMENT IN THE NORTH-WESTERN ITALIAN ALPS

Freppaz Michele^[1], Filippa Gianluca^[1], Bruno Enrico^[1], Viglietti Davide^{*[1]}, Zanini Ermanno^[1]

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Among the potential effects of climate change in the Alpine environment during the winter season, of particular interest is the delay of snow pack accumulation and the increase in frequency of rain on snow events (ROS). We set up a study site in a subalpine forest (Piedmont NW-Italy) in order to simulate for two consecutive years (2009-10 and 2010-11) the influence of a change in precipitation regimes on carbon and nitrogen in soil and soil solution. In some plots the snow was removed in the first part of winter, to simulate late winter snowfalls; in other plots the snow was drizzled, with liquid water chemically comparable to rain; in the control plot, the snowpack was left undisturbed. The plots were equipped with soil moisture and temperature sensors and suction lysimeters. Late snowfall caused a soil mild-hard freezing (soil temperature $<-7^{\circ}\text{C}$) and several freeze/thaw cycles, with a consequent reduction of soil moisture while no any significant effect due to ROS events was observed. Both snow treatments did not affect the soil microbial biomass while a significant effect of the snow removal during winter was observed on the dissolved organic C (DOC) and ammonium (NH_4^+) pools. During summer, a significant increase in DOC, NH_4^+ and NO_3^- concentration was observed in the ROS plots. The concentration of DOC and DON in the soil solution was not affected by the treatments. Globally late snowpack accumulation and rain on snow events influenced the soil C and N dynamics with different magnitude and timing response.



S06.04-P -16

SMOOTHING NOISY WEIGHING DATA OF A LYSIMETER WITH A LEVER-ARM-COUNTER-BALANCE WEIGHING SYSTEM

Nolz Reinhard*^[1], Kammerer Gerhard^[1], Cepuder Peter^[1]

^[1]University of Natural Resources and Life Sciences, Vienna ~ Institute of Hydraulics and Rural Water Management ~ Vienna ~ Austria

Weighing lysimeters are valuable devices for measuring soil water balance components. Whereas modern lysimeters are usually equipped with three load cells measuring directly changes in weight with high temporal resolution and precision, lever-arm-counter-balance systems transmit a proportional force to a single load cell. Such weighing devices can usually be found at older lysimeter stations. A disadvantage of lever-arm-counter-balance systems is their sensitivity to external disturbances, mainly forces exerted by wind. The latter can affect the measuring accuracy significantly, especially at short measuring intervals. The weighing data of a lysimeter that is operated since 1983 were studied regarding the performance of the weighing system and data processing. During the past years the peripheral equipment (e.g. load cells, storage devices) was improved. Subsequently, the measuring frequency was increased (every few seconds), and the storage interval was shortened to 10 minutes. Despite averaging, the weighing data show a kind of random noise that is greater on windy days. Detailed measurements showed that the lever-arm-counter-balance weighing system is oscillating, and the amplitudes are influenced by spurious impulses. Since the disturbances – e.g. wind gusts – build up the system, common averaging procedures (e.g. moving average) do not lead to the expected results. Thus, alternative smoothing functions were tested on a data set. A basic piecewise sigmoid function was easy to fit, and it gave proper results of the typical diurnal variation of evapotranspiration on single days without rainfall. However, on a longer time period with rainfall events, a polynomial spline function performed better.



S06.04-P -17

**SURVEY OF WATER BALANCE COMPONENTS AS DETERMINED ON SELECTED
LYSIMETER SITES IN AUSTRIA**

Cepuder Peter*^[1]

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Austria is a relative small mountainous country in the centre of Europe. Due to the Alps the country is splitted in different climatic regions. A mediterranean impact can be found in the south, continental in the North and pannonical in the East. Also annual precipitation may have a range from 500 mm in the East up to more than 2500 mm in the Alps. Therefore the water consumption of the planted crops differs also depending on these climatic condition. Several Lysimeters were installed during the last decades in these different regions to monitor the evapotranspiration rates for grass and field crops. These lysimeters have a surface area from 1 to 3 m² and contain soil monoliths of shallow brown to repacked deep czenosem, and are planted with grass and field crops. As these stations are situated in different climatic areas the evapotranspiration rates for the last years were measured. Most of the lysimeters own a weighing system and are connected with weather stations. Therefore evapotranspiration and percolation can be registered in very short time intervals and high resolution. In this paper the measured water balance components for 5 years will be presented and compared with calculated data. Mainly evapotranspiration and percolation will be in the focus of the work. But also yield and biomass production depending on the available water will be reported.



S06.04-P -18

SUSTAINED STIMULATION OF SOIL RESPIRATION AND CO₂ RELEASE AFTER 10 YEARS OF EXPERIMENTAL WARMING

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A number of forest and grassland studies indicated that stimulation of the soil respiration by soil warming ceases after a couple of years. A long-term soil warming lysimeter experiment (4 soil monoliths from an agricultural field, 1m² x 2 Meter depth, temperature = ambient + 3°C; with a regionally usual crop rotation with 5 crops) was conducted in southern Germany. It results in a sustained stimulation of soil respiration after 10 years. Moreover, both warmed and control treatments exhibited a similar temperature response of soil respiration indicating no adaptation in terms of temperature sensitivity. Carbon dioxide concentration measurements within the profiles are supporting these findings. The increased soil respiration occurred although vegetation productivity in the warmed treatment was not higher than in the control plots. These findings strongly contrast current soil carbon modeling concepts, where carbon pools decay according to first-order kinetics, and thus a depletion of labile soil carbon pools leads to an apparent down-regulation of microbial respiration. Consequently, the potential for positive carbon-climate cycle feedback may be larger than represented in current models of soil carbon turnover and in general assessments.



S06.04-P -19

THE FUTURE OF ALPINE FARMING - WATER BALANCE AND GLOBAL CHANGE

Leitinger Georg^{*[3]}, Obojes Nikolaus^[2], Tasser Erich^[2], Tappeiner Ulrike^[3]

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The water balance of mountain grasslands is already and will be affected by climate and land-use change. Using different types of lysimeters, detailed process-analyses and numerous spatially distributed analyses are combined to deepen our understanding of the effects of vegetation and biodiversity change as well as the impact of topography on the water balance. In the last decades, extensive areas of the Alps were abandoned due to socio-economic pressure and especially manually mown areas at higher altitudes were affected. With regard to the more balanced water household of higher elevated meadows, recently abandoned areas might be of particular importance in a future climate. In our study site Stubai Valley (300km², Tyrol, Austria) 24 sites on 8 different altitudinal transects were equipped with 24 manually weighted small lysimeters each. Additionally, continuous measurements of the water balance were conducted by 12 automatic weighing small lysimeters accompanied by 80 deep seepage collectors (DSCs) to enlarge number of replicates as well as investigated land-use/cover types. Results revealed a more balanced water household with increasing altitude whereas intensively used meadows in the valley bottom were faced with water stress and thus lower or equal transpiration rates compared to lightly used meadows. Regarding management, cutting had a more severe effect on EVT, soil wetness as well as deep seepage in all altitudes.



S06.04-P -20

UPSCALING UNCERTAINTIES DUE TO INSUFFICIENT SOIL DEPTH INFORMATION FOR MODELLING GROUNDWATER RECHARGE AND NITROGEN LEACHING

Klammler Gernot*^[1], Fank Johann^[1], Kupfersberger Hans^[1], Draxler Johannes C.^[1]

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Groundwater recharge and nitrogen leaching vary considerable due to weather, land-use and soil characteristics (e.g. soil depth). While at specific point locations groundwater recharge and nitrogen leaching can be measured by lysimeters, at aquifer scale simulation models are common tools for quantifying water and nitrogen balances. However, at aquifer scales input data concerning land-use and soil is usually rare. E.g., available soil information at aquifer scale in Austria only contain one “representative” soil depth for soil polygons of about 100 to more than 1,000 ha area. The goal of this work is to quantify the uncertainty which arise by upscaling the soil water and nitrogen transport model STOTRASIM due to the lack of soil depth information on aquifer scale. Therefore, STOTRASIM is set up and calibrated for the lysimeter site Wagna, Austria, where water movement and nitrate leaching below two lots have been monitored by two lysimeters over more than seven years. The complete test site consists of 32 lots covering an area of approximately 4.4 ha. There, by means of about 140 soil depth measurements, a very heterogeneous distribution of soil thickness from 20 to more than 200 cm is observed, which serves as basis for quantifying the upscaling uncertainty. It is expected that groundwater recharge and nitrogen leaching generally reduce with deeper soils and that different soil textures lead to individual decreases. That implicates that the used “representative” soil depth per soil polygon is very sensitive concerning over- or underestimating groundwater recharge and nitrogen leaching at aquifer scale.



S06.04-P -21

**USING AUTOMATIC SMALL LYSIMETER SYSTEMS TO MEASURE CLIMATE CHANGE
INDUCED DROUGHT EFFECTS ON ALPINE GRASSLANDS**

Obojes Nikolaus*^[1], Leitinger Georg^[3], Tasser Erich^[1], Tappeiner Ulrike^[3]

^[1]EURACresearch ~ Institute for Alpine Environment ~ Bolzano ~ Italy ^[2]LFU ~ Institute of Ecology ~ Innsbruck ~ Austria

^[3]University of Innsbruck ~ Institute of Ecology ~ Innsbruck ~ Austria

In addition to rising temperatures climate change will likely increase the occurrence of meteorological extreme events. A project by the European Academy Bolzano and the University of Innsbruck is investigating the effects of droughts on productivity and water balance of alpine grasslands. We hypothesize that early season droughts will reduce both plant biomass and leaf area and impact ecosystem water balance in various ways: decreasing transpiration and interception, increasing soil evaporation, modified water uptake, etc. Delayed plant development and soil memory effects might prolong drought effects further into vegetation period. We are using automatically weighted lysimeters with a diameter and depth of 0.3 m which are equipped with soil moisture sensors and tensiometers at two depths as well as tipping gauges to register percolation water. A total of 21 lysimeters were installed at an irrigated hay meadow at 1500 m a.s.l. in the Macia Valley/Italy and an alpine grassland at 2000 m a.s.l. in the Stubai Valley/Austria. In 2012 they will be divided in several groups (of three lysimeters each): one sheltered with a foil tunnel from all precipitation for 4-6 weeks during the growing period, the second unsheltered and receiving rainfall and irrigation, the third sheltered but watered to the outside precipitation level to quantify the tunnel's impact on microclimate. While we focus additional drought effects on an already dry agricultural system in Macia Valley, we will investigate implications of land use by comparing an alpine hay meadow with abandoned alpine grassland in the humid Stubai Valley.



W06.01-P - FOREST BIOENERGY AND SOIL SUSTAINABILITY

Tuesday 03 July 2012 from 17:00 to 18:30. Room Poster Areas

W06.01-P -1

BIOMASS UTILIZATION AND ITS CONSEQUENCES ON SOILS – THE RETROSPECT VIEW

Viktor J. Bruckman, Vienna - Austria

W06.01-P -2

ENZYME ACTIVITIES IN SOIL PROFILE OF TWO BEECH FORESTS ON CAMPANIA APENNINES

Stefania Papa, Caserta - Italy

W06.01-P -3

ESTIMATION OF METHANE POTENTIAL OF AGRICULTURAL SECTOR IN KOREA

Joungdu Shin,-

W06.01-P -4

EXAMINING WHOLE SITE PRODUCTIVITY WHEN INTERCROPPING GIANT MISCANTHUS (MISCANTHUS × GIGANTEUS) WITH LOBLOLLY PINE (PINUS TAEDA) FOR BIOENERGY FEEDSTOCK PRODUCTION IN SOUTHEASTERN UNITED STATES

Ryan Heiderman, Raleigh - United States

W06.01-P -5

FOREST BIOENERGY CLIMATE IMPACT CAN BE IMPROVED BY ALLOCATING FOREST RESIDUE REMOVAL

Anna Repo, Helsinki - Finland

W06.01-P -6

GETTING QUANTITATIVE: HOW MUCH SLASH SHOULD REMAIN ON SITE TO SUSTAIN TREE GROWTH?

David Paré, Québec - Canada

W06.01-P -7

IMPACTS OF DISC TRENCHING ON SOIL WATER AND HEAT FLOWS IN A FOREST REGENERATION AREA IN SWEDEN

Linnea Hansson, Uppsala - Sweden



W06.01-P -8

LONG-TERM SUSTAINABILITY OF FOREST SOIL FERTILITY ASSESSED BY NUTRIENT INPUT-OUTPUT BUDGETS AND A MODELING APPROACH

Gregory Van Der Heijden, Nancy - France

W06.01-P -9

RESULTS FROM INTENSIVE HARVESTING FIELD TRIALS: HOW DOES EUROPE COMPARE WITH NORTH AMERICA?

Brian Titus, Victoria - Canada

W06.01-P -10

WHOLE-TREE HARVEST AT FINAL-FELLING; LONG-TERM EFFECTS ON SOIL PROPERTIES IN A NORWAY SPRUCE STAND

Lilli Kaarakka, Helsinki - Finland



W06.01-P -1

BIOMASS UTILIZATION AND ITS CONSEQUENCES ON SOILS – THE RETROSPECT VIEW

Bruckman Viktor J.*^[1], Glatzel Gerhard^[1]

^[1]Austrian Academy of Sciences ~ Commission for Interdisciplinary Ecological Studies ~ Vienna ~ Austria

Biomass was the major source of energy until the early utilization of fossil energy sources. Its availability is strongly linked to the development, prosperity and extinction of former civilizations. Biomass from forests became scarce as the industry developed, leading to increasing transport distances from biomass sources and vast deforested patches of land along streams. There is good evidence from the past that unsustainable biomass extraction and consequent soil degradation had significant impact on soil properties in specific cases. In central Europe, litter raking and pollarding were common practices until the mid of the last century. Nutrients were directly extracted from forest ecosystems to sustain the human population by setting up forest pastures and harvesting of edible parts of plants. Starting from the bronze age, mining and proto-industrialization had significant impacts on forests because of the rising demand on fuelwood, charcoal and even woodash. Such historical practices led to significant base cation loss in many forest ecosystems and consequently to soil acidification and reduced growth potential. Consequences of such practices should be kept in mind when evaluating the impact of harvesting residues management (utilization of slash) which is extensively discussed at the moment.



W06.01-P -2

ENZYME ACTIVITIES IN SOIL PROFILE OF TWO BEECH FORESTS ON CAMPANIA APENNINES

Papa Stefania^{*[1]}, Pellegrino Antonella^[1], Fioretto Antonietta^[1]

^[1]Second University of Naples ~ Department of Life Science ~ Caserta ~ Italy

Soil organic matter (OM) is a key component of terrestrial ecosystems and it is functionally and structurally integrated into basic ecosystem processes. Therefore, it is very important to understand the mechanisms that determine the decomposition and accumulation rates of OM in the soil in order to predict responses to climate change. Forest soils in Europe act as sink of organic C, but it is not clear how much longer this can be maintained. Beech forests cover a lot of European lowlands but, in Italy, they cover Alps and Apennines generally above 600 and 1000 m a.s.l., respectively. The focus of this study was to analyse and compare cellulase, xylanase and chitinase activities along the soil profile (organic horizon and mineral soil until 40 cm depth) of two beech forests on Campania Apennines. The experimental sites were located within the Regional Park of Monte Matese (CE) and on the Raiamagra Mountain (AV), respectively. Both soils arise from a calcareous bedrock covered by pyroclastic material and had deep profiles. The trees were 70-80 years old. The two sites did not show significant differences of OM content along the profile, but the enzyme activities were generally very higher in the Raiamagra respect to Monte Matese soil, in particular, in the decomposition continuum of the organic horizon. Only cellulase activity in the mineral soil did not differ between the forest sites. Some other physical, chemical and climatic characteristics were also compared. In addition, the relationship between enzyme activities and active fungal biomass were investigated.



W06.01-P -3

ESTIMATION OF METHANE POTENTIAL OF AGRICULTURAL SECTOR IN KOREA

Shin Joungdu^{*[1]}, Hong Seunggil^[1], Kim Sung-Chul^[2], Yang Jae E.^[3]

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Potential methane emission from agricultural residuals such as livestock manure, agro-industrial wastes and crop residues in Korea was estimated following IPCC guideline, and some modifications. Main parameters for estimating the methane emission were total waste amount generated from agricultural sectors, emission factor (EF), and physicochemical properties of each waste. Calculated total methane production of representative categories for livestock, crop residues and agro-industrial wastes was 435,511 tons/yr in Korea. Among them, poultry waste generated the highest methane potential with 177,680 tons/yr of total estimated methane production followed by 61,026 tons/yr of methane from cattle waste. For crop residues and agro-industrial wastes, estimated methane production was 707 and 125,650 tons/yr, respectively. Results of this study suggested that methane emission from livestock manures occupied the highest portion in agricultural sector, and more effective management for livestock waste should be necessary to minimize the emission of methane from agricultural sector. Keywords: Global warming, Greenhouse gas (GHG), Agricultural biomass, Methane, Inventory



W06.01-P -4

EXAMINING WHOLE SITE PRODUCTIVITY WHEN INTERCROPPING GIANT MISCANTHUS (MISCANTHUS × GIGANTEUS) WITH LOBLOLLY PINE (PINUS TAEDA) FOR BIOENERGY FEEDSTOCK PRODUCTION IN SOUTHEASTERN UNITED STATES

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There is growing interest in production of dedicated biomass crops to be used as feedstock for bioenergy production. Perennial grasses have been identified as attractive feedstock. Giant miscanthus (Miscanthus × giganteus), a perennial, warm season grass related to the sugarcane family is one potential high yielding, bioenergy crop. European experience with miscanthus has shown yields up to 22 Mg ha⁻¹ and also has potential to sequester carbon below ground. Although miscanthus is native to the tropics, it has been shown to be tolerant of cooler climates. In the Southeastern United States, forest-based biomass may be able to provide raw materials to help build a biomass-based energy industry. Loblolly pine (Pinus taeda) planted on wide row spacing (e.g. for sawtimber production) allows dedicated energy crop intercropping. Intercropping for bioenergy feedstock production may maximize economic and biomass output from the land early in the forest rotation while still maintaining long-term production of traditional forest products. This study examined effects of managing miscanthus as a feedstock for biofuels on crop tree growth and soil sustainability in a loblolly pine plantation. Extent of these potential effects on yield and soil needs a detailed investigation and will facilitate development of sustainable forest management strategies for intercropping. This intercropping system is evaluated in three areas: (1) Productivity of pine and miscanthus, (2) Above- and below ground carbon dynamics and storage, and (3) Soil nitrogen dynamics.



W06.01-P -5

FOREST BIOENERGY CLIMATE IMPACT CAN BE IMPROVED BY ALLOCATING FOREST RESIDUE REMOVAL

Repo Anna*^[1], Känkänen Riina^[1], Tuovinen Juha-Pekka^[2], Antikainen Riina^[3], Tuomi Mikko^[1], Vanhala Pekka^[1], Liski Jari^[1]

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Bioenergy from forest residues can be used to avoid fossil carbon emissions, but removing biomass from forest reduces carbon stocks. The magnitude and longevity of these carbon stock changes determine how effective forest bioenergy is to reduce GHG emissions and to mitigate climate change. We estimate the variability of GHG emissions and consequent climate impacts resulting from producing bioenergy from stumps, branches and thinning wood in Finland, and the contribution of the variability in key factors, i.e. forest residue diameter, tree species, geographical location of the forest biomass removal site and harvesting method, to the emissions and climate impacts. The GHG emissions and the climate impacts estimated as changes in radiative forcing were comparable to fossil fuels when bioenergy production was initiated. Both decreased over time because forest residues were predicted to decompose releasing CO₂ even if left in the forest. Both were mainly affected by forest residue diameter and climatic conditions of the collection site. Tree species and harvest method of thinning wood had a smaller effect on the emissions. The largest reduction in the climate impacts after 20 years, up to 62%, was achieved when coal was replaced by the branches collected from Southern Finland; smallest reduction 7% was gained by using stumps from Northern Finland instead of natural gas. After 100 years the corresponding values were 77% and 21%. The choice of forest residues collected affects critically the magnitude and the timing of emission reductions and climate benefits that a country can achieve with forest bioenergy.



W06.01-P -6

GETTING QUANTITATIVE: HOW MUCH SLASH SHOULD REMAIN ON SITE TO SUSTAIN TREE GROWTH?

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An experimental design was set up to test the effect of various levels of slash (forest harvest residues) on soil and tree growth and to elucidate the mechanisms that are operating. It included four sites located under different soil and climatic conditions in the boreal forest. Based on estimates of the average level of biomass that should remain on site when the stand is harvested by stem-only harvesting (1 load), the experimental design included the following gradient of slash loading: no slash, half a load, full load, double load. A combination of fertilisation, herbicide and plastic mulches were also used as treatments designed to simulate and isolate specific mechanisms by which slash affects plant growth: providing nutrients, shading the soil, and limiting the growth of competing plants. The design included different tree species with contrasting traits, some of the conservative type such as black spruce and others are from the acquisitive type such as hybrid poplar. Results indicate slash effects that were linear with dose application but only on sites where plant competition is important or on very poor soil. The results indicated that the beneficial effect of slash on soil nutrient and on the reduction of plant competition was not as optimal as standard silvicultural techniques such as fertilization and vegetation control. Quantifying the effect of slash on soil conditions and tree development may help putting forward recommendations on the amount of slash that should be left on site to maintain ecosystem functions and on mitigation alternatives.



W06.01-P -7

**IMPACTS OF DISC TRENCHING ON SOIL WATER AND HEAT FLOWS IN A FOREST
REGENERATION AREA IN SWEDEN**

Hansson Linnea^{*[1]}, Ring Eva^[2], Gärdenäs Annemieke^[1]

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Site preparation is executed on more than 80 % of the forest regeneration areas in Sweden and disc trenching is the most common method. It is done to stimulate a successful regeneration and thereby improve the productivity for the whole rotation period. The environmental consequences of disc trenching are poorly understood. The aim of this study was to analyze the impact of disc trenching on the heat and water dynamics both by measurements and by process-oriented modeling. This is of importance for understanding the abiotic conditions for decomposition, soil fauna, nutrient leaching and the reestablishment of vegetation after disc trenching. The study site is situated on a sandy soil in the western part of central Sweden. The Scots pine stand was harvested in 2006 and disc trenching was carried out shortly afterwards. Soil moisture content and temperature were monitored on an hourly basis for five years in disc trenched areas; i.e. below furrows, ridges, between ridges and in undisturbed soil respectively. The dynamic bio-geophysical ecosystem model, Coup Model (Jansson & Karlberg 2010), was used for simulating soil water- and heat fluxes. We will present an analysis of the impact of disc-trenching on the daily and seasonal amplitudes of soil temperature and moisture in the furrows, the ridges and the control. We will also assess the duration of the impact of disc trenching. Preliminary results indicate that they are leveling off after five years. The study was funded by the Swedish Research Council Formas and the Swedish University of Agricultural Sciences.



W06.01-P -8

LONG-TERM SUSTAINABILITY OF FOREST SOIL FERTILITY ASSESSED BY NUTRIENT INPUT-OUTPUT BUDGETS AND A MODELING APPROACH

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^[1]INRA ~ BEF ~ Nancy ~ France ^[2]ONF ~ Département recherche ~ Fontainebleau ~ France ^[3]INRA ~ Carrel ~ Chambéry ~ France

Since the 1980s, atmospheric deposition acidity has generally decreased in European forest ecosystems. However, at many sites, little or no sign of recovery has been observed yet. Concerns are rising about the sustainability of these ecosystems because of reduced nutrients inputs in atmospheric deposition and the increase in biomass harvesting to supply bio-energy. Nutrient input-output budgets are widely used tools to diagnose the forest ecosystem nutrient status and the changes in soil fertility over time. This approach was applied to two different poor forest ecosystems: a 60-year old silver fir stand in the Vosges Mountains (Lorraine, France) and a 30-year old beech stand in the Morvan Mountains (Burgundy, France). The monitoring data of the silver fir stand was used to calibrate a process-orientated biogeochemical model (NuCM) over a 12 year period which was used to simulate the consequences on soil fertility of two main scenarios and their combinations: constant or reduced atmospheric deposition, and traditional or whole-tree harvesting. Although the acid deposition load has been decreasing since the 1990s, input-output nutrient budgets showed an ongoing acidification. The model NuCM was successfully calibrated and scenarios were implemented. A slight recovery was simulated when deposition was maintained constant but combined acid and nutrient atmospheric deposition reduction delayed recovery. Moreover, whole-tree harvesting drastically decreased soil fertility compared to traditional silviculture. Hence, biomass harvesting in forests on poor soils may counter recovery in the future.



W06.01-P -9

RESULTS FROM INTENSIVE HARVESTING FIELD TRIALS: HOW DOES EUROPE COMPARE WITH NORTH AMERICA?

Titus Brian*^[1], Fleming Robert^[2], Smith C.t. (tat)^[3], Egnell Gustaf^[4], Morris David^[5], Thiffault Evelyn^[6], Mason W.I. (bill)^[7], Vanguelova Elena^[8], Pitman Rona^[8], Wall Antti^[9], Scott Andy^[10]

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A range of field trials have been established in various parts of the world to assess the environmental impacts of intensive forest biomass removals. While some trials were designed to address bioenergy-related questions, others have different objectives but include some relevant treatments. Meta-analysis increases the amount of information that can be extracted from a range of field trials. The types of analyses that can be carried out with meta-analysis can be used (within the limits of the data available) to test hypotheses and generate empirical results to feed into our scientific understanding – and from there directly into development of guidelines and standards. Building on their experience with meta-analysis in the LTSP network (Fleming et al. (2006) Can. J. For. Res. 36: 529-550), researchers have recently embarked on a program to apply meta-analysis to intensive harvesting trials to test hypotheses that tree growth response to intensity of biomass removals is dependent on factors such as tree species (conifer vs. hardwood, genus and genus groups, fast-growing vs. slow-growing), ecosystem type, climate, site index, soil properties (time since glaciation, texture, soil moisture, major nutrients, base cations, acidity), and surficial and bedrock geology. The literature usually only reports site-level mean values, and un-published plot-level data is also being used to increase the power of the meta-analysis. Preliminary results comparing Europe and North America will be presented.



W06.01-P -10

**WHOLE-TREE HARVEST AT FINAL-FELLING; LONG-TERM EFFECTS ON SOIL PROPERTIES
IN A NORWAY SPRUCE STAND**

Kaarakka Lilli*^[1]

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The objective of this study was to determine and compare differences in soil properties after conventional harvest and whole-tree harvest in a fertile Norway spruce (Picea abies (L) Karts.) stand in Southern Finland. Only a limited number of long-term studies have been carried out on the topic in the boreal region. In my thesis, I studied changes in acidity, cation exchange capacity and base saturation amongst other things, in the humus layer and upper mineral soil after the two different treatments.



S07.01-P - SOIL ORGANIC MATTER FROM BULK TO MOLECULAR SCALE: INNOVATIVE METHODS AND APPLICATIONS

Thursday 05 July 2012 from 17:00 to 18:30. Room Poster Areas

S07.01-P -1

14C STUDY ON THE FATE OF ISOPROTURON APPLIED TO AGRICULTURAL SOILS OF MOROCCO

Ahmed Bouhaouss, Rabat - Morocco

S07.01-P -2

AN INTEGRATED PHYSICAL-CHEMICAL PROCEDURE TO MONITOR SOIL ORGANIC CARBON CHANGES IN SHORT-TERM STUDIES

Hamada Abdelrahman, Bari - Italy

S07.01-P -3

APPROACHES TO ESTIMATION OF SOIL ORGANIC CARBON STOCK ON NATIONAL SCALE

Gabriela Barancikova, Presov - Slovakia

S07.01-P -4

ASSESSMENT OF SOIL ORGANIC CARBON FRACTIONS ALTERED BY PRESCRIBED FIRE IN LOWLAND FORESTS OF SOUTH-EASTERN AUSTRALIA

Saravanan Krishnaraj, Creswick - Australia

S07.01-P -5

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Laurent Grasset, Poitiers - France

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MICROBIAL TRANSFORMATION OF AMINO ACIDS IN SOIL ASSESSED BY POSITION-SPECIFIC LABELLING OF ALANINE

Michaela Dippold, Bayreuth - Germany



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Mohammad Ali Hajabbasi, Isfahan - Iran, Islamic Republic of

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Lorena Recio-Vázquez, Madrid - Spain



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Alexey Dymov, Syktyvkar - Russian Federation

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Masako Kajiura, Tsukuba - Japan

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Katell Quenea, Paris - Franc



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14C STUDY ON THE FATE OF ISOPROTURON APPLIED TO AGRICULTURAL SOILS OF MOROCCO

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Adsorption, desorption, degradation and immobilisation of ¹⁴C-isoproturon into clayey Moroccan soils collected from Gharb area has been investigated under laboratory conditions. The influence of different fractions of soil organic matter on the retention of the herbicide isoproturon has been also evaluated. Water and methanol extractable residues of ¹⁴C labelled isoproturon have been determined in collected soil samples by β -counting-liquid chromatography. Adsorption follows a non-linear isotherm. A high affinity of isoproturon to soils was observed. Isoproturon affinity to Dehs soil was stronger than Tirs soil, showing Koc values of 112.1 (mL/g) and 84.5 (mL/g) respectively. Laboratory incubations experiments under controlled conditions showed that after 43 days 2.5 to 8 % of applied isoproturon was mineralised. Non-extractable residues in Tirs soil, Tirs soil treated with nitrogen, and Dehs soil were found 36, 35 and 32% of the initial applied amounts after 60 days, respectively. The pseudo half-life of isoproturon ranged from 31 to 50 days. Degradation products of isoproturon were N'-(4-isopropylphenyl)-N,N-dimethylurea et N'-[4-(2-hydroxyisopropylphenyl)]-N-methylurea, and other non-identified products. The fractionation of soils organic matter allowed to specify the distribution of bound residues within the organic compartments. The total amount of residues retained into the organic matter of the soil samples was ranging from 62 to 68 % (mean 65 %) of not-extractable fraction, and this percentage did not change with incubation time. Humins seemed to be the most quantitative organic compartment responsible for accumulation of bound residues.



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AN INTEGRATED PHYSICAL-CHEMICAL PROCEDURE TO MONITOR SOIL ORGANIC CARBON CHANGES IN SHORT-TERM STUDIES

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Soil organic matter (SOM) and specifically soil organic C (SOC) is crucial for building soil fertility and reducing CO₂ emissions in the atmosphere. Monitoring SOC is a very important tool for site-specific evaluation and consequent management planning. Adoption of new agronomic practices, as converting from conventional to organic management, may disrupt the C production-respiration balance, altering the SOC level. Isolating and quantifying responsive SOC fractions can show the effects of management and better provide information on SOC pattern in a short-term scale. A fractionation procedure was introduced to isolate labile SOC fractions including particulate organic matter (POM), light fraction (LF) and mobile humic acid (MHA). Further, the LF, POM and MHA were characterized for their biochemical constituents. Soil samples collected from fields undergoing the transition from conventional to organic farming were subjected to the proposed fractionation and characterization procedures. LF-C accounted for 4% of SOC while POM and MHA accounted for 6% and 13%, respectively. In spite of correlations between LF-C ($R^2 = 0.66026$) and MHA-C ($R^2 = 0.92703$) with total SOC, changes in the total SOC could not be correlated to management and agronomic practices. Carbohydrates content decreased, moving from younger fraction, LF, to more mature, MHA, fraction of SOC. The fractionation procedure efficiently separated SOC fraction that responded to changes in land management and is evidently recommended for short-term studies on SOC.



S07.01-P -3

APPROACHES TO ESTIMATION OF SOIL ORGANIC CARBON STOCK ON NATIONAL SCALE

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*Estimation of base line of soil organic carbon (SOC) stock is crucial for the quantification of changes in stocks of SOC in time. In developing of the estimation of SOC stocks at national scale various approaches are using. On Slovakia in the first approach data of SOC from monitoring database were used. At construction of SOC map soil map of Slovakia 1:400 000 was used. Based on Land parcel identification system data, agricultural area was divided on arable soils and pasture. Evaluation of SOC of soil classes according Slovak regions was realized. This approach gives us only a rough estimate because dataset of SOC consist only 318 sampling site. In second approach as input data for SOC database of agricultural soils of Slovakia two databases were used: a) Database of Selected Soil Profiles of General Survey of Agriculture Soils in Slovakia (source of soil organic carbon concentration data) b) Database of Soil ecological units (source of land cover data) For SOC Database of agricultural soils were chosen 16 636 Selected Soil profiles. Data of SOC for particular soil profiles were interpolated by Theisen polygons. Using zonal analysis tools were computed surface weighted averages of SOC parameter for cells grid with resolution 1 * 1 km. This approach enables to give basic information about the level of SOC in agricultural soils of Slovakia. In present time approach base on the complex predictors affecting SOC at different regions of Slovakia to create spatial model SOC at regional level is using.*



S07.01-P -4

ASSESSMENT OF SOIL ORGANIC CARBON FRACTIONS ALTERED BY PRESCRIBED FIRE IN LOWLAND FORESTS OF SOUTH-EASTERN AUSTRALIA

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This study sampled forest floor and soil from low and high intensity fuel reduction burning in lowland forests of South-western Victoria, to determine potential impacts on forest floor organic materials and to characterize the differentially stabilized carbon fractions produced by burning. Forest floor and soil were sampled before and after fire and standard chemical analyses for mass and organic matter change were applied. High intensity prescribed fire partially oxidizes surface litter and fine fuel fractions and deposits charcoal and ash on the soil surface; more so than low intensity fire. Fire reduced forest floor mass and resulted in black carbon deposition on and in surface soil. To characterize these effects, soils were scanned using diffuse reflectance mid infra-red spectroscopy (MIRS), to evaluate the potential of the technique in predicting the changes in chemistry of soil organic carbon due to prescribed fire. Relative to pre-fire soils, new aromatic peaks that represent charcoal were found in the finger print region of post-fire soil spectra. The preliminary results revealed that the impact of fire is restricted to the surface soil layer. Total carbon and black carbon contents of soil fine fraction (<2mm) will be correlated to the intensity of spectral bands derived from MIRS analyses of the soils, using a partial least squares approach, and the results will be discussed.



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CHARACTERIZATION OF FERRIHYDRITE-HUMIC SUBSTANCE (FE-HS) COPRECIPITATES BY TRANSMISSION ELECTRON MICROSCOPY (TEM) AND DYNAMIC LIGHT SCATTERING (DLS)

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Humic substances (HS) may act to mobilize Fe from insoluble Fe minerals. HS are negatively charged polyelectrolytes of varying molecular weight and can strongly react with surfaces of poorly ordered iron oxides. Coprecipitation between HS and iron oxides in soil was demonstrated by the presence of poorly ordered Fe minerals that was explained by the site distortion of the octahedral Fe, possibly due to partial removal of interacting organic molecules. To compare the chemical interaction of HS with iron minerals during coprecipitation, we prepared ferrihydrite-HS associations by coprecipitation using a leonardite. The reaction products were studied by Transmission Electron Microscopy (TEM), RAMAN spectroscopy and Dynamic light scattering (DLS) analysis. TEM and DLS data suggest that the particle distribution of Fe-HS complexes were structured as a large aggregate particle with diameter in the range of 500-1500 nm formed by different nanoparticle aggregates with very small size ranging from 50-200 nm. The structure of Fe-HS complexes show a woven network of two class of particle into a micelles structure, which can include nanoparticle of iron phases into the cavity of the HS as an intermediate characteristics from ferrihydrite- coprecipitates products and iron-humic soluble water substances. This is important not only for the knowledge of factors affecting Fe availability in soils but also to characterize the particle structure and the possibility HS occlusion in the coprecipitated Fe-HS complex.



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COMBINED QUANTIFICATION OF FAECAL STEROIDS AND ANALYSIS OF THEIR BINDING TYPES IN SOILS

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Stanoles, stanones and bile acids can be used as molecular markers to detect faeces deposition in the environment. The combined analysis of these steroids and their precursors (Delta5-sterols) would give robust and specific information about faecal inputs, but was not reliably possible so far in soils. We developed a GC/MS-method for their simultaneous detection and compared the amounts of free and differently bound steroids in soils. The purification, separation and derivatization steps were evaluated by standard addition to lipid extracts from three Anthrosol-reference-profile-pairs with different soil properties and history: one sandy and one clayey Amazonian Anthrosol under pre-Columbian settlements, one loamy German Anthrosol next to a Celtic settlement and reference soils close to each Anthrosol. To get information about the content of faecal biomarkers in differently bound lipid fractions, saponified lipid extracts were compared with non-saponified extracts and directly saponified soil samples. Recoveries =85% and precisions =0.25 (RSD) showed that this method is applicable for the quantification of different steroids. The different saponification treatments revealed that high amounts (20 – 50%) of steroids were encapsulated or bound to the soil matrix. Thus, only a direct saponification of the soil makes a high amount of steroids accessible for quantification. The high amounts of bound steroids question if a solvent extraction is in any case the best extraction method for lipid biomarkers in soils. Especially for the analysis of a wide range of lipid biomarkers differing in age and origin a direct saponification of the soil could be more appropriate.



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DIFFERENTIATION OF MICROBIAL COMMUNITIES IN DEEP SUBSOIL AS A FUNCTION OF DISTANCE FROM CALCIFIED ROOTS – ASSESSED BY GDGTs AND 16S RRNA GENES

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Plant tissue and microbial residues are main sources for soil organic matter (OM). For deep subsoil material like loess, aboveground biomass from synsedimentary grass vegetation is considered as main source of OM. However, postsedimentary penetration of loess by deep-rooting plants can entail incorporation of considerable amounts of root and rhizomicrobial OM. The aim of this study was to differentiate microbial communities in vicinity of and distant from roots in subsoil. Calcification of roots, leading to formation of rhizoliths, entails improved preservation of root and rhizomicrobial residues accumulated during the lifespan of former roots. At Nussloch (SW Germany), rhizoliths, surrounding loess (rhizoloess) and root-free loess were sampled at different depths and analysed for their composition of branched glycerol dialkyl glycerol tetraethers (GDGTs, membrane lipids produced by unknown bacteria), and gene of the RNA of the small subunit of the prokaryotic ribosome (16S rRNA gene). The composition of branched GDGTs varied between rhizoliths and loess, reflecting the fact that branched GDGTs were biosynthesized at different times (Pleistocene in loess and Holocene in rhizoliths), and therefore, under different environmental conditions. Further, high GDGT concentration in rhizoliths compared to low concentration in rhizoloess and root-free loess supported the hypothesis of a heterotrophic lifestyle for branched GDGT-producing bacteria. 16S rRNA gene data also suggest the presence of prokaryotic microorganisms in the former rhizosphere. Further studies of other sites, including vertical profiles of rhizoliths in subsoil, are necessary to comprehensively evaluate the impact of deep-rooting plants on the original composition of loess OM.



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DOUBLE-SHOT THERMOCHEMOLYSIS FOR SOIL ORGANIC MATTER CHARACTERISATION APPLIED TO AN OMBROTROPHIC PEAT BOG (JURA MOUNTAINS, EAST FRANCE).

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Thermochemolysis was applied to a wide variety of polymeric organic materials, including complex and intractable samples (i.e. soils and sediments) for rapid structural characterization, chemical profiling or source determination of the original material. "Multi-shot" pyrolysis was used in the last few years for the analysis of complex natural organic matters by the sequential examination of the products released successively by thermal desorption and by thermal cracking from the same sample. Here, we present the results obtained after a double-shot thermochemolysis performed on the lipid-free fraction of a peat sample from a wooded Sphagnum-dominated mire. The first shot consists in a syllilation-desorption with hexamethyldisilazane at 300°C. The second shot, done on the remaining sample, consists in a thermochemolysis with tetramethylammonium hydroxide at 400°C. Analysis of the thermolysates showed conspicuous differences between the shots regarding the nature and/or the distribution of the numerous products identified in the two thermolysates. Various types of molecules, labile and/or tightly trapped, were released during the first shot (mostly carbohydrates and aromatic units from tannins). Covalently linked compounds and units with a relatively higher thermal stability (monomers from biopolymers such as lignin and cutins, suberins or waxes) were released during the second shot. Differences observed between the two shots afforded important additional information on the composition and sources of the original material. Double-shot thermochemolysis thus appears as an interesting tool to help deciphering the composition, origin and nature of soil and sediment organic matter.



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FATE OF LOW MOLECULAR WEIGHT ORGANIC SUBSTANCES IN SOIL EVALUATED BY ^{13}C APPLICATION IN A FIELD EXPERIMENT

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Low molecular weight organic substances (LMWOS) are a product of plant litter degradation and root exudation. As the LMWOS are extremely dynamic part of soil organic matter it is difficult to study their turnover and transformation pathways under field conditions. For the short-term field experiment plastic tubes were installed into Luvisol soil in four replications for each treatment. Uniformly ^{13}C labeled glucose, ribose, alanine, glutamic acid, potassium acetate and palmitate were injected into the cores with the same amount of C and N. After 3 and 10 days the experiment was stopped, total C and ^{13}C in soil, in microbial biomass, and in phospholipid fatty acids (PLFA) were determined. Microbial uptake of the LMWOS followed the trend sugars > potassium acetate > amino acids. The ^{13}C content in PLFA had similar sequence. The amount of palmitate ^{13}C incorporated into 16:0-PLFA was higher than in other PLFA, as palmitic acid is a direct constituent of this phospholipid. The average portion of investigated LMWOS decomposed to CO_2 was 70% after three days, but palmitic acid was decomposed significantly slower. The amount of LMWOS decomposed and incorporated into the microbial biomass after three days was more than 90% of the applied tracer. Dominant microbial groups of the above described processes were the prokaryotes. Application of labeled LMWOS and analyzing their incorporation into PLFA and total microbial biomass reveals that microbial utilization dominates the turnover of LMWOS in soil.



S07.01-P -10

HOW ARE SOIL CARBON DYNAMICS AFFECTED BY BLACK CARBON VS. LITTER INPUTS?

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*Many fire-prone ecosystems are characterized by high inputs of aboveground litter to fuel load accumulation. In these systems, annual litterfall also contributes a significant amount of organic debris for soil organic matter (SOM) formation. In years of fire, much of this annual organic matter input is lost by combustion and what is left behind is charred plant material, or black carbon. We hypothesize that this alteration of SOM inputs significantly alters soil carbon cycling in terrestrial ecosystems. In order to investigate how soil carbon dynamics are altered by black carbon inputs vs. litter inputs, we incubated ¹³C labeled *Andropogon gerardii* leaf litter and ¹³C labeled black carbon produced from the same *A. gerardii* litter in the fire-prone tallgrass prairie in Kansas, USA. Over the duration of the two year field experiment, we will trace the fate of black carbon and litter carbon into CO₂, SOM fractions, dissolved organic carbon, and the microbial community (using phospholipid fatty acids). We present here our project design and hypotheses, as well as some initial CO₂ flux results from our field incubation.*



S07.01-P -11

IDENTIFYING POTENTIAL ANTIOXIDANT COMPOUNDS IN NaOH EXTRACTS OF UK SOILS AND VEGETATION

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NaOH extracts of soil and vegetation have been shown to have antioxidant capacity. Previously we showed that some lignin-derived phenolic compounds, which are antioxidants, could only account for a very small percentage of the overall antioxidant capacity of soil extracts. The aim of this study was to analyse soil and vegetation extracts using pyrolysis field ionisation mass spectrometry (Py-FIMS), to identify both specific compounds and groups of compounds. We could then find which compounds were correlated with the antioxidant capacities of the extracts and of those which might be antioxidants. Six soils with a range of antioxidant capacities (AOCs) and their associated vegetation associated were extracted. For soil samples, most compound groups were correlated with the antioxidant capacities, but particularly carbohydrates, peptides, and free saturated fatty acids. Of these the peptides could include antioxidants, whereas carbohydrates and fatty acids must be indirectly correlated with AOC. Evidence from single mass signals suggested that certain compounds from lignin phenols and amino acids, and some heterocyclic N-containing compounds were related to the AOC; but these tentative assignments have to be verified. For the vegetation samples, there was one sample with an extremely large antioxidant capacity, which corresponded to a large concentration of the antioxidant alpha-tocopherol (vitamin E). We conclude that above-ground biomass contributed to the AOC in soils, since there were a number of coincident mass signals in soil and vegetation correlating with AOC. There was also evidence that AOC in soils was further determined by soil organic matter formation and rhizosphere processes.



S07.01-P -12

IMPACTS OF LAND USE CHANGE ON CARBOHYDRATES, PROTEINS AND SOIL AGGREGATES AS DEPENDENT ON TIME

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Land use change from pasture to cropland is known to strongly affect soil aggregation and aggregate stabilizing compounds such as carbohydrates and proteins. In two chronosequence studies the temporal and the spatial dimension of these processes were analysed. One chronosequence was formed by groundwater affected soils (35 sites) and a second chronosequence was formed by stagnant water affected soils (10 sites). TOC stocks in the topsoils decreased by 60% in the groundwater affected soils (68.0 to 25.8 t ha⁻¹) and by 76% (195.2 t ha⁻¹ to 45.1 t ha⁻¹) in the stagnant water affected soils. A new equilibrium of the TOC in the stagnant water affected soils was reached 23 (\pm 5) years after land use conversion. Carbohydrate concentrations in both chronosequences decreased much faster than the TOC, and a new equilibrium of the carbohydrate concentration in the stagnant water affected soils was reached 14 (\pm 6) years after land use conversion. Concentrations of protein, in contrast, reacted very slowly towards land use change and reached a new equilibrium after 56 (\pm 5) years. The mean weight diameter of the water stable aggregates decreased more slowly than the TOC in both chronosequences. Despite these strong changes in time, the spatial distribution of organic compounds among different aggregate size fractions was not significantly changed by land use conversion. The studies show that TOC stocks in mineral hydromorphic soils decrease strongly after land use change, and that carbohydrates react very fast towards land use change, while protein stocks are comparatively stable.



S07.01-P -13

IMPROVED QUANTIFICATION OF PYROGENIC CARBON IN SOILS BY A HPLC-DAD METHOD

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Fire-derived (pyrogenic) carbon (PyC) is produced by the incomplete combustion of biomass, for example during wildfires. It can persist in the environment for a long time due to its relative resistance against biological and chemical breakdown. Its accurate quantification in soils is of great interest because the slow turn-over of PyC have implications for the global carbon cycle and carbon budget calculations. A whole suite of PyC quantification methods exists because PyC is not a defined chemical structure but rather a continuum of thermally altered biomass. The benzene polycarboxylic acids (BPCA) analysis is a molecular marker method that was shown to give conservative estimates of PyC quantity in soils. In addition, it yields qualitative information about the degree of aromaticity and condensation of PyC. The commonly used BPCA method consists in digesting soil samples with nitric acid that breaks down the PyC into a suite of BPCAs, which are cleaned, derivatized and finally analyzed by gas chromatography-flame ionization detection (GC-FID). Here, we present a newly developed BPCA method for soils and other complex matrix samples that uses a high performance liquid chromatography system coupled to diode array detection (HPLC-DAD). We demonstrate that this method greatly enhances the reproducibility of PyC quantification in soil samples while reducing analysis time. Moreover, much less sample material is needed for precise PyC quantification and we show that the HPLC-DAD method yields higher PyC contents than the GC-FID method. The new method also facilitates $\delta^{13}\text{C}$ and $\delta^{14}\text{C}$ measurements of the PyC fraction in soils.



S07.01-P -14

MICROBIAL TRANSFORMATION OF AMINO ACIDS IN SOIL ASSESSED BY POSITION-SPECIFIC LABELLING OF ALANINE

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Degradation of high molecular substances in soil ends up in a small number of low molecular substances (LMWOS). Thus, transformation of LMWOS is one of the most important processes in biogeochemical cycles. We used the unique feature of isotope applications – the position-specific labeling – to identify the mechanisms of LMWOS transformation in soil. We assessed short-term transformations of the free and mineral-bound alanine by mixing position-specifically labeled ¹⁴C-alanine with soil. We observed sorption, microbial utilization and mineralization of C from individual positions. Sorption occurred as a whole molecule, whereas exoenzymes preferentially decarboxylate alanine. Microbes also first mineralized the C1-position, whereas C2 and C3 were mainly incorporated into the microbial biomass. Adsorbents have a significant influence on the fate of alanine. We showed that the application of position-specifically labeled substances opens a new way to investigate step-by-step transformations of LMWOS in soil and thus improves our understanding of soil carbon fluxes.



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MODIFICATION OF PLANT BIOMARKERS BY CHARRING AND DURING THE INITIAL PHASE OF BIODEGRADATION OF PYROGENIC ORGANIC MATTER IN SOILS

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*Wildfires convert large amounts of biomass to CO₂, but concomitantly alter soil C pools. Biomass burning causes changes in the lipid pattern, and the composition of aliphatic and aromatic hydrocarbons of fire-affected recent and fossil soils offers specific fingerprint indicators for diagnosis of vegetation burning and burning conditions. However, up to now, knowledge is scarce to which extent the decomposition of pyrogenic organic matter (PyOM) can affect this pattern. Therefore, the present study focuses on the biochemical stability of biomarkers and lipids in plant chars of *Lolium perenne* and *Pinus sylvestris*. Chars were mixed with material of an organic C-poor B horizon and incubated under laboratory conditions for seven weeks. Our results show that already during the initial phase of PyOM biodegradation, n-alkanes and fatty acid (FA) fractions are quickly modified either by decomposition, but also due to neosynthesis of microbial biomass. The incubated pine chars were enriched in the n-alkane octadecane (C18) and mid-chain homologues in the range C22 to C26. In contrast, for the grass chars, n-alkanes and its FA fraction were more degraded. It was observed that levoglucosan, usually formed from the pyrolysis of carbohydrates was efficiently decomposed in the soil. This compound is usually used as a chemical tracer for biomass burning. Attending to its instability against biodegradation, care has to be taken, if used as a tracer in soils containing aged char since it may lead to an underestimation of the charcoal content.*



S07.01-P -16

MOLECULAR COMPOSITION OF THE SOIL ORGANIC MATTER FROM SUBTROPICAL FOREST SYSTEMS

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Lipids characterization of soil organic matter (SOM) is an useful tool for the understanding of SOM source and also to monitorate the effect of land use change on its chemical composition. This study evaluated the lipids distribution pattern of the SOM (0-5 cm) of a Cambisol under two forest systems: Acacia and Eucalyptus forest. In each site, an adjacent area under native vegetation was used as a reference of the natural condition. Soil lipids were extracted via Soxhlet with dichloromethane/methanol (3:1 v/v) and their composition was determined by gas chromatography-mass spectrometry (CG-MS). In general, fatty acids were more abundant in the lipid soil fraction than alkanes. A homologous n-fatty acids series from C8 to C25 with predominance of even numbered C chain was observed in all environments. The higher relative abundance of C16 and C18 chains to the fatty acids, may indicate a relevant contribution from the vegetation to the soil lipid composition. The n-alkane series showed a dominance of molecular chains higher than C20 and a predominance of odd over even carbon chains in all environments. This result points to a SOM derived mainly from plant, especially from the epicuticular leaf waxes. The small difference in the lipids distribution between the forest systems and the respective reference suggests that the cultivation of forest causes little change in soil quality.



S07.01-P -17

MOLECULAR DIFFERENTIATION OF ROOT AND EARTHWORM DERIVED CARBON IN SOIL VIA FATTY ACIDS

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Earthworms and roots lead to chemical impregnation of soil material in earthworm burrows and root channels, respectively. The chemical modification beneath the root surface is related to root exudates, which lead to an input of carbon in the rhizosphere. These exudates contain water soluble compounds, which provide nutrient supply for microorganisms due to easily available substrates. After root death and degradation of root tissues, former root channels can often be distinguished from earthworm burrows by their shape. Compared to root channels, earthworm burrows are commonly more regularly shaped and contain cemented faeces, with gut-derived bacterial organic matter are part of the remains. However, with increasing time after burrowing or rooting, fresh roots can penetrate both types of channels as rooting is easier and they are attracted by higher nutrient supply compared to bulk soil distant to these channels. Simultaneously, it gets more difficult to distinguish, if old pores were originally produced by roots or earthworms. To understand the main drivers leading to a deep penetration of soils and promotion of nutrient acquisition from subsoil it is a main prerequisite to identify the organisms or plants producing such biopores. In the current study we present the lipid composition and especially fatty acids in earthworm burrows, root-derived biopores and mixtures of both to differentiate these biogenic sources of pores in soil samples deriving from different soil depths of a field experiment. We show to which extent lipid molecular markers can be used to trace the source organic matter in these pores.



S07.01-P -18

NANOCLAYS FROM ALLOPHANIC AND NON-ALLOPHANIC SOILS: THEIR IMPLICATIONS ON CARBON SEQUESTRATION POTENTIAL

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Recent studies indicate that global warming is partially caused by the increased emission into the atmosphere of greenhouse gases from the burning of fossil fuels, decomposition of carbon-rich materials and intensive deforestation. Carbon stabilization and sequestration is one of the ways to mitigate the greenhouse effect. It has been suggested that nanoparticles, could be highly effective in carbon sequestration, due to their large surface volume ratio. Nanoparticles occur widely in the natural environment, especially in soil. Andisols, soils derived from volcanic ash contains different inorganic nanoparticles, among which allophane is the most abundant. The association of soil organic matter (SOM) with inorganic nanoparticles, has been found to increase their stability and may therefore contribute to the long-term storage of carbon in soil. In previous research we focus attention on extracting nanoparticles from soil to assess their potential for carbon sequestration. We found that the extracted aggregates of nanoparticles retain a significant amount of carbon (11.8 %) against intensive peroxide treatment. The aims where i) to evaluate the changes in chemical composition when SOM is stabilized by nanoclays, compared to other soil fractions (silt, clay and nanoclay) from an Chilean Andisol, and ii) to extract nanoclay fraction from French soils, in order to investigate the molecules associated to the nanoclay fraction in non-allophanic soils. Thus we could contribute the knowledge concerning with the characterization of organic matter stabilized by nanoclays on a molecular basis, in order to determine the carbon sequestration potential.



S07.01-P -19

NEAR INFRARED SPECTROSCOPY FOR CARBON QUANTIFICATION MODEL USING SOUTH AMERICA AND AFRICA SOIL SAMPLES

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Carbon quantification is an essential analysis to evaluate soil quality, as well as, carbon sequestration capability in different land uses. However, the quantification, in general, is expensive (TOC, CHN) or environmentally inadequate (Walkley-Black). Near Infrared Spectroscopy (NIRS) is an excellent way to quantify carbon in soils because it allows fast and cheap analyses. For the quantification model, it is necessary a well characterized samples bank, used as reference, and also a statistical multivariate analysis. We describe the building of a C quantification model based on NIRS, using elemental analysis as reference. They were used 400 different samples, mostly Oxisols, obtained from Kenya (Savanna and Forest), Peru (Arid Pacific Coast, Andes and Amazonia) and Brazil (Savanna and Pantanal), in a 0.3 to 14% w/w C range. The samples were air dried, milled and sieved (250 μ m). NIR analyses were carried out using a Perkin-Elmer (Spectrum 100N) spectrometer with an ATR accessory. Quant+ software was used to obtain the quantification model. A regression model showed a very good correlation (97%) between the specified (NIRS) and estimated (CHN) analyses, even using samples from very different places. External validation, using 10% of total samples, showed 5.8 % mean deviation (reference x model values). Results show NIRS as useful tool for soil carbon quantification analysis, making possible the elaboration of carbon distribution maps with quickness and reasonable cost.



S07.01-P -20

ORGANIC MATTER ALTERATIONS ALONG AN ALTITUDINAL GRADIENT IN MEDITERRANEAN HIGH-MOUNTAIN SOILS

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The objective of this study was to characterize the changes in soil organic matter (SOM) composition with a climatic elevation gradient in Mediterranean high-mountain soils. The Mediterranean area and high-mountain ecosystems are especially vulnerable to degradation and climate change. In these environments, SOM is particularly important for ecosystem services, because of its key role in important soil processes, its rapid responses to environmental changes, and feedback to the atmospheric climate system. Four soil profiles were sampled along an altitudinal gradient (1250, 1900, 2400, 3101 m a.s.l.) in the Sierra Nevada Natural Park (SE-Spain). This area provides Europe's first barrier against the advance of desertification from North Africa. Higher percentages of total carbon, total humic extract and humin fractions were observed in the fine-earth samples of the soils from lower altitudes. Although the profile at 1900 m showed the highest humification degree (HA/FA ratio), in general SOM quality decreases with height. Py-GC/MS and ¹³C NMR spectroscopy have been used to characterize the SOM composition. Results suggest that the upper soil layers were dominated by labile organic matter with high abundances of polysaccharide derived compounds, whereas more resilient materials occurred in deeper horizons. Along the altitudinal climosequence, the aliphatic-C region in the NMR spectra (0-110 ppm) is lower in the low-altitude soils compared to those from higher altitude, where harsh climatic conditions seems to be limiting the decomposition of the aliphatic compounds. The decrease in alkyl-C/O-alkyl-C ratio with altitude is well correlated with the decrease in the humification degree.



S07.01-P -21

PERIODICAL EFFECTS OF GROWING SAFFRON (*CROCUS SATIVUS*) ON SOIL PHYSICAL AND CHEMICAL PROPERTIES IN EASTERN IRAN

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In arid and semi arid zones, due to low rate of rainfall and low soil fertility, soil management practices such as organic matter modification is of great importance. Saffron is a native plant in eastern part of Iran. It was estimated that the area of saffron growing to be 23000 h in 2009 over central and southern Khorasan provinces. Saffron is a perennial plant which can grow up to 5-7 years through its corms. In contrast to most plant, saffron grows in autumn and winter seasons. So there is no need to irrigate the soil due to saffron summer hibernation. The main aim of the present research was to evaluate physical and chemical properties of soil in saffron farms over a seven period (1 to 7 years growing background). Fifty hectares saffron farms were selected from Gezik region. Soil samplings were conducted from the farms including eight replicates. In the samples, organic material percentage, soil POM, saturated pH, MWD, FC, PWP, total nitrogen, absorbable phosphorus, micro elements including Fe, Mn, Cu, Zn, Ni, Co which were extractible with DTPA, were measured. The comparison among the farms revealed that organic materials increased over the growing years but no significant increase for POM over the growing years. The MWD, FC and PWP were greater for 7-year farms as compared the first year. It can therefore be concluded that soil physical and chemical properties enhance in saffron farms over the growing years.



S07.01-P -22

PYROLYTIC MOLECULAR ASSEMBLAGES AS INDICATORS OF SOIL PHYSICAL VARIABILITY IN CENTRAL SPAIN SOILS

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Pyrolysis–gas chromatography/mass spectrometry (Py–GC/MS) is an analytical technique suitable for molecular characterization of humic substances. The efficient cleavage of recalcitrant C–C-bonded structures under controlled high flash temperature yields diagnostic fragmentation compounds arising from specific macromolecular precursors, thus providing structural information on the complex forms of soil organic C at the molecular level. In this work, the humic acids from 28 topsoil samples were extracted, purified and analysed by double-shot Py–GC/MS. The major pyrolytic products consisted of methoxyphenols in addition to series of other aromatic compounds (phenols, benzenes, naphthalenes...), N-compounds (pyrroles, indoles...) and aliphatic compounds such as well-defined alkyl homologous series (n-alkanes, alkenes and fatty acids) and carbohydrate-derived ketones and furans. The cumulative abundances of the different compound groups were calculated and processed by multivariate data treatments in order to examine relationships between the molecular features of the humic acids and the different physical and chemical characteristics of the soils (pH, electrical conductivity, total organic carbon, total organic nitrogen, CaCO₃ content, cation exchange capacity, soil particle-size distribution, total porosity, water holding at field capacity and water infiltration rate). Moreover, different classification factors were used to establish the main sources of variability in the structural composition of the humic acids from the different soils. The preliminary results suggest that vegetation, land use and soil texture are the main factors reflected in the molecular structure of the soil organic matter.



S07.01-P -23

QUANTIFYING THE DEGREE OF MICROBIAL REWORKING OF PLANT-DERIVED SUBSTRATES IN MEDITERRANEAN FOREST SOILS, BY MEANS OF TMAH-THERMOCHEMOLYSIS-GC-MS

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Quantifying the ageing, the biochemical evolution which results from decomposition, is essential to interpret soil C cycle. How far a given substrate has gone in this evolution may be inferred from the biochemical composition of the decomposing substrates: lipids, macromolecular lipids, proteins, lignin, carbohydrates, etc. Biochemical signatures for sugars, phenolics, alkanolic acids, etc., give insight about the ageing of the decomposing substrate; but since decomposing substrates are heterogeneous, their overall ageing can not be approached with a single signature. In our approach, a panoramic view of the decomposing substrate is achieved by means of TMAH-thermochemolysis GC-MS. The list of the compounds identified gives insight about the status of a collection of chemical compounds: linear alkanolic acids, branched alkanolic acids, α,ω -alkanedioic acids, alkan-1-ols, aromatic compounds and carbohydrates. From them it is possible to distillate numerical indicators of the degree of microbial reworking. We applied this approach to soil profiles under *Quercus rotundifolia*, over calcareous substrates. Soils were fractionated by density, using Na-Polytungstate; TMAH-thermochemolysis-GC-MS was applied to light and dense fractions. The dense fraction appears more evolved than the light fraction, but the difference among them depend on the horizon, being highest in B horizons and lowest in H horizons, where the ageing of light and dense fractions differs little. Parent materials effect are less clear. Overall, our work stresses the interest of taking techniques that give a panoramic view of the composition of a substrate, such as TMAH-thermochemolysis, as the depart point for quantifying the degree of microbial reworking.



S07.01-P -24

SOM CHARACTERIZATION BY HUMIC ACIDS APPLIED ON A DIVERSE SET OF AUSTRIAN FOREST SOIL SAMPLES

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In a ¹⁴C-labeled long-term field experiment humic acids (HAs) extracted with 1M NaOH turned out to be a quite dynamic fraction of soil organic matter (SOM). In a next step, the methodology was applied on a diverse set of Austrian forest soil samples from the BIOSOIL project to elucidate the ability of HAs to reflect characteristics of SOM. With this set (n=113) correlations of parameters of extracted HAs (representing a part of SOM) with bulk soil parameters (containing the bulk pool of SOM) were calculated. Spearman coefficients were calculated for correlations of the parameters of HAs and bulk soils. High and highly significant ($P < 0.01$) positive correlations of HA yields were obtained with bulk soil Corg (0.795) and Nt (0.705), showing the potential of this fraction to reflect changes in the pool size of organic carbon and nitrogen in soils. Another important result were high or at least medium and high significant positive correlations of aliphatic characteristics of bulk soil mid-infrared bands with yields of HAs (aliphatic band 1, 2950 cm⁻¹: 0.711; aliphatic band 2, 2850 cm⁻¹: 0.670). This suggested that this fraction was corresponding preferably with aliphatic parts of bulk SOM. Further, a significant medium and negative correlation was obtained between HA yields and their relative fluorescence intensities. This underlines the comparably low humified character of the HA-fraction. Hence, these results showed the distinct potential of this SOM fraction to reflect site characteristics.



S07.01-P -25

THE ORGANIC MATTER AMPHIPHILITY OF AUTOMORPHIC MIDDLE-TAIGA SOILS AND THE CHANGES IN IT CAUSED BY VEGETATION SUCCESSION (AFTER CUTTING)

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The soils of taiga ecosystems contain a great deal of biogeocoenotic carbon stocks. By using the ability of humic substances (HSs) of linking hydrophobic substances as a complex sign, it is possible to re-establish in vitro the genetic natural HS affinity to water as soon as water is a driving force and obvious participant in soil forming processes of taiga soils. The majority of hydrophilic components are present in forest litters but the amount of them in pine wood litters is higher than that in spruce wood litters. In soils on loam, the content of hydrophilic fractions in upper mineral soil horizons is higher compared to that on sand. Podzols are more typical of illuvial accumulation of hydrophilic components. Vegetation succession after clear tree cuttings changes the qualitative and quantitative composition of fallen plant waste, as well as its transformation micro-climate conditions. As identified, on condition of natural reforestation the soils at felling areas undergo transformation of HS system which is expressed by the hydrophility increase of the study extracts. The greatest changes occur at the initial after-felling restoration stages (first tens of years). 'Young' cutting areas increase in the SOM reaction ability. As a result, mineral soil part increases in hydrolysis visualized by the rise in both absolute and relative contents of Fe, Al-organic complexes in upper mineral horizons. The observed changes in the HS system during natural reforestation may favor the changes of chemical composition of water flows. This work was supported by the RFBR 08-04-90718-mob_st., 11-04-00885-a.



S07.01-P -26

THRESHOLD PYROLYSIS TEMPERATURE CONTROLS THE FATES OF CHARRED ORGANIC CARBON: A CASE STUDY USING RICE STRAW AND HUSK

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Field burning of crop residues is a common practice. The burned residues are incorporated into a plow layer. Pyrolysis conditions (esp. temperature and O₂ concentration) might strongly affect the fate of the residue carbon – the mass of the residues likely decreases at higher pyrolysis temperature and O₂ level through combustion whereas the residues underwent low-temperature pyrolysis would rapidly decompose due to minimum charring. We thus tested the hypothesis that there is a threshold range in pyrolysis temperature to maximize the “longevity” of the residue-derived carbon in soil and that the range differs by the O₂ level during pyrolysis. We pyrolyzed rice straw and rice husk in a muffle furnace under gradually-increased temperature up to 4–5 different levels (200–600°C) at two O₂ levels (ambient vs. reduced). The residues were charred at different degrees, resulting in the C/O molar ratios ranged 0.10–0.75. We incubated each residue in a sand medium under an aerobic condition for over six months and monitored the respired CO₂. Using the respiration data, we developed an empirical model and found that the decomposition rate constants negatively correlated with the C/O ratio. By the model extrapolation, we assessed the interactive effect of pyrolysis temperature, O₂ level, and type of plant residues on the mass of remaining carbon over prolonged time. The analysis showed that, in decadal time scale, the residues pyrolyzed at around 300-360 °C remained longer compared to those pyrolyzed at higher or lower temperatures regardless of the O₂ conditions.



S07.01-P -27

VARIABILITY OF ^{13}C -LABELING IN PLANT TISSUES

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*A major challenge in studying the fate of soil organic matter (OM) is the diversity of its sources: aerial parts or roots, bacteria, fungi etc. An approach to evaluate these different contributions or the modification of OM during biodegradation is to monitor material labelled with stable isotopes. Carbon stable isotope labeling of plant (^{13}C) has been widely used to estimate the fate of bulk OM and OM individual compounds. Natural or artificially labeling either by pulse or continuous labeling are commonly used. While the isotopic difference between C_3 and C_4 plants ($\sim 15\text{‰}$) is adequate to monitor bulk OM, it may not be sensitive enough to detect small effects at the molecular level. Nevertheless, the molecular nature of plant residues is suspected to largely govern their fate in soils. Consequently, incubation of artificially ^{13}C -enriched OM is becoming increasingly favoured to unravel biogeochemical processes. Incorporation of labeling in the different plant components could differ largely leading to potential variability of ^{13}C -labeling. However when labelled plant material is incubated in soil, such variability may lead to inaccurate conclusions if labelling is considered as homogenous within plant constituents. The aim of this work was thus to document the variability of ^{13}C -labeling of plant material after continuous heavy labeling. Thus, we have measured labeling of above ground and below ground part of *Lolium multiflorum* but also on young vs old leaves and active growth zone and dead part of roots and in soil.*



S07.02-P - INNOVATION AND SOIL SCIENCE - APPLICATION OF ADVANCED NMR AND MRI TECHNIQUES FOR IMPROVING OUR UNDERSTANDING OF SOIL ORGANIC MATTER FORMATION AND ITS INTERACTION WITH THE MINERAL PHASE

Tuesday 03 July 2012 from 17:00 to 18:30. Room Poster Areas

S07.02-P -1

APPLICATION OF FAST FIELD CYCLING NMR RELAXOMETRY FOR THE EVALUATION OF THE EFFECTS OF ORGANIC AMENDMENTS ON STRESSED SOILS

Maria A. Rao, Portici - Italy

S07.02-P -2

APPLICATION OF FAST FIELD CYCLING NMR RELAXOMETRY TO DIFFERENTIATE AMONG AFFORESTED SOILS

Pellegrino Conte, Palermo - Italy

S07.02-P -3

ASSESSING THE INFLUENCE OF BIOCHAR ON SOIL STRUCTURE AND SOIL WATER RETENTION: A ¹H NMR RELAXOMETRY STUDY COUPLED WITH HIGH-ENERGY MOISTURE CHARACTERISTIC TECHNIQUE ON A LABORATORY SCALE

Claudio De Pasquale, Palermo - Italy

S07.02-P -4

COMBINING SOLID-STATE ¹³C NMR SPECTROSCOPY WITH CHEMICAL ANALYSIS TO STUDY SOM STABILIZATION MECHANISMS IN BRAZILIAN SOILS.

Marta Velasco-Molina, Santiago de Compostela - Spain

S07.02-P -5

EFFECT OF HF DEMINERALIZATION PRE-TREATMENT ON THE QUALITATIVE AND QUANTITATIVE ASSESSMENT OF SOM IN ANDOSOLS. PY-GC/MS AND SOLID STATE NMR SPECTROSCOPY

José A. González-Pérez, Seville - Spain

S07.02-P -6

EFFECTS OF MANURE AND MINERAL FERTILIZATION ON SURFACE AREA (SA) OF DIFFERENT WATER STABLE AGGREGATES

Gianluca Simonetti, Legnaro (PD) - Italy



S07.02-P -7

ESTIMATED AND DIAGNOSTIC CRITERIA OF QUALITATIVE COMPOSITION OF SOIL ORGANIC MATTER

Alexander Popov, St. Petersburg - Russian Federation

S07.02-P -8

EXPLOITING ¹³C MAGNETIZATION VIA MULTIPLE CONTACTS: AN EFFICIENT CROSS POLARIZATION SCHEME FOR SOIL ORGANIC MATTER STUDIES

Denis Courtier-Murias, Toronto - Canada

S07.02-P -9

IMPROVING STRUCTURAL CHARACTERIZATION OF SOIL ORGANIC MATTER BY 2-DIMENSIONAL HETERONUCLEUS CORRELATION SOLID-STATE ¹³C NMR (HETCOR) SPECTROSCOPY

Heike Knicker, Sevilla - Spain

S07.02-P -10

LONG-TERM EFFECTS OF MANURE AND MINERAL FERTILIZATION ON SAND SOIL ORGANIC MATTER

Gianluca Simonetti, Legnaro (PD) - Italy

S07.02-P -11

NON-INVASIVE LOCALIZATION OF SOIL ORGANIC MATTER IN SOIL AGGREGATES USING SYNCHROTRON-BASED X-RAY MICROTOMOGRAPHY

Stephen Peth, Kiel - Germany

S07.02-P -12

NOVEL APPROACHES FOR IDENTIFYING PHOSPHORUS SPECIES IN TERRESTRIAL AND AQUATIC ECOSYSTEMS BY ³¹P NMR

Johan Vestergren, Umeå - Sweden

S07.02-P -13

ORGANO-MINERAL INTERACTIONS IN THE ALLOPHANIC ANDOSOL AND ARENOSOL: THE IMPACT OF MICRO-MORPHOLOGY AND SURFACE CHEMISTRY AS REVEALED BY ¹²⁹XE- AND ¹³C NMR SPECTROSCOPES

Filimonova Svetlana, Freising, - Germany



S07.02-P -14

SOLID STATE ^{13}C NMR AS A WAY TO EVALUATE ORGANIC MATTER IN AGRICULTURAL SOILS.

Marco Panettieri, Seville - Spain

S07.02-P -15

SOLID-STATE ^{13}C AND ^{15}N NMR SPECTROSCOPIC ANALYSIS OF ORGANIC MATTER IN A MEDITERRANEAN SOIL AFTER AMENDMENT OF N-AMMOXIDIZED LIGNINS

Heike Knicker, Seville - Spain

S07.02-P -16

THE USE OF 2D-HETCOR IN SOIL SCIENCE

Anne E. Berns, Jülich - Germany

S07.02-P -17

THERMAL INDUCED CHANGES IN PHYSICAL STRUCTURE OF DISSOLVED ORGANIC MATTER AS ASSESSED BY FAST FIELD CYCLING NMR RELAXOMETRY

Jiri Kucerik, Landau - Germany



S07.02-P -1

APPLICATION OF FAST FIELD CYCLING NMR RELAXOMETRY FOR THE EVALUATION OF THE EFFECTS OF ORGANIC AMENDMENTS ON STRESSED SOILS

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Very recently, development of a new low field NMR technique has been achieved. Namely, this technique investigates the effect of variable Zeeman magnetic fields over the spectral densities ($J(?)$) and the strength (C) of the dipolar interactions being modulated. The technique known as Fast Field Cycling (FFC) NMR relaxometry allows a fast investigation of the conformational and dynamic properties of whole complex molecular systems through measurement of longitudinal or spin-lattice relaxation rates ($R_1 \propto 1/T_1$). FFC relaxometry is based on the cycling of the Zeeman magnetic field (B_0) through three different values traditionally indicated as polarization (B_{pol}), relaxation (B_{relax}), and acquisition (B_{acq}) fields. In this study, FFC NMR was applied to assess the effects of different organic amendments on soils strongly stressed by agricultural practices. During the two years of study, two farms, in an important agricultural area of Campania Region, Italy, were selected in order to study the effect of different organic amendments on soils cultivated under plastic cover. Namely, a compost from municipal solid wastes and wood-wastes (scraps of poplars pruning) were applied, yearly, in different doses and ratios. The results obtained by FFC NMR relaxometry showed interesting information on the effects of organic amendments on soil properties. In particular results suggested that the amendments induced an increase of the soil pore size, by organo-mineral aggregates formation, which, in turn, had positive effects on soil structure and soil aeration.



S07.02-P -2

APPLICATION OF FAST FIELD CYCLING NMR RELAXOMETRY TO DIFFERENTIATE AMONG AFFORESTED SOILS

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Afforestation is a practice used to restore or maintain soil functionalities such as fertility. Tree species used for afforestation show a great potential to affect the degree, rate and direction of changes in soil attributes. Although the influence of forest plant cover on edaphic characteristics has been extensively studied, there are only few papers concerning the effect of plant cover on the interactions between the organo-mineral colloids and soil solution. In the present study, fast field cycling (FFC) NMR relaxometry was applied to discriminate among four afforested soils in a central-Sicily (Italy) area. Results showed that three dynamically different water systems characterized each soil, and they could be explained by the water restrained in silt-, clay- and sand-type pores. In addition, the differences in the relaxation time distributions were attributed to the effect of dissolved organic matter on water mobility. This study shows the suitability of FFC NMR relaxometry in the understanding of water dynamics in afforested soils, thereby opening new possibilities for the prediction of the dynamics of micro- and macro-nutrients in soil environments.



S07.02-P -3

ASSESSING THE INFLUENCE OF BIOCHAR ON SOIL STRUCTURE AND SOIL WATER RETENTION: A 1H NMR RELAXOMETRY STUDY COUPLED WITH HIGH-ENERGY MOISTURE CHARACTERISTIC TECHNIQUE ON A LABORATORY SCALE

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Production of biochar and its storage in soils have been suggested as an efficient way to mitigate global climate changes through carbon sequestration in soils. In addition, application of biochar to soils concomitantly results in increase of soil structure, improvement of crop yield and enhancement of drought tolerance by plants. Application of biochar to soils also promotes reduction of irrigation needs in arid and semiarid regions which are affected by droughts and considerable climate variability. In order to understand the molecular mechanisms involved in the positive effects of biochars applied to soils, soil structural stability and soil water retention capacity were investigated by high-energy moisture characteristic technique (HEMC) after amendment of a Sicilian soil with different amounts of an industrially produced biochar. HEMC was applied under laboratory conditions on re-packed soil samples mixed with the different biochar amounts. Matric potential values were varied in the range between 0 and 150 cm. The soil/biochar samples were also analysed by fast field cycling (FFC) NMR relaxometry for the understanding of water molecular dynamics. Both HEMC and FFC NMR relaxometry results revealed that water mobility increased with increasing biochar amounts in soils. These results confirmed that soil amendment with biochar may enhance water availability, and hence soil solution, for plant nutrition. Finally, to the best of our knowledge the present study combined for the first time results from HEMC and FFC NMR relaxometry, thereby showing the suitability of both techniques for the evaluation of soil structural stability.



S07.02-P -4

COMBINING SOLID-STATE ^{13}C NMR SPECTROSCOPY WITH CHEMICAL ANALYSIS TO STUDY SOM STABILIZATION MECHANISMS IN BRAZILIAN SOILS.

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Soil organic matter (SOM) is an important pool in the global carbon cycle and has a determining role as a C sink. Maintenance of SOM is critical because of its importance for soil fertility, water retention, CEC and adsorption capacity, especially in sub- and tropical regions where climatic conditions allow for intense mineralization of SOC and fast C-turnover in the highly weathered soils. The SOM protection is affected by different factors, the importance of which for soils to act as a C sink may vary between areas and along a profile. To reveal this impact, the chemical composition of SOM of selected Southern Brazilian soils (Ferralsols, Umbrisols and Acrisols), developed under different climatic conditions and vegetation, was studied by solid-state ^{13}C NMR spectroscopy and correlated with soil texture, climate and aluminium and iron oxides. ^{13}C NMR spectra show a dominance of O-alkyl C and aryl-C compounds. No or low correlation was observed between climatic parameters and CT. An improved correlation ($R^2 \sim 0.65$) was achieved using the humic fractions (Cp) of A horizons. Even though, in general, CT and Cp increased when clay decreased and silt increased, any correlation was observed between C content and size fractions. Poorly crystallized Fe and Al oxides correlated strongly with humified components of soils. But no relationship was found between the oxides and the C fraction of A horizons, which were both extracted with pyrophosphate. This indicates that in the studied soils, aside from organic-mineral complexation additional factors may play an important role in SOM stabilization.



S07.02-P -5

EFFECT OF HF DEMINERALIZATION PRE-TREATMENT ON THE QUALITATIVE AND QUANTITATIVE ASSESSMENT OF SOM IN ANDOSOLS. PY-GC/MS AND SOLID STATE NMR SPECTROSCOPY

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*Andosols are usually formed from volcanic substrates, with thick A horizons high in organic carbon mainly in the form of stabilized humic fractions. The peculiar properties of these soils are, to large extent, affected by poorly crystalline materials like allophanes, imogolite and other Fe and Al oxyhydroxides that induce intense organo-mineral interactions. The samples studied were from the organic A horizons of three soils with andic properties and one non-andic soil (Sodic Cambisol) from the island of Tenerife (Canary Islands, Spain); Los Frailes is a Vitric Andosol under Canarian pine (*Pinus canariensis*), Ravelo is a Fulvic Andosol under Monterey pine (*Pinus radiata*), Siete Lomas is an Umbric Leptosol under tagasaste/lucerne trees (*Chamaecytisus proliferus*) and Tabaibal de Rasca is a non-andic soil, with high salinity and very low SOM content, this soil is under Canarian xeric euphorbiaceae vegetation with aridic soil moisture regime and is classified as a Sodic Cambisol. In order to enlighten soil organic matter (SOM) molecular composition and its relation with the mineral soil matrix, the results from a comparative study is described where whole soil and HF demineralised soil samples were analysed by solid state NMR spectroscopy (CP-MAS ¹³C-NMR) and analytical pyrolysis (Py-GC/MS).*



S07.02-P -6

EFFECTS OF MANURE AND MINERAL FERTILIZATION ON SURFACE AREA (SA) OF DIFFERENT WATER STABLE AGGREGATES

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In a long-term experiment established in 1964 (experimental farm of the University of Padova, Italy), comparing three types of soil (Clay, Peaty and Sand), we evaluated the effect of mineral fertilization (M2) and farmyard manure (FYM) on the soil specific surface area (SA). Analyses were performed on soil water stable aggregates (WSA), divided in macroaggregates (2000-250 μm), microaggregates (53-250 μm) and silt-clay fractions (< 53 μm). The SA of WSA fractions were measured with physical adsorption methods, using N₂ (77 K) and CO₂ (273 K) as adsorbents and evaluating the SA with the use of BET and Dubinin-Radushkevich (DR) methods, respectively. Results were strongly affected by soil organic carbon (SOC) content. Peaty - SOC > 61 g kg⁻¹ -- had higher SACO₂ (24.19 m²g⁻¹) than SAN₂ (9.82 m²g⁻¹). This effect was not instead observed in the Clay (41.87 m²g⁻¹ SAN₂ vs 36.1 m²g⁻¹ SACO₂) and Sand (2.37 m²g⁻¹ SAN₂ vs 1.80 m²g⁻¹ SACO₂). FMY decreased SAN₂ in all the soils. In particular, in Clay values ranged from 33 m²g⁻¹ in FMY to 47 m²g⁻¹ in M2. Contrasting effects were instead observed for SACO₂. Spectroscopic analyses of SOC highlighted a different effect of functional groups on SA. Both SAN₂ and SACO₂ were positively correlated with carbonyl-C compounds, while the other functional groups had variable effects on the two SA measurement methods.



S07.02-P -7

ESTIMATED AND DIAGNOSTIC CRITERIA OF QUALITATIVE COMPOSITION OF SOIL ORGANIC MATTER

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The qualitative composition of soil organic matter (SOM) is necessary for estimating from a position of their stability to a mineralization with aim the characteristic of climatic and/or anthropogenous influence. The method of chemical destructive fractionating (CDF) has been developed for this purpose (Popov, Tsiplenkov, 1991). This method is based on determination of stability of SOM components and/or various parts of organic macromolecules to action of oxidizers. A lot of solutions with same concentration of an oxidizer ($K_2Cr_2O_7$), but with linearly increasing oxidizing capacity prepare with this aim. The higher oxidizing capacity of a solution-oxidizer, the higher chemical decomposition of organic material. Labile parts of SOM are oxidized by solutions with low oxidizing capacity, and stable parts – by solutions with higher one. A comparison of qualitative composition of SOM humus-accumulative horizons by CDF method testified that the organic matter of different types of virgin soils contained equal quantity labile and stable parts. Also it was revealed, that labile part in SOM composition was prevalent in soil, which was formed in hydromorphic conditions. Long intensive agricultural use of soils can lead to predominance a stable part in SOM composition, despite of a rather high content of total organic matter. Parameters of an estimation of SOM qualitative composition can be based on value of Shannon's entropy (H_0), which calculated on the basis of CDF results.



S07.02-P -8

EXPLOITING ^{13}C MAGNETIZATION VIA MULTIPLE CONTACTS: AN EFFICIENT CROSS POLARIZATION SCHEME FOR SOIL ORGANIC MATTER STUDIES

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Solid-state Nuclear Magnetic Resonance (NMR) is arguably the most commonly applied NMR technique in the study of soil organic matter partially because soil analysis can be performed without sample extraction. Mainly due to its large chemical shift dispersions, ^{13}C is often the preferred nucleus and cross polarization (CP) is a convenient mean of increasing the sensitivity of ^{13}C NMR. Since CP conditions are highly sensitive to the molecular motions, high contents of paramagnetics and moisture will affect the CP dynamics, making it difficult to attain optimal sensitivity under conventional ramped CP schemes. To address this limitation, we propose a robust CP scheme, which has been successfully applied in the study of membrane protein in aligned samples, yielding an overall twofold sensitivity enhancement. This new method uses multiple contacts to overcome the thermodynamic limit efficiency of single contact experiments, which it is beneficial to systems with short rotating-frame spin-lattice relaxation ($T_{1\rho}$) times. Concurrently, it also gains the advantage of ^{13}C magnetization generated by direct polarization for those nuclei with relatively long polarization (TXH) and short longitudinal relaxation (T_1) values. The direct polarization provides better detection of groups such as aromatics and carboxyls. Our preliminary results indicate an increase of ~40% in sensitivity for soils in general with non-protonated positions being better represented. Considering rep-CP requires no additional spectrometer time compared to conventional CP and produces a more representative and intense spectrum, the approach may likely find widespread application in environmental research.



S07.02-P -9

IMPROVING STRUCTURAL CHARACTERIZATION OF SOIL ORGANIC MATTER BY 2-DIMENSIONAL HETERONUCLEUS CORRELATION SOLID-STATE ^{13}C NMR (HETCOR) SPECTROSCOPY

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One emphasis of NMR spectroscopy is to determine, via chemical shift assignments, the gross chemical structure of a material, and to quantitatively correlate between the different signal intensities and the chemical composition. Up to now, in soil science mainly 1-dimensional solid-state NMR is used for chemical characterization of soil organic matter (SOM). However, additional structural information can be obtained with 2-dimensional HETeronucleus CORelation ^{13}C NMR (HETCOR) spectroscopy. Here, the C-signal intensity is modulated by the proton chemical shift via scalar coupling, which allows a more detailed correlation of proton chemical shifts to carbon chemical shifts. Combining this technique with relaxation time measurements gives further information about the mobility of the respective functional group and a rough measurement of the internuclear distance between H and C. Thus, applied in soil science, this technique offers a powerful means to relate spatial molecular properties to biochemical recalcitrance of SOM which opens new doors for a deeper understanding of the mechanisms, responsible for its retention and stabilization in soils. In the present work, we applied this approach to charred biomolecules and plant material. Combined with elemental analysis, we were able to show further evidence supporting that pyrogenic organic matter represents a heterogeneous mixture of partly altered molecules, rather than a highly condensed polyaromatic network. With those first experiments, important acquisition parameters were determined and we clearly demonstrated that this technique can also applied to more complex samples.



S07.02-P -10

LONG-TERM EFFECTS OF MANURE AND MINERAL FERTILIZATION ON SAND SOIL ORGANIC MATTER

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A long-term experiment was conducted over 44 years on a sand soil, located at the experimental farm of the University of Padova (Italy), to study the effect of mineral fertilization and farmyard manure (FYM) on chemical features of soil organic matter (SOM) extracted from coarse (2000-250 μm) and fine (53-250 μm) soil fractions. The experiment began in 1964 on open lysimeters of 80 cm deep. Fertilization treatments consisted of no application (untreated), farmyard manure (FYM) (40 t ha⁻¹ yr⁻¹), mineral NPK fertilizer (200 kg N ha⁻¹ yr⁻¹, 100 kg P₂O₅ ha⁻¹ yr⁻¹, 240 kg K₂O ha⁻¹ yr⁻¹). The extracted SOM from each fraction was characterized by using elemental, isotopic ($\delta^{13}\text{C}$), CP MAS ¹³C NMR and DRIFT analyses. Chemical and spectroscopic analyses showed that the SOM structure quali-quantitatively changed in relation to treatments. In particular, FYM led a considerable increase in carbonyl, aromatic and alkyl C in SOM of macro and microaggregates with respect to untreated and mineral fertilization. Anomeric C and N,O alkyl C seem to be positively affected by mineral fertilization but their distribution changed in both aggregates. The natural abundance of ¹³C stable isotope revealed fundamental information regarding the impacts of FYM on SOM.



S07.02-P -11

NON-INVASIVE LOCALIZATION OF SOIL ORGANIC MATTER IN SOIL AGGREGATES USING SYNCHROTRON-BASED X-RAY MICROTOMOGRAPHY

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Modelling carbon mineralisation in natural soils is a major topic in soil and climate research but current models need to be improved by including soil structure as an influencing factor to better predict C fluxes between pedosphere and atmosphere and to estimate carbon sequestration potentials. Geometry-based mechanistic modelling approaches have recently been developed to systematically study the effect of soil structure on carbon decomposition. Such models require spatially explicit input parameters describing the architecture of the pore space and the heterogeneous distribution of microbes and organic matter as decomposable substrate. The latter is very difficult to determine in situ thus adding uncertainty to modelling results. To obtain more realistic input data we have developed an approach to localize soil organic matter (SOM) non-invasively with a combination of synchrotron-based X-ray microtomography and osmium as a staining agent for SOM. Here we present the first results using 5 mm sized soil aggregate samples with contrasting C-contents providing a detailed 3D map of aggregate scale soil organic matter distribution and its association with soil structure.



S07.02-P -12

NOVEL APPROACHES FOR IDENTIFYING PHOSPHORUS SPECIES IN TERRESTRIAL AND AQUATIC ECOSYSTEMS BY ^{31}P NMR

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Phosphorus (P) limits plant growth in many of the world's biomes. Predictions propose that rock P production peaks within 35 years with severe impacts on future global food production¹. Most soil P occurs as organic P species, but there is a severe lack of knowledge about the molecular processes controlling their reactivity and bioavailability. Our aim is to develop high resolution NMR techniques to identify P species in soils; information ideal for correlating different organic P species to plant and soil processes². For liquid-state NMR, soil organic P is commonly solubilized by NaOH-EDTA extraction, leading to co-extraction of heavy metal which gives detrimental line broadening in the ^{31}P NMR spectra even though complexed with EDTA. To evade line broadening these ions have to be physically removed. We find that sulfide precipitation removes Fe and Mn ions without affecting the P-composition. It dramatically reduces line widths from over 100 Hz down to 2 Hz on soil extracts allowing 2D ^1H - ^{31}P NMR to be applied³. 2D ^1H - ^{31}P NMR resolves the highly crowded spectral region where abundant monoester P appears. Exploiting 2D ^1H - ^{31}P correlations in NMR of soil extracts identifies individual organic P species by a combination of their ^{31}P and ^1H chemical shifts and coupling constants^{3, 4}. The novel sulfide treatment is now being applied on boreal and tropical soils⁴. Studies using passive sampling with ion exchange resin analyzed with solid state ^{31}P MAS NMR have the potential to analyze the reservoir of organic P-species in aquatic systems e.g. streams



S07.02-P -13

ORGANO-MINERAL INTERACTIONS IN THE ALLOPHANIC ANDOSOL AND ARENOSOL: THE IMPACT OF MICRO-MORPHOLOGY AND SURFACE CHEMISTRY AS REVEALED BY ^{129}Xe - AND ^{13}C NMR SPECTROSCOPES

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To understand the dynamics of organic C in soils, a simultaneous studying of organic- and mineral components is required. We describe the advances achieved by the use of ^{129}Xe NMR of adsorbed xenon to recognize both the micro-structural features of soil components and their adsorption sites interacting with organics. We studied allophanic Andosols, a fire-affected Arenosol, and organo-mineral mixtures compositionally modeling these soils. An important finding was the possibility to extrapolate the Xe adsorption behaviour for the adsorption of small organics onto soil minerals, as we revealed the ^{129}Xe shifts to be sensitive to acidic centres indicative by the parabolic “d versus Xe loading” plots. OM sorption onto allophane occurred via carboxyl groups through incorporation of organics into the inner spaces of primary spherules, or blocking the spherule openings. By analysing the paramagnetic ^{129}Xe shifts (soils with varying Fe content) we evidenced a homogeneous distribution of Fe oxides throughout allophanic compounds supposable through inclusions of the Fe oxide islands into allophanic clouds and/or isomorphic substitution of Al- by the Fe in the lattice (confirmed by Mössbauer). Those “mixed” phases account for multiple mechanisms of SOM binding. Finally, we report on the progress achieved by studying the porous domains within soil organic fractions (particulate organic matter). In the mineral Arenosol fractions (fire-affected), the comparative ^{13}C - and ^{129}Xe NMR analysis was shown to help revealing the extent of association between the soil char and minerals. Acknowledgements: Prof. R.Jahn, Prof. H.Knicker and Dr. A.Hilscher are gratefully acknowledged for sharing their soil materials.



S07.02-P -14

SOLID STATE ^{13}C NMR AS A WAY TO EVALUATE ORGANIC MATTER IN AGRICULTURAL SOILS.

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Soil Organic Matter (SOM) is extensively influenced by tillage practices in agricultural soils. Frequent tillage operations change physical, chemical and microbiological status that can evolve in SOM losses which is worsening soil fertility and crop yields. Conservation Agriculture (CA) has been promoted as a solution for these constrains. It involves minimal soil disturbance, crop rotations, crop residues retention and the use of integrated nutrient management. In semi-arid Mediterranean areas, studies of the performance of CA practices have demonstrated advantages in crop yield, soil water storage and soil protection. In the present work we combined routine solid-state ^{13}C -NMR spectroscopy and relaxation time measurements for an improved characterization of soil organic matter in order to assess the effects of the implementation of a traditional tillage (moldboard plowing) (TT) and a reduced tillage (chiseling) (RT) on soil quality and crop yield. This dryland calcareous soil was previously cultivated for 9 years under no tillage management (NT) in SW-Spain. To study the interaction between physical, microbial and biochemical processes on topsoil, soil samples were dry-sieved and aggregate-size fractionated. For each fraction chemical parameters (total organic carbon, water soluble carbon, and active carbon), microbial parameters (microbial biomass carbon and nitrogen, β -glucosidase and dehydrogenase activities) and physical properties (aggregate distribution) were analyzed. Results demonstrated that TT causes SOM loss, a decrease in microbial activity, aggregates disruption and higher amounts of oxidized products originated from SOM degradation. The more oxidative environment and the lack of fresh residue material change SOM quality after only 2 years since TT implementation.



S07.02-P -15

SOLID-STATE ^{13}C AND ^{15}N NMR SPECTROSCOPIC ANALYSIS OF ORGANIC MATTER IN A MEDITERRANEAN SOIL AFTER AMENDMENT OF N-AMMOXIDIZED LIGNINS

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Nitrogen (N) availability is a crucial factor for maintaining soil productivity. However, application of mineral N fertilizer encounters environmental concerns. Therefore, the use of ammonoxidised technical lignins was suggested, since they may act as potential slow N-release fertilizers. Testing their applicability to agricultural soils, studying their impact on soil organic matter composition and stability, bioavailability of added N and the impact on soil fertility and are still needed, and were the major goals of this study. For those purposes we performed pot experiments in which *Lolium perenne* was grown on a typical Andalusian soil (calcareous Rhodoxeralf) after amendment of N-lignins, highly enriched in ^{15}N (^{15}N -Sarkanda and ^{15}N -Indulin ammonoxidized lignins) for 75 days (Liebner et al, 2011). The ^{15}N enrichment allowed the application of solid-state ^{15}N NMR spectroscopy. The solid-state ^{13}C NMR spectra of the ^{15}N -lignins showed the typical lignin pattern and the respective solid-state ^{15}N CPMAS NMR spectra demonstrated signals assignable to pyrrole-type N, aminobenzoquinones, aminohydroquinones, aromatic amines and ammonium. However, after 30 days of incubation those signals disappeared in favor to signals typical for peptide structures, although some intensity remained in the chemical shift region assignable to pyrrole-type N. The shift of ^{15}N signal intensity is most tentatively caused by the fast and efficient recycling of amino groups released from the lignin backbone for the build-up of new microbial biomass. With respect to soil organic C, the solid-state ^{13}C NMR spectroscopy revealed no major alteration due to incubation. Reference; Liebner, F., et al., 2011. *Angewandte Chemie* 50, 34-39.



S07.02-P -16

THE USE OF 2D-HETCOR IN SOIL SCIENCE

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In the last two decades solid-state NMR has established itself as valuable nondestructive tool for analyzing chemical structures in soil. However, a detailed analysis of the spectra is often hampered by the fact that the line widths in SS NMR are quite large and usually a number of chemical species with overlapping signals are present in soil. An elegant way to reduce the problem of peak overlap is to spread the signals in a second dimension. 2D Heteronuclear-Correlation (HETCOR) NMR achieves this by modulating the ¹H signal prior to the transfer of the ¹H polarization to the ¹³C nuclei (i.e. cross-polarization). Through incrementation of the ¹H modulation with subsequent recording of the corresponding ¹³C spectra a 2D spectra is obtained. Furthermore, recording of several HETCOR spectra with increasing cross-polarization times gives further insight into the spatial arrangement of the identified chemical species as the polarization transfer can act over a greater distance. In this work we present the application of HETCOR NMR to lignin using different recording parameters. The 2D recording technique allowed us to gain a more detailed insight into the spatial structure of lignin.



S07.02-P -17

THERMAL INDUCED CHANGES IN PHYSICAL STRUCTURE OF DISSOLVED ORGANIC MATTER AS ASSESSED BY FAST FIELD CYCLING NMR RELAXOMETRY

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Physical structure of dissolved organic matter is closely linked with its reactivity and transport properties. Recent results obtained by ultrasonic spectroscopy indicate that temperature fluctuations and concentration play a significant role in the stability and conformation of humic and fulvic acids. In fact, a progressive dilution brought about the predominant importance of hydrophobic hydration and structural weakening. Applied technique, i.e. ultrasonic resonator with high resolution, however, provides only an indirect insight into the structure. In order to better understand observed phenomenon, variable temperature Fast Field Cycling (FFC) NMR relaxometry has also been applied. Results revealed that correlation times changed upon thermal treatment. Namely, the correlation times before heating were longer than those after heating. This indicates that temperature variations have altered the weak interactions among the small humic components, thereby favoring a conformational rearrangement with weaker interactions. The possible implications of such findings are related to the easiness of humic decomposition under heating and cooling conditions. Finally, the present study revealed the potentiality of FFC-NMR relaxometry in the understanding of the conformational properties of the dissolved organic matter.



S07.03-P - MOLECULAR DYNAMICS OF SOIL ORGANIC MATTER: CHALLENGES, OPPORTUNITIES AND LIMITS

Thursday 05 July 2012 from 17:00 to 18:30. Room Poster Areas

S07.03-P -1

BINDING OF CHLORINATED ORGANIC POLLUTANTS TO SOIL ORGANIC MATTER: CHROMATOGRAPHIC MEASUREMENTS, SPECTROSCOPIC CHARACTERIZATION AND THEORETICAL MODELING

Ashour Ahmed, Rostock - Germany

S07.03-P -2

CHANGES IN PHYSICAL, BIOLOGICAL AND CHEMICAL STABILIZATION PROCESSES OF PYROGENIC CARBON AFTER ONE YEAR IN FOREST TOP-SOIL

Nimisha Singh, Zurich - Switzerland

S07.03-P -3

CHARACTERIZATION OF ORGANIC MATTER IN RENDZINA SOILS

Tünde Nyilas, Szeged - Hungary

S07.03-P -4

COMPOSITION OF THE WATER-EXTRACTABLE SOIL ORGANIC MATTER CHARACTERIZED BY CHROMOPHORIC INDICATORS: EFFECTS OF SOIL TYPE AND IRRIGATION WATER QUALITY

Mikhail Borisover, Bet Dagan - Israel

S07.03-P -5

EFFECT OF NITROGEN DEPOSITION ON COMPOSITION AND TURNOVER OF AMINO SUGARS IN FOREST SOIL DENSITY FRACTIONS

Marco Griepentrog, Zurich - Switzerland

S07.03-P -6

EFFECTS OF NATURAL AFFORESTATION OF GRASSLANDS IN NORTHERN ITALY ON STOCKS AND FRACTIONS OF SOIL ORGANIC CARBON

Claudia Guidi, San Michele all'Adige (TN) - Italy



S07.03-P -7

EFFECTS OF SHORT-TERM EXPERIMENTAL CLIMATE WARMING ON THE ABUNDANCE AND DISTRIBUTION OF BRANCHED GDGTS IN A FRENCH PEATLAND

Arnaud Huguet, Paris - France

S07.03-P -8

ELECTROCHEMICAL CHARACTERIZATION OF THE REDOX PROPERTIES OF HUMIC SUBSTANCES

Michael Sander, Zurich - Switzerland

S07.03-P -9

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Samuel Abiven, Zurich - Switzerland

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Damien Ertlen, Strasbourg - France

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THERMAL STABILITY INDICES AS A PROXY FOR ORGANIC CARBON STABILIZATION IN SOIL

Maria Teresa Dell'Abate, Rome - Italy



S07.03-P -1

**BINDING OF CHLORINATED ORGANIC POLLUTANTS TO SOIL ORGANIC MATTER:
CHROMATOGRAPHIC MEASUREMENTS, SPECTROSCOPIC CHARACTERIZATION AND
THEORETICAL MODELING**

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Binding of chlorinated organic pollutants by soil has been studied experimentally and theoretically. Experimentally, we investigated the adsorption of hexachlorobenzene (HCB) on different soil samples. The soil organic matter (SOM) composition was changed systematically by two ways as prerequisite to the adsorption process. In the first way, we removed hot water-extractable (HWE) organic matter from an original soil. We have added this HWE in increasing amounts to the original soil samples to obtain samples which are soil+3HWE and soil+6HWE. In the second way, we pyrolyzed the original soil sample in order to decrease the polar character of SOM. We obtained soil samples with similar mineralogy but gradual differences in the SOM content and polarity. We checked the success of these gradual alterations by Py-FIMS and XANES. The experimentally determined adsorption data of HCB on the original soil, soil+3HWE, soil+6 HWE, and pyrolyzed soil were fitted to the Freundlich equation. The adsorption of HCB became stronger in the order original soil < soil+3HWE < soil+6HWE < pyrolyzed soil. Explanation of these results indicated that the adsorption became stronger as the proportions of carbohydrates, peptides, N-heterocyclic compounds and/or phenols + lignin building blocks increased. These experimental data were tested theoretically by modeling the SOM by small molecular complexes that contain the most interesting SOM functional groups. The binding energy for HCB with each molecule was calculated in the gas phase. These calculations revealed that the binding energy increased in the presence of polar functional groups, which confirmed the experimental results.



S07.03-P -2

CHANGES IN PHYSICAL, BIOLOGICAL AND CHEMICAL STABILIZATION PROCESSES OF PYROGENIC CARBON AFTER ONE YEAR IN FOREST TOP-SOIL

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Pyrogenic carbon (PyC, the product of incomplete combustion of biomass) is ubiquitous in the environment and widely assumed to remain stable in the soil. However, the stability of PyC has been challenged in recent studies. However, underlying decomposition processes of PyC in soil remains unclear. We are conducting a long-term PyC degradation study in a temperate mixed forest field setup (Wettingen, Switzerland). We installed cylindrical mesocosms (20 cm long and 10 cm diameter) with 3 treatments (wood, PyC, and control) and 2 levels of nitrogen (N) input (+N = +60 kg ha⁻¹ y⁻¹ and -N = ambient N deposition). Wood (*Pinus ponderosa*) and PyC were highly labelled (¹³C 800‰) and were added at a rate of 1.5 g-C kg⁻¹ soil and 2.8 g-C kg⁻¹ soil, respectively. We observed that PyC decomposed at a rate of 0.64 % year⁻¹. We extracted the mesocosms after 10 months of treatment and sampled soil at different depths (0–5, 5–10, 10–15 cm) and analysed d¹³C and d¹⁵N to estimate the total recovery of the added substrate and its transport within the soil profile. The benzenepolycarboxylic acid molecular marker method was employed to quantify and characterize the PyC before and after its addition to the soil. Density fractionation was applied to identify organo-mineral interactions and understand the dynamics of PyC degradation in soil. We also studied the effect of PyC on enzyme activity of three soil enzymes namely, β -1,4-glucosidase, β -N-acetylglucosaminidase and β -cellobiohydrolase. In this communication, we will present the first results.



S07.03-P -3

CHARACTERIZATION OF ORGANIC MATTER IN RENDZINA SOILS

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The aim of this work is to characterize the soil organic matter in three subtypes of lithomorphic rendzina soils on Triassic limestone. Black (BIR) and brown rendzina (BrR) are found on Bükk Plateau covered by grassy vegetation. Red clay rendzina (RCR) is on Aggtelek Karst covered by mixed beech and oak (North-East Hungary). According to the World Reference Base for Soil Resources the types of soils are Leptosols. BIR and BrR were developed under same climatic conditions but on different base matter. The BIR was formed on uncovered limestone the BrR was formed on a mixture of clayey, trapped weathered material and weathering limestone. The RCR was developed on clayey weathered material under subtropical climate. Micromorphological marks of clay mobilization (clay films) can be observed in BrR and RCR soils. While nearly the same humus contents were measured using chrome sulphuric acidic destruction and the same proportions of the inert and reactive carbon were determined by Rock-Eval pyrolysis in all three samples, the total organic carbon content was higher in BIR than others. Humic materials were found as calcium-humates in BIR and ferri-humates in BrR and RCR. Susceptibility to acidification is revealed in BrR. Because of acidic pH, large quantity of fulvic acids were produced and leached, whereas humic acids and humic material remained in the upper horizons. Organic geochemical data revealed the lowest proportion of biological substances and relatively high-grade degradation in RCR. The project was supported by the Hungarian Scientific Research Found through grant K 81181.



S07.03-P -4

COMPOSITION OF THE WATER-EXTRACTABLE SOIL ORGANIC MATTER CHARACTERIZED BY CHROMOPHORIC INDICATORS: EFFECTS OF SOIL TYPE AND IRRIGATION WATER QUALITY

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The molecular composition of soil organic matter (SOM) and its water-extractable portion may be affected by irrigation with treated wastewater (TWW). We characterized the chromophoric dissolved organic matter (CDOM) components of water-extractable SOM fraction for differently irrigated soils and examined the relations between CDOM composition and various soil properties. Aqueous extracts from four different soil types irrigated with either TWW or fresh water (FW) and their acid-soluble and acid-precipitated fractions were characterized by excitation-emission matrices of fluorescence combined with parallel factor (PARAFAC) analysis. Two humic-like fluorescent components and one tryptophan-like component were identified in these extracts and their quantity was expressed by PARAFAC-based concentration scores. Irrigating the coarse-textured soils with TWW generally increased the concentrations of fluorescent components compared to irrigation with FW. In the fine textured soils an opposite trend was generally noted. Thus, the impact of TWW irrigation on water-soluble SOM relative to that of FW irrigation was soil dependent. The concentration scores data suggest that the increase in soil clay content enriches the pool of water-soluble humic-like CDOM with smaller-size and less conjugated humic-like components. Strong linear relations ($r > 0.7$) were found within CDOM indicators including concentration scores of fluorescent components and absorbance measured at 254 nm. Weak or no relations were found (i) between dissolved organic carbon (DOC) concentration and CDOM indicators, and (ii) between attributes related to organic matter properties and basic soil properties. Hence, nor DOC concentration neither SOM content can be used for estimating changes in concentrations of chromophoric components in water-extractable DOM.



S07.03-P -5

EFFECT OF NITROGEN DEPOSITION ON COMPOSITION AND TURNOVER OF AMINO SUGARS IN FOREST SOIL DENSITY FRACTIONS

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Anthropogenic activities increased nitrogen (N) deposition, which substantially impacts carbon (C) dynamics in soil, but its interactions are not well understood. Individual organic molecules might respond differently to N, depending on their internal N content. Microbial cell-wall-constituents with high-N content like amino-sugars are reliable molecular markers to distinct between fungal- and bacterial-derived organic residues. Here, we test effects of N deposition on amino-sugar dynamics by studying their composition and turnover in forest soil fractions. We use soil samples from a 4-year elevated CO₂ and N deposition experiment with model forest ecosystems, that were fumigated with ¹³C-depleted CO₂ and treated with ¹⁵N-labeled fertilizer. Bulk soil was separated into free light fraction (fLF), occluded light fraction (oLF) and heavy fraction (HF) by density fractionation and ultrasonic dispersion. HF material was further separated at 20µm using particle-size fractionation. We determined C and N contents and isotopic compositions (δ¹³C, δ¹⁵N) within bulk soil and density fractions. Therein, we conducted compound-specific stable-isotope-analysis of amino-sugars using LC-c-IRMS. No influence of N deposition on C allocation in soil fractions was observed over the experimental period. Density fractions are more enriched in ¹³C and more depleted in ¹⁵N from light to heavy fractions. New C, formed during the experiment, was preferentially incorporated into fLF material. Except for HF material >20µm, N deposition showed no effects on distribution of new C in soil fractions. Besides bulk soil data we will present data on amino-sugar dynamics in forest soil fractions based on a combined ¹³C and ¹⁵N labeling experiment.



S07.03-P -6

EFFECTS OF NATURAL AFFORESTATION OF GRASSLANDS IN NORTHERN ITALY ON STOCKS AND FRACTIONS OF SOIL ORGANIC CARBON

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Land-use change is considered one of the major driving forces of global carbon fluxes; moreover it can induce significant alteration of soil carbon stocks. In the Italian pre-alps socio-economic structural changes have led in the last decades to a process of reduced management intensity/abandonment of grasslands characterized by low fertility or located in unfavorable areas. These areas are usually colonized by seedlings of the tree species growing in the surrounding areas. The net effect of grassland afforestation on soil carbon is not completely clear, due to the differences in management intensities and different turnover times of aboveground and belowground carbon stocks. The aim of the project is to study the effects of abandonment of grassland on soil carbon stocks, along a land-use management intensity gradient in Trentino region (northern Italy). Four different contrasting land uses were considered: I) managed grassland; II) abandoned grassland; III) natural afforested area abandoned after 1973; IV) reference forest (older than 1861). The study area has an elevation of about 1150 m, with south aspect and gentle slope. Both the afforested area and the reference forest are mixed forests, dominated by Norway spruce and beech. Each sampling point consisted of eight soil cores collected according to a systematic sampling scheme to a depth of 30 cm. After dividing the cores into four depth increments, carbon and nitrogen content were determined with an elemental analyzer. SOM fractionation by size and density will be performed in order to detect carbon changes in functionally homogeneous SOM fractions.



S07.03-P -7

EFFECTS OF SHORT-TERM EXPERIMENTAL CLIMATE WARMING ON THE ABUNDANCE AND DISTRIBUTION OF BRANCHED GDGTs IN A FRENCH PEATLAND

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Branched glycerol dialkyl glycerol tetraethers (GDGTs) are complex lipids of high molecular weight, recently discovered in soils and increasingly used as paleoclimate proxies. The aim of this work was to study the effects of experimental climate warming on the abundance and distribution of branched GDGTs in a Sphagnum-dominated peatland (French Jura Mountains). Branched GDGTs either present as core lipids (CLs; derived from dead biomass) or intact polar lipids (IPLs; markers for living cells) were analysed. Air temperature was experimentally increased using a warming system consisting of in situ open mini-greenhouses (Open-Top Chamber – OTC). The effect of the OTCs was especially apparent in spring and summer, with an increase in mean and maximal air temperatures of ca. 1 and 3°C respectively. Branched GDGT distribution was significantly affected by this temperature rise. The difference in branched GDGT-derived temperatures between control and OTC plots was in the same range as the increase in maximal temperature induced by the OTCs in spring and summer, suggesting that branched GDGT-producing bacteria might be more active during the warmest months of the year. The OTC treatment had no significant effect on the abundance of branched GDGTs, mainly present as “fossil” CLs. Furthermore, no significant differences in branched GDGT distribution were observed between CLs and IPLs. This suggests that the fossil pool of branched GDGTs has a very fast turnover (less than the 2 year duration of the experiment) at peat surface and that branched GDGT distribution may rapidly respond to changes in environmental conditions.



S07.03-P -8

ELECTROCHEMICAL CHARACTERIZATION OF THE REDOX PROPERTIES OF HUMIC SUBSTANCES

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Humic substances (HS) play a key role in biogeochemical and pollutant redox reactions. Yet, key redox properties and dynamics of HS remain poorly characterized. This contribution presents the results of a systematic electrochemical characterization of the electron accepting and donating properties of a diverse set of terrestrial, aquatic, and microbial HS as a function of solution pH and redox potential and links redox properties to HS chemical composition, origin, and oxidative transformation. The electron accepting capacities (EACs) of HS were linearly correlated to aromaticity ($R^2 = 0.85$) and electron transfer to HS was largely reversibly over reduction O₂-reoxidation cycles, suggesting quinones as major reducible moieties. The apparent standard reduction potentials of the reducible moieties covered a wide range and were in good agreement with the standard reduction potentials of naphthoquinones and anthraquinones. The electron donating capacities (EDCs) were linearly correlated to the acid-base titrated phenol contents ($R^2 = 0.94$) and the oxidation of HS was largely irreversible, suggesting mono-hydroxybenzene moieties as the major electron donating moieties. This is further supported by an increase in EDC with pH, consistent with thermodynamically and kinetically more favorable oxidation of phenolate than phenol moieties. Relatively young HS from higher plant precursors show high EDCs and relatively low EACs, while older, terrestrial HS show the opposite. The systematic differences suggest a preferential loss of electron-donating polyphenolic moieties over quinone moieties during oxidative transformation of HS and, hence, that electron donation by polyphenolic moieties contributes to the recalcitrance of organic matter in oxidative environments.



S07.03-P -9

EXPLORING SOIL ORGANIC MATTER DYNAMICS THROUGH μ CODE AND D13C: LAND COVER INFLUENCE AT A REGIONAL SCALE

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Dissolved organic matter plays a major role in decomposition, thus contributing to the mobility potential of soil organic matter. The aim of our study was to investigate the effect of environmental factors on the molecular composition of organic matter pools in soil at a large scale and with a high spatial resolution. The French Soil Quality Monitoring Network (RMQS) covers the whole of France and more than two thousand soils have been sampled, using a 16km grid. To study the influence of land cover and bedrock on soil organic matter at a regional scale, we analysed 120 soils from the Burgundy region, which is characterised by great geological and land use diversity. μ CODE is the organic carbon extracted under conditions of high pressure and temperature using the Schwesig method (1999). The quality of μ CODE was characterised by spectrophotometry and carbon isotopic enrichment measurements. μ CODE composition and mineralisation potential were measured after a three-week incubation period. Our results show that land cover strongly influences μ CODE composition at the regional scale. Quantities of extracted μ CODE relative to the total organic carbon in soil are low in forest soils and highest in grassland soils, while cropland soils show intermediate results. $\delta^{13}\text{C}$ values of μ CODE revealed a clear distinction between grassland and forest soils. In cropland soils, $\delta^{13}\text{C}$ values cover a wider range of values, suggesting the influence of past land cover on organic matter composition. A decrease in the $\delta^{13}\text{C}$ value was systematically observed after the incubation, revealing the geochemical transformation of μ CODE.



S07.03-P -10

HOW WATER DYNAMICS AFFECT SOIL ORGANIC MATTER (SOM) - A COMBINED ¹H SOLID STATE NMR & DSC STUDY

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Understanding the interplay of water molecules and soil organic matter (SOM) is of fundamental interest in understanding complex soils and to develop a general soil microscale model. Fundamentally, water is acting as a physical agent in terms of soil rigidity and soil structure, generating a network in the organic matrix consisting of water molecule bridges (WaMB) between polar organic matter sites. By applying ¹H wideline nuclear magnetic resonance (NMR) and differential scanning calorimetry (DSC) we gain access to the network properties, being sensitive to a number of external parameters (e. g., humidity, ion concentration or temperature) acting on it. These techniques combine high sensitivity on the one hand and long term accuracy on the other hand, as some of the parameters undergo changes on a time scale of weeks up to months. Prior to the experiments, samples are equilibrated in atmospheres of different relative humidity, controlling the water content in WaMB and their stability. ¹H NMR wideline spectra straightforwardly yield information on the matrix rigidity, differentiating the water amount in hydrogen bonding networks from unbound water. By applying a defined heating event (30 min at 110°C) the hydrogen-bonded network is destroyed. Afterwards, the reformation of the network is monitored for three months. In parallel to that, DSC measurements are performed, analyzing dynamic changes of soil, expressed in step like transitions, being characteristic for the soil rigidity and showing the reformation of the WaMB structure. These long term results are then compared and set into context with the WaMB model predictions.



S07.03-P -11

IMPORTANCE OF STOICHIOMETRY OF LABILE C AND N FOR UNDERSTANDING THE DYNAMICS OF SOIL AMINO ACIDS

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Amino acids (AAs) are the major N-containing compounds in soil organic matter (SOM) and play active roles in the stabilization and decomposition process of SOM. The substrate availability controls the transformation of AAs, but how the stoichiometry of labile C and N influences the dynamics of soil amino acid pool was not well understood. The transformation pattern of individual AAs can only be explored by tracing the temporal change of both newly synthesized and the intrinsic portions in soil matrix. Therefore, laboratory incubations of soil samples amended with glucose and ¹⁵N-labeled inorganic N in either NH₄⁺ or NO₃⁻ form were conducted to investigate ¹⁵N enrichment in soil AAs, which were identified by an isotope based HPLC/MS method. The rapid microbial incorporation of ¹⁵N into AAs was found by utilizing the extraneous substrates and then the new AAs were accumulated in soil as important metabolic constituents. Higher rate of ¹⁵N enrichment by using ¹⁵NH₄⁺ than ¹⁵NO₃⁻ indicated microbial preference to the reduced N form than the oxidized one due to differences in energy requirement. In addition, the ¹⁵N enrichment in AAs was more significant in an Alfisol (with lower SOM) than a Mollisol (with higher SOM). However, the decline of native amino acids was more significant in the Alfisol. The findings indicate that soil AAs were apt to be decomposed for compensating the intensive C demand, in particular, in an energy-poor environment. In conclusion, the stoichiometry of labile C and N is pivotal for the dynamics of soil amino acids.



S07.03-P -12

INFLUENCE OF SOIL ORGANIC MATTER IN THE FORMATION OF STABLE COMPLEXES WITH CHROMIUM

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Environmental issues have increasingly become a focus of scientific discussion in recent years. Amongst the various pollutants that are indicative of environmental contamination, metals should be viewed with especial concern, since these elements are not degradable and affect the entire trophic chain. Their presence at elevated concentrations causes species mortality, while their introduction into humans, via the food chain, can lead to a wide variety of diseases, or even death. Studies of contamination by metal species, as well as remediation of areas impacted by anthropogenic (and natural) action have become increasingly relevant. For example, trivalent salts of chromium are normally used in the processing of leather, with the most common form employed being the basic chromium sulphate salt. In the absence of environmental impact studies, the inadequate disposal onto soils of leather residues (clippings) containing chromium can contaminate different compartments of the environment, due to leaching as well as volatilization of compounds formed during decomposition of the waste material. In the city of Dobrada in São Paulo State, leather clipping wastes were stored improperly, in direct contact with the soil, for approximately nine years. Due to its mobility, chromium is transported by leaching to subterranean and surface waters, and is deposited in sediments. The results of the present work show that organic matter plays an important role in the complexation of chromium ions, acting as a natural protective barrier and temporarily reducing the environmental impact caused by the leaching of chromium directly into the water body.



S07.03-P -13

INFLUENCE OF SOIL ORGANIC MATTER ON THE POTENTIAL FOR METHYLATION OF MERCURY IN AREAS TO BE FLOODED FOR HYDROELECTRIC POWER PROJECTS

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Methylmercury is a neurotoxic pollutant that accumulates in organisms and is biomagnified along the trophic chain. It is formed as a result of the transfer of a methyl group to inorganic mercury. This transformation, termed methylation, can occur as a result of microbial activity, as well as by interaction with humic substances present in soils. In the present work, laboratory experiments were designed, using samples of water and soil, in order to estimate the temporal production of organic mercury from Hg⁰ and Hg²⁺, according to the characteristics of the natural vegetation of different regions (the Madeira River, in Rondônia, and the Tocantins River, in Goiás). According to Spangler et al. (1973), production of MeHg is greater during the first days following an input of Hg. After this phase, production can either decrease or exhibit a cyclical pattern. Here, in the presence of excess Hg⁰, maximum methylmercury formation (2 µg L⁻¹) occurred on the second day. After seven days, production remained constant at around 1 µg L⁻¹ for both rivers. Using Hg²⁺, maximum methylmercury formation of 35 µg L⁻¹ was obtained for the Tocantins River, and production stabilized at 10 µg L⁻¹ after fifteen days. For water from the Madeira River (higher organic matter content), the methylmercury concentration peaked at 45 µg L⁻¹ on the second day, and stabilized at 10 µg L⁻¹ on the fifth day. The formation of methylmercury was indicative of the availability of methyl groups in the soil organic matter, which could react with inorganic Hg.



S07.03-P -14

INORGANIC NUTRIENTS MEDIATE THE SEQUESTERING OF SOIL CARBON AS HUMUS

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A near constant ratio of CNPS in soil humus suggests that the formation and accumulation of stabilized organic matter in soil from C-rich inputs is dependent on the availability of inorganic nutrients (Kirkby et al., 2011 [Geoderma 163:197]). To test this hypothesis, laboratory-based soil microcosm experiments were conducted using wheat straw with wide C to NPS ratio. Straw and NPS nutrient treatments were added (equivalent to an incorporation rate of 10 t/ha) to four soils with varying texture and initial soil-C contents. Soil-microcosms were incubated under a constant temperature and moisture regime over seven consecutive cycles, each of three months duration, with repeated addition of straw and nutrients for each cycle. Supplementary nutrient addition resulted in significantly greater accumulation of humic-C in all soils as compared to controls incubated with straw alone. ¹³C-enriched wheat straw was used to assess 'gross' and 'net' humification efficiencies over a single incubation cycle. Changes in total humic-C content along with gains of 'new-C' and losses of 'old-C' were determined. Significant losses of 'old-C' were observed (ie, microbial priming effect) in all treatments across all soils, with higher losses occurring in straw-amended soils, both with and without supplementary nutrients. However, higher gross humification efficiencies occurred in soils that received nutrients, which resulted in an overall increase in net humification and thus greater accumulation of soil C. These findings confirm the importance of inorganic nutrients for formation and accumulation of soil humus and therefore have significant implication for sequestration of soil carbon.



S07.03-P -15

MODELLING THE MIGRATION OF DISSOLVED ORGANIC MATTER THROUGH THE CLAY ACCUMULATION HORIZON OF AN ALBELUVISOL IN UNDISTURBED SOIL COLUMN EXPERIMENTS

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Dissolved organic matter (DOM) migration in cultivated soils is a major process affecting transport and fate of nutrients and pollutants in the unsaturated zone. During this migration the concentration of DOM and its quality may change due to biogeochemical and physical processes. We studied the migration of DOM in an argic horizon (BT 60-90 cm) of a Luvisol. Two soils cores were submitted to three successive rainfall simulation experiments. The two first ones focused on the mobility of endogenous DOM and were separated by a one week flow interruption. The third one concerned the transport of DOM extracted from the upper L (0-30 cm). We aimed to characterize the change in DOM concentration (TOC) and quality (SUVA, fluorescence) during the elution through the BT horizon. During the first two elutions DOM concentrations rapidly decreased to reach a threshold level of 1mg DOC l⁻¹ but transiently increased after the flow interruption. For the last elution, DOM progressively increased to reach the concentration of DOM extract (12mg DOC l⁻¹). Aromaticity of DOM decreased to a constant value for the two first elutions, while it increased to a higher value for the third one, indicating a different quality of the percolated DOM. The migration of DOM was modelled using a 1D water flow and solute transport model, HYDRUS-1D, where DOM was assumed to behave as a reactive solute undergoing adsorption/desorption reactions onto the solid phase. The soil hydrodynamics and solute transport properties were estimated by inverting the experimental data with HYDRUS-1D.



S07.03-P -16

**MOLECULAR CHARACTERISATION OF SOIL ORGANIC MATTER BY LASER-DESORPTION
IONIZATION FOURIER-TRANSFORM ION CYCLOTRON RESONANCE MASS
SPECTROMETRY (LDI-FT-ICR-MS)**

Abiven Samuel^[1], Fuchser Jens^[2], Schmidt Michael W.i.^[1], Dittmar Thorsten^[3]

^[1]University of Zurich ~ Department of geography ~ Zurich ~ Switzerland ^[2]Bruker ~ Daltonics ~ Bremen ~ Germany

^[3]Max Planck Institute ~ Research Group for Marine Geochemie ~ Oldenburg ~ Germany

Soil organic matter (SOM) characterisation has been an analytical challenge for decades. On one hand, methods like humic substances extraction describe large molecules, but these extractions target operationally- rather than chemically-defined compounds. On the other hand, specific compound analysis provides a precise overview of the molecules present in the soil, but represents only a minor portion of the SOM. Despite these shortcomings, SOM characterisation is used in many concepts of soil science, like soil aggregation hierarchical model for example. Due to this discrepancy in the methods, most of these concepts still need to be validated. We took advantage of a unique analytical set-up coupling laser-desorption ionization (LDI) to ultrahigh-resolution mass spectrometry via the Fourier-transform ion cyclotron resonance technique (FT-ICR-MS) to further characterize SOM and to validate the soil aggregation hierarchical model. Soil aggregates (3-5 mm) were collected from two soils, a cambisol (32 % clay, 4.2 %C), and a loess-derived soil (15% clay, 1.6 %C). Aggregates were fractionated by fast wetting into <63, 63-125, 125-250 and > 250 mm fractions. These fractions were air-dried and ground to powder prior to analysis. LDI-FT-ICR-MS analyses were performed on otherwise untreated samples. Thousands of molecular formulae were identified in each sample, many of them could be associated with polyphenolic, and polycondensed, fire-derived structures. First results show a striking similarity between the SOM characteristics in the two soils and in the different fractions of the soils. The combination of LDI with ultrahigh-resolution FT-ICR-MS offers fundamentally new insights into SOM.



S07.03-P -17

**MOLECULAR CHARACTERISATION OF SOIL ORGANIC MATTER BY LASER-DESORPTION
IONIZATION FOURIER-TRANSFORM ION CYCLOTRON RESONANCE MASS
SPECTROMETRY (LDI-FT-ICR-MS)**

Abiven Samuel^[1], Fuchser Jens^[2], Schmidt Michael W. I.^[1], Dittmar Thorsten^[3]

^[1]University of Zurich ~ Soil Science and Biogeography ~ Zurich ~ Switzerland ^[2]Bruker Daltonics ~ / ~ Bremen ~ Germany ^[3]Max Planck Research ~ Group for Marine Geochemie ~ Oldenburg ~ Germany

Soil organic matter (SOM) characterisation has been an analytical challenge for decades. On one hand, methods like humic substances extraction describe large molecules, but these extractions target operationally- rather than chemically-defined compounds. On the other hand, specific compound analysis provides a precise overview of the molecules present in the soil, but represents only a minor portion of the SOM. Despite these shortcomings, SOM characterisation is used in many concepts of soil science, like soil aggregation hierarchical model for example. Due to this discrepancy in the methods, most of these concepts still need to be validated. We took advantage of a unique analytical set-up coupling laser-desorption ionization (LDI) to ultrahigh-resolution mass spectrometry via the Fourier-transform ion cyclotron resonance technique (FT-ICR-MS) to further characterize SOM and to validate the soil aggregation hierarchical model. Soil aggregates (3-5 mm) were collected from two soils, a cambisol (32 % clay, 4.2 %C), and a loess-derived soil (15% clay, 1.6 %C). Aggregates were fractionated by fast wetting into <63, 63-125, 125-250 and > 250 mm fractions. These fractions were air-dried and ground to powder prior to analysis. LDI-FT-ICR-MS analyses were performed on otherwise untreated samples. Thousands of molecular formulae were identified in each sample, many of them could be associated with polyphenolic, and polycondensed, fire-derived structures. First results show a striking similarity between the SOM characteristics in the two soils and in the different fractions of the soils. The combination of LDI with ultrahigh-resolution FT-ICR-MS offers fundamentally new insights into SOM.



S07.03-P -18

**MOLECULAR CHARACTERISATION OF SOIL ORGANIC MATTER BY LASER-DESORPTION
IONIZATION FOURIER-TRANSFORM ION CYCLOTRON RESONANCE MASS
SPECTROMETRY (LDI-FT-ICR-MS)**

Abiven Samuel^[1], Fuchser Jens^[2], Schmidt Michael W.i.^[1], Dittmar Thorsten^[3]

^[1]University of Zurich ~ Department of geography ~ Zurich ~ Switzerland ^[2]Bruker ~ Daltonics ~ Bremen ~ Germany

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Soil organic matter (SOM) characterisation has been an analytical challenge for decades. On one hand, methods like humic substances extraction describe large molecules, but these extractions target operationally- rather than chemically-defined compounds. On the other hand, specific compound analysis provides a precise overview of the molecules present in the soil, but represents only a minor portion of the SOM. Despite these shortcomings, SOM characterisation is used in many concepts of soil science, like soil aggregation hierarchical model for example. Due to this discrepancy in the methods, most of these concepts still need to be validated. We took advantage of a unique analytical set-up coupling laser-desorption ionization (LDI) to ultrahigh-resolution mass spectrometry via the Fourier-transform ion cyclotron resonance technique (FT-ICR-MS) to further characterize SOM and to validate the soil aggregation hierarchical model. Soil aggregates (3-5 mm) were collected from two soils, a cambisol (32 % clay, 4.2 %C), and a loess-derived soil (15% clay, 1.6 %C). Aggregates were fractionated by fast wetting into <63, 63-125, 125-250 and > 250 mm fractions. These fractions were air-dried and ground to powder prior to analysis. LDI-FT-ICR-MS analyses were performed on otherwise untreated samples. Thousands of molecular formulae were identified in each sample, many of them could be associated with polyphenolic, and polycondensed, fire-derived structures. First results show a striking similarity between the SOM characteristics in the two soils and in the different fractions of the soils. The combination of LDI with ultrahigh-resolution FT-ICR-MS offers fundamentally new insights into SOM.



S07.03-P -19

MOLECULAR COMPOSITION OF LIPIDS FROM MEDITERRANEAN SOILS IN TERMS OF THEIR PHYSICO-CHEMICAL PROPERTIES AND LAND USE

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The soil lipid fraction is frequently considered as a source of biogeochemical proxies due to its variable composition and relatively high resistance to degradation. In many cases, lipid assemblages provide representative records of the occurrence and activity of specific taxonomic groups of organisms involved in biodegradation and humification processes of soil organic matter. This study aims at investigating the free lipid fraction from 14 soils from Mediterranean region (Central Spain). The soils show dissimilar bioclimatic and geological conditions (mountain, valley and foothill areas), vegetation and use (pine and oak forest, bush, peatland vegetation and crop fields). Soil samples were collected from the topsoil, sieved to 2mm and lipids were Soxhlet-extracted with petroleum ether (40–60°C), methylated with trimethylsilyldiazomethane and analysed by GC/MS. The major lipid groups included acyclic compounds (alkanes, fatty acids, alcohols and ketones) and minor amounts of cyclic compounds (basically terpenoids and steroids). To obtain information on the selective preservation and degradation dynamics of plant and microbial material in soils, the distribution patterns of n-alkanes and n-fatty acids were studied. For these homologous series, the carbon preference indices (even-to-odd C) and the chain length ratios (>20/<20 C) point to plant origin of lipids in most sites, with substantial microbial inputs in oak forest and some cultivated soils (vineyard). Analysis of biodiversity indices and multivariate data treatments by non-linear clustering methods lead to the appraisal of the different complexity of the molecular assemblages, which was interpreted in terms of resilience associated to functional redundancy in the diverse soil ecosystems.



S07.03-P -20

NEAR INFRARED SPECTRA OF SOIL ORGANIC MATTER AS A TOOL TO RECONSTRUCT PAST LAND USE

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A near infrared spectra (NIR) dataset is proposed to study soil organic matter memory. NIR measures the absorbance of a material on the spectral range 1100-2500 nm. It provides a "fingerprint" of organic matter. In soil science, it has been mostly used to quantify the soil constituents. This work is focused on the properties of soil organic matter that is related to the types of present and past land use. Spectra of surface horizons from 56 sites are used as a referential. They are discriminated according land use/vegetation. Than NIR signatures of complete soil profiles are investigated and coupled with a simple model of organic matter dynamics based on mean residence time radiocarbon measurements. The age of the last major land use change is estimated. Century to millennium scale scenarios proposed for several studied sites confirm the existing palaeoenvironmental results. For well documented sites it gives important information about organic matter dynamics related to long-term land use changes.



S07.03-P -21

ORGANIC MATTER "FINGERPRINT" DETERMINATION BY ROCK-EVAL PYROLYSIS

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^[1]University of Szeged ~ Department of Mineralogy Geochemistry and Petrology ~ Szeged ~ Hungary

Soil organic matter is a mixture of many organic matters with different chemical compositions and physical qualities. Humification of biopolymers is determined by those environmental parameters which define soil types. Consequently, proportion of the essential organic materials should correspond to genetic horizons of diverse soil types what therefore is recognizable by its typical organic matter pattern (OMP). The aim of this work is to construct an algorithm to calculate such a pattern. Rock-Eval (RE) pyrolysis is considered as a quick and effective tool for evaluating the amount and properties of the organic matter. We use a modified application of RE pyrolysis approach for estimating the proportion of the components with different thermal stability and the measure of humification. On a pyrogram each unique organic matter is represented by a normal distribution curve. A pyrogram is a sum of numerous single Gauss curves what can be decomposed using a proper algorithm. In order to calculate possible composite curves, first the uncertainty of mean and standard deviation of RE measurement was determined by independent runs. On this basis using a Monte Carlo type simulation 1000 different realizations were calculated. The envelope of all these curves defines the stripe what is the typical fingerprint of the soil organic matter in question. We examined forest soils and marsh samples. We accepted the „unknown” sample belongs into the specified soil type if it's pyrogram coincide 90% with the soil type's envelope. The project was supported by the Hungarian Scientific Research Found through grant K 81181.



S07.03-P -22

PYROGENIC CARBON LOSSES UNDER AMBIENT AND INCREASED MINERAL N DEPOSITION

Maestrini Bernardo*^[1], Abiven Samuel^[1], Singh Nimisha^[1], Bird Jeffrey A.^[2], Torn Margaret S.^[3], Schmidt Michael W. I.^[1]

^[1]University of Zurich ~ Department of Geography ~ Zurich ~ Switzerland ^[2]City University of New York ~ School of Earth and Environmental Sciences ~ New York ~ United States ^[3]Lawrence Berkeley National Laboratory ~ Earth Sciences Division ~ Berkeley ~ United States

Pyrogenic carbon (PyC) is considered to have potential as a C sink due to its supposed resistance to mineralization. Long-term field samples under uncontrolled conditions suggested losses of PyC from soil profile. However, how PyC is lost from the soil remains uncertain. Loss of PyC as CO₂ has been observed in short-term incubation studies [1,2]. The relative contribution of PyC losses as dissolved organic carbon to its disappearance from the soil profile remains largely unknown. Moreover, in the long term, N deposition from the atmosphere are likely to decrease the decomposition rate of complex compounds [3] like PyC. We set up a field experiment to measure and partition between PyC and native soil organic matter C fluxes from the soil (carbon dioxide, and dissolved organic carbon), using C stable isotopes. The experiment was carried out over one year, under ambient and increased mineral N levels. We found that: 1) approx. 0.64% PyC ca. was mineralized as CO₂, 2) N application to soil decreased the amount of PyC decomposed by a factor of ca 0.5; and 3) the quantity of PyC lost in soil water was negligible. We conclude that mineralization is the main process leading to PyC losses and that PyC decomposition in the field is occurring at rate comparable with the one observed in incubation studies. Possible mechanisms explaining our results will be presented. [1] Kuzyakov, et al. *Soil Biology and Biochemistry*, 41(2):210–219, 2009. [2] Zimmerman, A. R. *Environmental Science and Technology*, 44(4):1295–1301, 2010. [3] Hagedorn, et al. *Soil Biology and Biochemistry*, 35(12):1683–1692, 2003.



S07.03-P -23

SOIL STRUCTURE AND ORGANIC MATTER REPARTITION AS CONTROLLING FACTORS OF PAH-TYPE COMPOUNDS AVAILABILITY IN A FORMER INDUSTRIAL SOIL

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In old industrial soils, organic compounds, like polycyclic aromatic hydrocarbons (PAH) are known to be poorly available. This low availability is a strong limit to any treatment either chemical (e.g. oxidation) or biological (e.g. phytoremediation, bioremediation). Both accessibility via soil structure and extractability via sorption to organic matter (OM) strongly limit this availability. We propose here to characterize these factors on a former industrial soil contaminated with PAH. The objectives are to i) describe soil structure; ii) identify the different OM types present in the soil size fractions; iii) define the respective contributions of the different OM types in soil structure; iv) link these results to PAH availability and its evolution. The methodology proposed is based on an extensive chemical characterization of the undisturbed soil granulometric fractions obtained after gentle water granulodensimetric fractionation and those obtained after a preliminary treatment (dichloromethane, n-hexane and hot water) extracting specific OM fractions. For each treatment, the molecular distribution, structure and chemical reactivity of OM of each size fraction (200-2000 μm , 50-200 μm , 20-50 μm , 2-20 μm and 0-2 μm) is analyzed by GC-MS (Gas Chromatography – Mass Spectrometry) and FTIR (Fourier Transformed Infrared spectroscopy). Except for the dichloromethane treatment, granulometric distributions were not significantly affected by OM removal, showing the high recalcitrance. However, chemical analysis clearly outlined the anthropogenic origin of the OM and the specific role of the fine silt fraction both as the main sink for PAH and highest reactive fraction.



S07.03-P -24

SOM GENESIS - MICROBIAL BIOMASS AS A SIGNIFICANT SOURCE

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^[1]UFZ - Centre for Environmental Research ~ Department of Environmental Biotechnology ~ Leipzig ~ Germany ^[2]UFZ - Centre for Environmental Research ~ Department of Isotope Biogeochemistry ~ Leipzig ~ Germany

Soil organic matter (SOM) needs to be properly managed for maintaining soil fertility and for mitigation of the global increase in atmospheric CO₂ concentrations. Such management should be informed by knowledge about the sources, spatial organisation and stabilisation processes of SOM. Recently, microbial biomass residues (i.e. necromass) have been identified as a significant source of SOM. Here, we propose that cell wall envelopes of bacteria and fungi are stabilised in soil and contribute significantly to small-particulate SOM formation. This hypothesis is based on the mass balance of a soil incubation experiment with ¹³C-labelled bacterial cells and on the visualisation of the microbial residues by means of scanning electron microscopy (SEM). At the end of a 224-day incubation, 50% of the biomass-derived C remained in the soil, mainly in the non-living part of SOM (40% of the added biomass C). SEM micrographs only rarely showed intact cells. Instead, organic patchy fragments of 200-500 nm size were abundant and these fragments were associated with all stages of cell envelope decay and fragmentation. Similar fragments, developed on initially clean and sterile in situ microcosms during exposure to groundwater, provide clear evidence for their formation during microbial growth and surface colonisation. Microbial cell envelope fragments thus contribute significantly to SOM formation. This origin and the related macromolecular architecture of SOM are consistent with most observations on SOM, including the abundance of microbial-derived biomarkers, the low C/N ratio, the water repellency and the stabilisation of biomolecules, which in theory should be easily degradable.



S07.03-P -25

THE ROLE OF ROOT LITTER FOR ORGANIC MATTER STORAGE IN SOILS

Solly Emily^{*[1]}, Schrumpf Marion^[1], Schoening Ingo^[1], Trumbore Susan^[1]

^[1]Max Planck Institute for Biogeochemistry ~ Biogeochemical processes ~ Jena ~ Germany

Fine root decomposition contributes significantly to biogeochemical cycling in terrestrial ecosystems. Land use and management may affect root litter decomposition through changes in plant species composition and diversity, effects on the decomposer community and differences in nutrient availability. We have established a large scale root litter decomposition study in three German regions using a standardized litterbag method for forest and grassland sites under different management and soil types. In one setup of the experiment we used standardized root litter for forest and grassland sites at all 300 plots, and in a second set root litter collected on-site was used. In total 4824 litterbags were buried in autumn 2011 at 10 to 40 cm soil depth. The main aims of these experiments are to analyze the links between root litter quality and decomposition rates and how these are affected by biotic and abiotic site conditions and soil depth. Furthermore we intend to study the transfer of organic carbon and nitrogen from litter to the mineral associated organic matter using ¹⁵N and ¹³C double-labelled root litter. The decomposition of fine roots is expected to be faster initially for material collected on-site, to differ between land use types, management classes and climatic conditions, and to be influenced by abiotic soil properties and soil depth. We present the setup of the experiments and results of the first collection of litterbags in spring 2012.



S07.03-P -26

THERMAL STABILITY INDICES AS A PROXY FOR ORGANIC CARBON STABILIZATION IN SOIL

Dell'abate Maria Teresa*^[1]

^[1]CRA- Agricultural Research Council ~ Research Centre for Soil-Plant System ~ Rome ~ Italy

The complex and continuous nature of soil organic matter requires the adoption of appropriate mechanistic approach to develop a link between its biogeochemical stability in soil and different operative fractions which can be chemically determined. Extraction of soil components (humic compounds, proteins, available N, nucleic acids, etc.) destroys soil architecture, thus it is questionable the functional meaning of such extracted pools. An alternative analytical approach is represented by the application of chemical-physical methods of thermal analysis, such as differential scanning calorimetry (DSC) and thermogravimetry (TG), which detect variations either in the energy release or weight loss induced by a controlled heating programme. DSC record is continuous over time/temperature, whereas the C pools reacting at the different temperature ranges are discrete, as detected and estimated by TG/DTG measurements. If considering thermal stability as a characteristics inherent to each investigated materials, DSC curves can be modelled through mathematical treatment and the sizes of the discrete pools deduced from TG can be compared with other measurable soil properties. Thus, quantitative estimation of organic matter within the soil mineral matrix is possible without chemical extraction. In addition, the dynamic measure conditions obtained through the thermal scans give the theoretical possibility to deduce the kinetics of the thermally induced processes. From the comparison of different patterns of thermal stability shown by soil humic fractions, fresh biomasses, compost or mineral soils some indices of thermal stability are proposed to describe C stabilization in soil and the organo-mineral interactions influence .



S07.04-P - SOIL ORGANIC MATTER DYNAMICS AND CLIMATE

Monday 02 July 2012 from 17:00 to 18:30. Room Poster Areas

S07.04-P -1

BIOAVAILABILITY OF FUNCTIONAL SOM POOLS

Elke Schulz, Halle - Germany

S07.04-P -2

CAN CONTINUOUS $^{13}\text{CO}_2$ PLANT LABELLING BE USED FOR CLOSING THE ANNUAL CARBON BUDGET OF AN AGRICULTURAL SOIL?

Enrico Weber, Jena - Germany

S07.04-P -3

CAN ENHANCED NITROGEN DEPOSITION LIMIT THE EFFECTS OF RISING TEMPERATURES ON DECOMPOSITION OF SOIL ORGANIC MATTER (SOM) IN TEMPERATE FORESTS?

Shimon Ozeri Ginzburg, Copenhagen - Denmark

S07.04-P -4

CHANGES INDUCED IN SOIL ORGANIC MATTER DYNAMICS BY CONVERSION TO IRRIGATION IN NAVARRE (NE SPAIN)

Marcos Apesteguía, Pamplona - Spain

S07.04-P -5

EFFECT OF SOIL STRUCTURE ON THE BIODEGRADATION OF NATIVE AND FRESH ORGANIC MATTER

Sabrina Juarez, Thiverval Grignon - France

S07.04-P -6

FATE OF NITROGEN IN EUROPEAN BEECH FOREST SOILS MONITORED USING LONG-TERM ^{15}N LABELLED LITTER EXPERIMENT

Jade Salleles, Nancy - France



S07.04-P -7

HIGH SOIL MOISTURE CAN IMPROVE C INCORPORATION AND TRANSLOCATION IN THE PLANT-SOIL SYSTEM, BUT CAN ALTER C PRESERVATION IN SOIL

Guido Wiesenberg, Bayreuth - Germany

S07.04-P -8

INFLUENCE OF CHEMICAL COMPOSITION AND ANATOMICAL STRUCTURE OF LEAVES ON LITTER DECOMPOSITION RATE OF QUERCUS FRAINETTO TEN. AND QUERCUS CERRIS L. IN SITU

Miroslava Mitrovic, Belgrade - Serbia

S07.04-P -9

LINKING MEASURED CARBON FRACTIONS WITH ROTHC MODEL POOLS

Michael Herbst, Jülich - Germany

S07.04-P -10

MASTER FUNCTION FOR THE SOLID:SOLUTION EQUILIBRIUM OF DOC IN TAIGA AND TUNDRA SOILS: EXPERIMENTAL AND MODELING RESULTS

Sjoerd Van Der Zee, Wageningen - Netherlands

S07.04-P -12

PHYSICAL FRACTIONATION OF AN ALFISOL UNDER SUGAR CANE IN RIO GRANDE DO SUL STATE.

Cláudia Liane Rodrigues De Lima, Pelotas - Brazil

S07.04-P -13

POTENTIAL OF THE OLIVE MILL WASTE AMENDMENT FOR IMPROVING SOIL FERTILITY AND CARBON SEQUESTRATION IN DEGRADED SOILS

José Manuel Rato Nunes, Lisboa - Portugal

S07.04-P -14

PRIMING EFFECTS ALTER THE TEMPERATURE RESPONSE OF SOIL ORGANIC MATTER MINERALISATION

Claire Ghee, Aberdeen - United Kingdom



S07.04-P -15

REGIONAL ESTIMATION OF SOIL CARBON STOCKS AND CHANGES IN GERMANY'S FOREST SOILS BASED ON THE NATIONAL FOREST SOIL INVENTORY TO PROVIDE THE GREENHOUSE GAS REPORTING

Erik Grüneberg, Eberswalde - Germany

S07.04-P -16

SOM CONTENT THRESHOLD LEVELS TAILORED TO NATURAL AND ANTHROPOGENIC CONDITIONS

Borut Vrscaj, Ljubljana - Slovenia

S07.04-P -17

TEMPERATURE SENSITIVITY OF DECOMPOSITION IN A PEAT PROFILE

Emmi Hiltavuori, Helsinki - Finland

S07.04-P -18

THE CONCEPTUAL MODEL OF INTERRELATIONSHIP OF CYCLES OF CARBON AND OXYGEN

Alexander Popov, St. Petersburg - Russian Federation

S07.04-P -19

USING A FULL ECOSYSTEM MODEL TO EXPLAIN THE SOIL CARBON DECREASE OBSERVED IN ENGLAND AND WALES

Bertrand Guenet, Gif Sur Yvette - France



S07.04-P -1

BIOAVAILABILITY OF FUNCTIONAL SOM POOLS

Schulz Elke*^[1], Marc Breulmann^[1], Nina P. Masyutenko^[2], Boris M. Kogut^[3], Reiner Schroll^[4], Ulrike Dörfler^[4], Francois Buscot^[1]

^[1]Helmholtz Centre for Environmental Research - UFZ ~ Soil Ecology ~ Halle ~ Germany ^[2]All-Russia Research Institute of Arable Farming and Soil Erosion Control ~ Soil Erosion ~ Kursk ~ Russian Federation ^[3]V.V. Dokuchaev Soil Science Institute ~ Soil Biology ~ Moscow ~ Russian Federation ^[4]Helmholtz Centre Munich, German Research Centre for Environmental Health ~ Institute of Soil Ecology ~ Munich ~ Germany

Various approaches have been applied to characterise SOM, but its relationships with decomposability have often only been inferred. There have been limited direct investigations linking the bioavailability of carbon in functional SOM pools to soil microbial communities. From grassland ecosystems (Haplic Cambisol and Typical Chernozem) functional SOM pools (complexed, clay-associated SOM and uncomplexed, specific light SOM) were isolated by size-density fractionation. Detailed information on the bioavailability of these OC sources for microbes was obtained from respiration measurements. Phospholipid fatty acid extractions were used to analyse changes in the soil microbial community structure of the soil during utilization of OC these pools. The results indicate that the utilisation of functional SOM pools depends on three factors: (1) specific traits, (2) the management intensity of the grasslands and (3) the soil type. The OC utilisation of the complexed SOM depends on specific pool characteristics (accessibility to soil microorganisms). The OC utilisation of the uncomplexed SOM depends on their chemical stability (readily degradable or recalcitrant). Depending on the stability and availability of the OC in individual functional SOM pools, the three above factors were responsible for the formation of a specific microbial community. By studying abiotic and biotic components, it was possible to obtain new insights into the interactions between the properties of individual organic substrates, functional SOM pools and the diverse members of the soil communities



S07.04-P -2

CAN CONTINUOUS ^{13}C CO₂ PLANT LABELLING BE USED FOR CLOSING THE ANNUAL CARBON BUDGET OF AN AGRICULTURAL SOIL?

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*Throughout the last decades various isotopic tracer techniques were frequently used to investigate the plant-soil-microorganisms-interaction. Many of these studies used the $^{12}\text{C}/^{13}\text{C}$ -ratio for the partitioning of soil CO₂-efflux into autotrophic and heterotrophic components. Most studies determining the fate of new carbon in soils were carried out in lab-experiments by adding labelled substrates or labelling by fumigating potted plants. In the field either C₃/C₄-vegetation-change was used to label the soil or FACE-experiments established a ^{13}C -depleted atmosphere around plants. However, in order to account for isotopic fractionation, unlabelled reference sites are desirable which is difficult for the C₃/C₄-change approach. CO₂-enrichment in FACE-experiments complicates the interpretation of results on soil-plant-interactions by additional effects induced by the modified atmosphere. To overcome those limitations we established an experimental field site where it is possible to continuously label parts of an agricultural field planted with *Mentha x piperita* without CO₂-enrichment. This is achieved by CO₂-removal from the air first and adding ^{13}C -depleted CO₂ in ambient concentrations afterwards. The experiment is performed in two similarly treated greenhouses: one is labelled, the other one serves as an unlabelled reference. Labelling was done throughout the whole growing season. All relevant factors of the system were measured continuously (soil respiration incl. isotopic analysis, soil-temperature and -moisture profiles, meteorology) or on a weekly basis (DOC, photosynthesis). Plant biomass and accumulation of new carbon in the soil are determined after the first year. We will present the methodology, show results from the vegetation period 2011, and try to close the soil-carbon-budget.*



S07.04-P -3

CAN ENHANCED NITROGEN DEPOSITION LIMIT THE EFFECTS OF RISING TEMPERATURES ON DECOMPOSITION OF SOIL ORGANIC MATTER (SOM) IN TEMPERATE FORESTS?

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Decomposition rates of soil organic matter (SOM) are expected to increase as global temperatures rise, a major concern in the climate change debate. Conversely, it is well documented that high nitrogen (N) deposition into forests can reduce the decomposition rates of SOM, however, the magnitude of this effect is uncertain. We hypothesize that effects of enhanced N deposition on decomposition of SOM can limit temperature effects on decomposition of SOM in forest soils. To test this we incubate soil samples taken from a floor of a temperate conifer forest in north-western Denmark, subjected to long-term high N deposition. The samples are characterised by a C/N ratio of the fine fraction (<4 X 4mm) in a range from 25 to 31 ($p < 0.0001$). Basal soil respiration is measured continuously as the samples are incubated for a period of 10 days under each of the following temperatures regimes: 5, 10, 15, 20, 25°C. We will use the Q10 expression to show that decomposition rate of SOM is expected to increase with temperature. However, we also expect lower Q10 values for soils characterised by low C/N ratio compared with those of high C/N ratio (control). We will further discuss the mechanisms responsible for these two contrasting processes. We hope that the results of this study will help substantiate the need to consider soil C/N ratio as an important parameter when estimating the carbon sink strength of forest ecosystems.



S07.04-P -4

CHANGES INDUCED IN SOIL ORGANIC MATTER DYNAMICS BY CONVERSION TO IRRIGATION IN NAVARRE (NE SPAIN)

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A vast extension of dryland agricultural land (53,000 ha) is at present under conversion to irrigation in Navarre (NE Spain). Assessing the impact of such transformation on the environment needs detailed information about its effects on the soil system. More precisely, information on the potential changes induced to soil organic matter (SOM) dynamics is needed. This cycle can be altered under irrigation because of greater organic inputs to the soil following enhanced biomass production. But also the incorporation and mineralization dynamics can change as a result of new soil conditions induced by irrigation. However, little information exists in the literature. In addition, as these changes depend on the soil characteristics and climatic conditions, their evaluation requires ad-hoc and site-specific analyses. With the aim of modeling the organic matter cycle on irrigated soils, a new experimental field was installed in september 2009. The experimental design is a randomized complete block design with three blocks and two factors: water management (irrigation vs. dryland), and crop (wheat (C3) and maize (C4)). Crops biomass production and inputs to the soil are controlled. Their incorporation to SOM, distribution in aggregate fractions and turnover are calculated based on the different discrimination of C isotopes of C3 and C4 plants. First results indicate a different effect of irrigation in different crops, and changes in the incorporation pace of organic matter. Continuous follow-up of this soil will make possible to determine the changes induced in the SOM cycle, by land conversion to an irrigation system in the area.



S07.04-P -5

EFFECT OF SOIL STRUCTURE ON THE BIODEGRADATION OF NATIVE AND FRESH ORGANIC MATTER

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In order to better understand how soil carbon dynamics will be affected by environmental changes and by the evolution of cropping systems, it is necessary to identify the mechanisms that regulate soil organic matter (OM) decomposition. A number of regulatory mechanisms have been postulated: intrinsic recalcitrance of OM, differential microbial activity related to microbial community structure or physical protection of OM from biodegradation. Whilst the first two mechanisms have received much attention and their importance in regulating C dynamics has been all but discounted, the role of physical protection has not been studied in any great detail. The aim of this study was to assess the relative importance of soil structure in regulating soil OM dynamics. Soil cores with different structures (undisturbed, disaggregated at the 5 mm scale by sieving and disaggregated at the 50 μ m scale by agitation in water) were incubated and the mineralisation of native and fresh (3C-labelled substrates, fructose and vanillin) OM measured. During the incubation, the CO₂ and 13C-CO₂ released were measured to differentiate the CO₂ of soil OM origin from that of fresh OM origin. In order to relate the respiration kinetics to physical structure parameters, X-ray micro-tomography was used to identify solid and pore space in the samples. The treatments appeared to have no effect on soil or fresh OM mineralisation, despite the different physical environments induced by the treatments. These results suggest that the physical controls on carbon dynamics take place at scales below those that were modified in this experiment (<50 μ m).



S07.04-P -6

FATE OF NITROGEN IN EUROPEAN BEECH FOREST SOILS MONITORED USING LONG-TERM ¹⁵N LABELLED LITTER EXPERIMENT

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Beech forests cover large areas in Europe and are recognized as climax ecosystems. They have been used for centuries to produce wood, litter and serve as pasture. Altogether, this high and continuous demand has reduced soil fertility and thus the productivity of these forests. Under such conditions, efficient recycling of nutrients is essential for forests to sustain an increasing number of ecosystem services. In the soil, aboveground litter is the most important annual input of organic matter, subject to decomposition, mineralization and stabilization. These topics are the focus of a series of papers derived from a long-term study of the fate of labelled litter (Zeller et al. 2001, Caner et al. 2004, d'Annunzio et al. 2010, Zeller & Dambrine 2011). The labelling was carried out in several plots in France and consisted in laying a litter, artificially enriched with ¹⁵N on the surface of the soil (Zeller et al., 2000). Leaves, litter and soil were sampled once or twice a year yielding a huge and original database about the movement of nitrogen in the soil over 10 years. Here, we report a synthesis of the data from this long-term experiment, focusing on the drivers (climate, soil type, tree growth, etc) responsible for the mineralization / stabilization of N. Using a modeling approach, we identify the possible pathways leading to the vertical distribution of litter N in the soil profile. Finally, we discuss how forest management and environmental change may affect litter related to the turnover of organic matter in soil.



S07.04-P -7

HIGH SOIL MOISTURE CAN IMPROVE C INCORPORATION AND TRANSLOCATION IN THE PLANT-SOIL SYSTEM, BUT CAN ALTER C PRESERVATION IN SOIL

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Soil moisture influences soil properties like pH, oxygen and C storage. Especially water-logged and peaty soils can be characterized by large amounts of organic C and provide opportunity for improved preservation of organic matter. However, studies are scarce investigating the particular effects of changing soil moisture for C uptake by plants and translocation and preservation of C in soils. In this study, laboratory experiments on *Juncus effusus* and *Lolium perenne* were conducted, where plants were kept at different soil moisture levels (adjusted daily to a difference of 30% between high and low moisture levels) for several months. C uptake and translocation towards soil was traced after $^{14}\text{CO}_2$ pulse labeling in bulk carbon and lipid fractions. Under higher moisture plants grew better and showed higher chlorophyll contents. The carbon uptake was almost identical for plants kept under different moisture taking into account the different amounts of the biomass. Differences were observed in translocation of C towards soil. This was slower for plants kept under low moisture, whereas C was stored in soil and plants for a longer period. This was observed for bulk carbon and on a molecular level for several lipidic compound classes. Also a different C incorporation in lipidic compounds was observed, whereas no lipid pattern changes were found under different moisture. Hence, our results suggest that i) plant biosynthesis mechanisms are not influenced by soil moisture except for speed and ii) incorporation of C into soil is higher under high moisture, whereas preservation is improved under low moisture.



S07.04-P -8

INFLUENCE OF CHEMICAL COMPOSITION AND ANATOMICAL STRUCTURE OF LEAVES ON LITTER DECOMPOSITION RATE OF QUERCUS FRAINETTO TEN. AND QUERCUS CERRIS L. IN SITU

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Leaf chemical composition and anatomical structure have a cause and effect relationship. Traits of fresh leaves, remain operational in the leaf litter and control interspecific variation in decomposition rate. This paper presents the results of a one-year experiment of litter decomposition of *Quercus frainetto* Ten. and *Quercus cerris* L. in natural conditions of the oak forest. The results indicate a clear difference in decomposition rate between the two species, which are induced by the differences in chemical composition and anatomical leaf structure. The decomposition rate constant (k) was $0.831 \pm 0.14 \text{ yr}^{-1}$ for *Q. frainetto* and significantly lower in *Q. cerris* ($0.458 \pm 0.12 \text{ yr}^{-1}$, $P < 0.001$). During the initial chemical composition of oaks' leaf litter, differences were found in water-soluble matter ($P < 0.001$), hemicellulose ($P < 0.01$) and cellulose ($P < 0.05$). In the beginning of the experiment differences were noted in the thickness of mesophyll ($P < 0.01$) and upper epidermis ($P < 0.05$). Later decomposition stages indicated that lignin and fats, waxes and oils fractions had a considerable influence on oaks' litter decay rate. Results after 12 months of decomposition revealed that, 48.04% of the entire leaf, 53.30% of mesophyll and 32.93% of lignified upper and 47.67% of lower epidermis of *Q. frainetto*, and 28.70% of the entire leaf, 31.60% of mesophyll, 25.17% of lignified upper and 20.93% of lower epidermis of *Q. cerris* was decomposed. Reduction in leaf thickness during the course of decomposition mainly occurred due to the reduction of mesophyll parenchyma, which consists of easily degradable plant materials available to decomposers.



S07.04-P -9

LINKING MEASURED CARBON FRACTIONS WITH ROTHC MODEL POOLS

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One of the major issues concerning model carbon pools is their purely conceptual definition by a turnover rate. Despite some attempts to link the conceptual model pools to the operationally defined measurable SOC fractions, this challenge basically remains unsolved. For 57 topsoil samples from arable fields a physical fractionation procedure was applied to determine the carbon contents in three particle-size fractions. Black carbon was determined using a biomarker method. To provide the model pools RothC was run into equilibrium based on site-specific soil properties and meteorological data ranging from 1961 to present. It was possible to prove a link between soil organic matter fractions and pools of RothC. The coefficient of correlation between POM and the resistant plant material (RPM) pool was 0.73. Establishing multiple linear regressions based on all measured fractions instead of using just one significantly improved the RPM pool estimation. The resultant adjusted coefficient of determination using all fractions to predict RPM was 0.94. The same was observed when linking the humic fraction of RothC (HUM) to the respective measured fraction. We conclude that the entire range of available fractions should rather be used than a single fraction to predict model carbon pools from measurements. The rapid assessment of measurable SOC fractions, would enable an independent initialization and validation of pool-based carbon turnover models.



S07.04-P -10

MASTER FUNCTION FOR THE SOLID:SOLUTION EQUILIBRIUM OF DOC IN TAIGA AND TUNDRA SOILS: EXPERIMENTAL AND MODELING RESULTS

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Whereas much attention has been given to the formation and degradation of DOC in arctic environments, in the context of DOC loading of arctic rivers as well as climate change. However, chemical interaction studies are more scarce, in particular those involving modeling. In our investigation of DOC interactions in Nordic soils, it appeared that water extractable organic carbon (WEOC) comprises only a small fraction of total organic carbon, and that DOC is a small fraction of WEOC. The chemical composition of DOC appears to differ profoundly for different horizons as well as between taiga and tundra soils. Using advanced modeling of DOC interactions with the dominant iron oxides, and major cations such as Al and Ca, it is possible to develop a master function that integrates the behavior of different soil types as well as horizons into one curve. The implication of this finding is that extrapolating DOC behavior if climate change affects soil development in arctic regions can be done much more objective and transparent.



S07.04-P -12

PHYSICAL FRACTIONATION OF AN ALFISOL UNDER SUGAR CANE IN RIO GRANDE DO SUL STATE.

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The soil organic matter (SOM) is an important indicator the soil quality because it is associated the several chemical, physical and biological processes. Few studies are related the SOM in areas cultivated with sugar cane in Rio Grande do Sul state. This study aimed to quantify the total organic carbon stocks (TOC), carbon in the coarse fraction (CCF) and carbon associated with minerals (CAM) in three experimental areas of an Alfisol under sugar cane. The experimental areas are located in Temperate Climate Embrapa, Rio Grande do Sul state. The treatments were: soil cultivated during one year (CA1), soil cultivated during two years (CA2) soil cultivated during three years (CA3). Were collected disturbed and undisturbed samples in layers from 0-0.05 m from 0.05-0.10 and from 0.10-0.15 m. The undisturbed samples were collected following procedure of Blake and Hartge (1986). The disturbed samples were designed to granulometric physical fractionation according to Cambardella and Elliott (1992). The stock of TOC and CCF were quantified by dry oxidation in an elemental analyzer being the results expressed considering the bulk density values. Concluded that were no significant differences for the evaluated parameters in the layer 0-0.10 m. However, the TOC and CAM were affected by the use soil in the layer from 0.10-0.15 m. Higher and lower TOC and CAM values were found in CA1 and CA3, respectively. Further studies in sugar cane areas should be done by increasing the soil quality.



S07.04-P -13

POTENTIAL OF THE OLIVE MILL WASTE AMENDMENT FOR IMPROVING SOIL FERTILITY AND CARBON SEQUESTRATION IN DEGRADED SOILS

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The increase in greenhouse gases concentration in atmosphere it's a huge environmental problem. Between those gases, being one of the most important is the carbon dioxide. Most of the world countries subscribe the Kyoto protocol, where the emission of this gas to the atmosphere was highly conditioned. Nevertheless, the countries involved in this protocol could establish several strategies in order to fulfil the Kyoto protocol requirements without compromising their own development and future. One of those strategies could be the increase of carbon sequestration in the soil. Is in this context that this paper appears, trying to determine the potential of olive mill waste to carbon sequestration in soil. With this main goal we establish a long term trial involved the application of olive mill waste as organic fertilizer in an irrigated olive grove. The main results obtain show that this residue can contribute significantly to increase the fertility and sustainability of this kind of agricultural ecosystems and simultaneously contribute significantly to the carbon sequestration in the soil being an important contribution for the Mediterranean countries fulfils the Kyoto protocol requirements.



S07.04-P -14

PRIMING EFFECTS ALTER THE TEMPERATURE RESPONSE OF SOIL ORGANIC MATTER MINERALISATION

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Abiotic factors such as temperature are recognised drivers of soil organic matter (SOM) mineralisation (e.g. in soil carbon models). Priming of native SOM mineralisation as a consequence of labile C inputs is, however, a poorly understood process. Interactive effects with biologically-mediated priming processes are unknown and remain unaccounted for. This study aimed to quantify temperature effects on SOM mineralisation and specifically, establish the response of priming to temperature change. Temperate, agricultural soils were incubated at 15oC, 20oC, 25oC and 30oC. Following a stabilization period, soils were amended with labile carbon additions of ¹³C enriched glucose. Isotopic partitioning of the soil CO₂ efflux was used to determine SOM mineralisation with priming measured relative to unamended-control soils. Destructive harvests were undertaken to account for 'apparent priming' effects resulting from pool substitution within the SMB. Basal SOM mineralisation (i.e. without labile C-additions) and net nitrogen mineralisation was positively correlated with increasing temperature. Real, positive priming effects were observed for each temperature, but regression analysis indicated that the amount of primed SOM-mineralisation (relative to basal respiration rates at each temperature) declined with increasing temperature. The results indicate that priming effects alter the effects of temperature on SOM mineralisation. These effects are not accounted for by standard soil incubation studies or included in current soil carbon models.



S07.04-P -15

REGIONAL ESTIMATION OF SOIL CARBON STOCKS AND CHANGES IN GERMANY'S FOREST SOILS BASED ON THE NATIONAL FOREST SOIL INVENTORY TO PROVIDE THE GREENHOUSE GAS REPORTING

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The National Forest Soil Inventory (BZE) provides Germany's greenhouse gas reporting with estimated organic carbon (OC) stocks of organic layer and mineral soil (30 cm) on basis of about 1.800 soils sampled from 1987 1992 and re-sampled from 2006 2008 in a nationwide grid of 8 x 8 km. Soil OC stocks of the organic layer between both inventories were classified into forest stands and regionalized with CORINE land cover data. Estimated OC stocks were attributed to dominant soil types according to the Soil Map of Germany 1:1,000,000 and subsequently related to Germany's forest area. The OC stocks of the organic layer under all forest stands decreased significantly about 0.04 ± 0.03 Mg ha⁻¹. The OC stocks of the mineral soil increased significantly, which means an annual increase of 0.32 ± 0.04 Mg ha⁻¹. In clayey soils OC stocks were higher than in sandy soils but larger changes were detected in sandy soils. We assume an accumulation of OC in the fine fraction with enhanced clay and silt contents. The high OC sequestration could be caused by (i) a higher biomass production, (ii) a long lasting input of nitrogen and sulphur to become acidified, (iii) a changed forest management or (iv) a limited microbial activity caused by changed climatic conditions. The data provided a valid sample and enabled a reliable and nationwide estimation of OC stocks and changes for a certain period. Nevertheless, there are still uncertainties in the estimation due to sampling errors or incomplete datasets.



S07.04-P -16

SOM CONTENT THRESHOLD LEVELS TAILORED TO NATURAL AND ANTHROPOGENIC CONDITIONS

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Soil organic matter (SOM) is the key soil quality parameter. SOM content information plays an important role in selection of agricultural land management practices maintaining the SOM contents on the adequate level. Widely accepted EU SOM content threshold levels are too general for highly diverse soil, relief, climate and environmental conditions in Slovenia. Instead of average value guidelines, the effective SOM evaluation approach was selected to reflect specific local and natural conditions and to be incorporated into national best practice guidelines. Study presents the conceptual risk assessment model for potential SOM loss from agricultural land in Slovenia. The model integrates natural (climate, soil map information), anthropogenic (land use) and relief factors which control SOM mineralisation. Average annual precipitation, temperatures, solar radiation, exposure, land use and soil properties in raster format were fed in the model where each layer was weighted in two consecutive stages according to its impact on mineralisation. Using ArcGIS software calculation methodology was integrated into SOM algorithm using AML programming language. Finally a map was elaborated, presenting areas under risk for SOM loss under selected criteria. The assessment was done for the entire country highlighting hotspots where agricultural management practices (tillage, land use change etc.) should be reconsidered/redesigned. The study also attempts to assess local-condition dependent SOM threshold values which in comparison to general SOM threshold values, should be used to steer the adaptation of agricultural practices towards sustainable soil use.



S07.04-P -17

TEMPERATURE SENSITIVITY OF DECOMPOSITION IN A PEAT PROFILE

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Peatlands contain a C reservoir representing at least one third of the total terrestrial C pools. This storage is threatened by such changes in the environment that could expose the sequestered peat to further decomposition. We studied a peat profile transferred to a laboratory from a raised *Sphagnum fuscum* dominated bog in southern Finland. We hypothesized that temperature sensitivity of SOM decomposition increases with depth due to increasing recalcitrance or complexity of soil organic matter and is affected by the water table that constrains the decomposition. The peat was sampled from the surface down to 44 cm and divided into five layers according to depth. Thus the uppermost samples were taken from a peat layer that has remained constantly above the water table, and the bottom most samples were taken from layers that remain in anaerobic conditions for most of the year. The age of each sub layer was determined by radiocarbon measurements. The temperature sensitivity of decomposition was detected by measuring CO₂ production and ¹⁴CO₂ signatures in respired CO₂ at different temperatures. The different sub layers of soil were characterized by dividing the organic matter into compartments using a chemical fractionation method. Also ¹³C abundances were determined from the profile and the organic matter fractions to evaluate their potential as tracers of decomposition processes. The results of this study will contribute to decreasing a source of uncertainty in the constraints on decomposition and to making more reliable estimates for the effects of climate change on soil organic carbon stocks.



S07.04-P -18

THE CONCEPTUAL MODEL OF INTERRELATIONSHIP OF CYCLES OF CARBON AND OXYGEN

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The aim of this article is a statement the conceptual model of interrelationship of cycles of carbon and oxygen. The soil organic matter plays main role in this model. The suggested model allows considering a gas composition of atmosphere as a result of a plant-soil system functioning. Green vascular plants may be considered as a facultative heterotrophic organisms with symbiotic both digestion and nutrition. From position of trophology the plant consumption of organic compounds broadens greatly a notion about the plant nutrition and ways of its regulation. In particular, beside the main known cycle of carbon: plant ? litter (soil) ? humic substances (HS) ? carbon dioxide ? plant, there is a second cycle of carbon (turnover of organic compounds, which are structural fragments of biological macromolecules): plant ? litter (soil) ? HS ? fragments of macromolecules (organic nutrients) ? plant; this turnover is an additional cycle of nitrogen too. As far as in the second biological carbon cycle the organic molecules, being structural and functional blocks of biological macromolecules, are built to bodies of photosynthesising organisms; and at the same time a content of the oxygen in atmosphere increases on the same amount of oxygen, which should be used up on the oxidizing of organic molecules c assimilated by photosynthesising organisms.



S07.04-P -19

**USING A FULL ECOSYSTEM MODEL TO EXPLAIN THE SOIL CARBON DECREASE
OBSERVED IN ENGLAND AND WALES**

Guenet Bertrand*^[1]

^[1]CNRS ~ LSCE ~ Gif Sur Yvette ~ France

An important decrease of the top soil carbon content over the period 1978-2003 was observed in England and Wales, corresponding to a carbon loss of 4.44 Tg y⁻¹. Several hypotheses were proposed to explain this result, such as land use change or climate driven modifications of soil respiration and/or primary production. Here, we use a process-based global vegetation model called ORCHIDEE to investigate the potential contributions of changes in soil carbon input versus changes in soil carbon mineralisation induced by climate changes. The soil carbon decomposition in ORCHIDEE relies on several carbon pools with different mineralization rates, following CENTURY model. We ran the model using climate forcing measured by the British atmospheric data centre, without land use change, over the period 1975-2006 on the sites where soil carbon was measured. The model reproduced the observed soil carbon decrease, when driven by climate alone, indicating that land use change may not be necessary to explain the observed trend. First results indicate that the decrease in soil carbon would be due to a decrease of carbon input from litter to the soil and not to an increase of the heterotrophic respiration. The modelled decrease in litter carbon is simulated to reflect a decrease in primary production. We performed a sensitivity analysis to the different forcing variables to estimate their role and contribution. Our results suggest that changes in solar radiation between 1978 and 2003 may be the most important explanatory factor, but interactions with others variables play also an essential role.



S07.05-P - DYNAMICS OF SUBSOIL ORGANIC CARBON IN RELATION TO SOIL PROPERTIES, CLIMATE AND BIOTA

Monday 02 July 2012 from 17:00 to 18:30. Room Poster Areas

S07.05-P -1

ASSESSMENT OF THE SPATIAL DISTRIBUTION OF SOIL ORGANIC CARBON AND RELATED FACTORS IN THE REGIONAL PARK OF PORTOFINO (LIGURIA-ITALY).

Ivano Rellini, Genova - Italy

S07.05-P -2

CARBON POOLS AND TEMPORAL DYNAMICS ALONG A ROTATION PERIOD IN QUERCUS DOMINATED HIGH FOREST AND COPPICE WITH STANDARDS STANDS

Viktor J. Bruckman, Vienna - Austria

S07.05-P -3

CHANGES IN UPPER SUBSOIL PROPERTIES AFTER 50 YEARS OF N FERTILIZATION IN THE SWEDISH LONG-TERM SOIL FERTILITY EXPERIMENTS

Thomas Kätterer, Uppsala - Sweden

S07.05-P -4

COMPONENTS OF FOREST SOIL CO₂ EFFLUX AS ESTIMATED FROM $\delta^{14}\text{C}$ VALUES OF SOIL ORGANIC MATTER

Mirco Rodeghiero, San Michele All'Adige - Italy

S07.05-P -5

DEPTH DEPENDENCY, RETENTION AND STABILISATION OF ORGANIC CARBON IN A SANDY TENOSOL

Eleanor Hobley, Newcastle - Australia

S07.05-P -6

DOCUMENTING AND MODELING THE ACCRETION OF SURFACE AND SUBSOIL ORGANIC CARBON IN AGRICULTURAL INCEPTISOLS RECLAIMED FROM MEDITERRANEAN SEA MARSHES IN SARDINIA.

Armen R. Kemanian, University Park (PA) - United States



S07.05-P -7

EFFECTS OF LAND-USE, WOOD HARVEST INTENSITY, AND RECENT CLIMATE CHANGE ON SOIL ORGANIC MATTER STOCKS IN DIFFERENT SOILS OF THE BAVARIAN ALPS

Christophel Dominik, Freising-Weihenstephan - Germany

S07.05-P -8

EVOLUTION OF SOIL ORGANIC MATTER WITH DEPTH UNDER DIFFERENT FORESTRY AND AGRICULTURE MANAGERMENTS MONITORED BY CALORIMETRY AND THERMAL ANALYSIS.

Josefa Salgado, Santiago de Compostela - Spain

S07.05-P -9

IMPACT OF FOREST REGENERATION METHOD ON ACCUMULATION OF CARBON IN LITTER IN SCOTS PINE (PINUS SYLVESTRIS L.) STAND

Andis Lazdinš, Salaspils - Latvia

S07.05-P -10

INCORPORATION OF ROOT AND RHIZOMICROBIAL ORGANIC MATTER IN SUBSOIL – ASSESSED BY N-ALKANE MOLECULAR PROXIES

Martina Gocke, Bayreuth - Germany

S07.05-P -11

MEASURING BELOW-GROUND CARBON INPUTS USING THE ¹³C NATURAL ABUNDANCE METHOD: COMPARISONS BETWEEN DIFFERENT LAND USE TYPES

Cristina Martinez, Firenze - Italy

S07.05-P -12

ROLE OF CLIMATIC SINGLE EVENTS AND PEDOHYDRAULIC FACTORS IN THE MOBILIZATION AND THE TRANSPORT OF MOBILE ORGANIC PARTICULATE SUBSTANCES IN AN ARABLE SOIL

Andreas Schmalwasser, Jena - Germany

S07.05-P -13

SOIL ORGANIC MATTER ACCUMULATION, FRACTIONATION AND ASSOCIATED MICROBIOCOMUNITY IN TWO CHRONOSEQUENCES ON POSTMINING SITES

Martin Bartuška, Prague - Czech Republic

S07.05-P -14

SOILS WITH HIGH ORGANIC CARBON STORAGE CAPACITY IN DEPTH

Romina Lorenzetti, Firenze - Italy



S07.05-P -15

SPATIAL VARIATION OF SUBSOIL ORGANIC CARBON CONCENTRATION AND THERMAL FRACTIONS UNDER AGRICULTURAL LANDSCAPES OF CENTRAL ENGLAND

Barry Rawlins, Nottingham - United Kingdom



S07.05-P -1

ASSESSMENT OF THE SPATIAL DISTRIBUTION OF SOIL ORGANIC CARBON AND RELATED FACTORS IN THE REGIONAL PARK OF PORTOFINO (LIGURIA-ITALY).

Rellini Ivano^[1], Scopesi Claudia^[1], Maerker Michael^[2], Olivari Silvia^[3], Firpo Marco^[1]

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In recent years, considerable interests have been generated in using soil as a carbon sink to sequester carbon dioxide under future climate change scenarios. But little is known about soil organic carbon (SOC) in Liguria region. The objective of this study was to investigate the spatial distribution of soil organic carbon in regional park of Portofino. The study area is a typical natural coastal area characterized by a mosaic of small rural settlements and vegetation types such as pine wood, chestnut wood, mixed mesophyll woods, mediterranean maquis, holm-oak tree wood, that occur on different soils. For this reason, the spatial characteristics of soil organic carbon and related factors, i.e. land use, topography, and soil type, etc., were explored using GIS and geostatistics. Total SOC was calculated from Organic Carbon (OC) concentrations, estimates of bulk density by texture and skeleton-free soil volume in more than fifty pedons. In this study we present a detailed analysis of the spatial distribution of SOC and the related factors influencing SOC stocks such as topography and land use.



S07.05-P -2

CARBON POOLS AND TEMPORAL DYNAMICS ALONG A ROTATION PERIOD IN QUERCUS DOMINATED HIGH FOREST AND COPPICE WITH STANDARDS STANDS

Bruckman Viktor J.*^[1], Yan Shuai^[2], Hochbichler Eduard^[3], Glatzel Gerhard^[1]

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Carbon pools in two Quercus petraea (sessile oak) dominated chronosequences under different forest management were investigated. The objective was to study temporal carbon dynamics in common forest management systems in eastern Austria along with stand development. The chronosequence approach was used to enable coverage of a full rotation period in each system. Carbon content was determined in the following compartments: aboveground biomass, litter, soil to a depth of 50 cm, living root biomass and decomposing residues in the mineral soil horizons. Total carbon pools were on average 143 Mg ha⁻¹ in the high forest stand (HF) and 213 Mg ha⁻¹ in the coppice with standards stand (CS). The mean share of the total organic carbon pool (TOC) which is soil organic carbon (SOC) differs only marginally between HF (43.4%) and CS (42.1%), indicating the dominance of site factors, particularly climate, in controlling this ratio. While there was no significant change in O-layer and SOC stores over stand development, we found clear relationships between living biomass pools and C:N ratio in topsoil horizons with stand age. SOC pools seem to be very stable and an impact of silvicultural interventions was not detected. Rapid decomposition and mineralization of litter, indicated by low O-horizon pools with wide C:N ratios of residual woody debris at the end of the vegetation period, suggests high rates of turnover in this fraction. CS, in contrast to HF benefits from rapid resprouting after coppicing and hence seems less vulnerable to conditions of low rainfall and drying topsoil.



S07.05-P -3

CHANGES IN UPPER SUBSOIL PROPERTIES AFTER 50 YEARS OF N FERTILIZATION IN THE SWEDISH LONG-TERM SOIL FERTILITY EXPERIMENTS

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^[1]SLU, Swedish University of Agricultural Sciences ~ Soil and Environment ~ Uppsala ~ Sweden

We hypothesized that high yields (N fertilized treatment) increase above- and belowground biomass and thereby the carbon input to the upper subsoil as compared to low N and no N treatments. We measured organic carbon, aggregate stability and readily dispersible clay in top- and subsoil of extreme fertilizer treatments. In addition, we tested the hypothesis whether high crop yields may cause a faster depletion of micronutrients in top- and subsoils than low yields. Investigation of adjacent soil profiles revealed that the upper subsoil in N fertilized plots was 10 cm thicker, contained more organic carbon, had a darker soil color and was more aggregated than those in no N treatment. However, analyses of auger sampled soil showed few significant differences due to a large variability of subsoils within plots. Soil organic matter differences were only statistically higher in a few layers between 25 and 40 cm depth in the high N compared to the no N treatment. A significant negative correlation between soil organic matter and pH was found. Aggregate stability and readily dispersible clay was equally influenced by soil organic matter, clay and pH. In the rotation with manure and N fertilizer, lower soil pH and higher organic matter counteracted each other and aggregate stability decreased. Total analysis of trace element contents in soil showed that there were no significant differences between treatments and depth. Variability in soil was larger than the decline caused by crop removal and leaching.



S07.05-P -4

COMPONENTS OF FOREST SOIL CO₂ EFFLUX AS ESTIMATED FROM $\delta^{14}\text{C}$ VALUES OF SOIL ORGANIC MATTER

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The partitioning of the total soil CO₂ efflux into its two main components: respiration from roots (and root-associated organisms) and microbial respiration (by means of soil organic matter (SOM) and litter decomposition), is a major need in soil carbon dynamics studies in order to predict the net response of soil carbon stores to climate change. In this study, SOM-derived CO₂ efflux was estimated for eleven forest sites as the sum of the ratios between the carbon stocks of different SOM pools and previously published ($\delta^{14}\text{C}$ derived) turnover times. The fraction of soil CO₂ efflux derived from recently fixed carbon, including root and root-associated respiration, was calculated by subtracting the SOM-derived respiration component from total soil chamber measured CO₂ efflux. Results suggested that, on average, ~ 50 % of total soil CO₂ efflux derived from the respiration of the living roots, ~ 40 % from decomposition of the litter layers and less than 10 % from decomposition of belowground SOM;. Estimates of SOM-derived soil CO₂ efflux in the current study were rather low compared with other two partitioning datasets. However a major problem in the comparison could have been the high spatial variability of soil carbon and related variables.



S07.05-P -5

DEPTH DEPENDENCY, RETENTION AND STABILISATION OF ORGANIC CARBON IN A SANDY TENOSOL

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We tested the hypothesis that finer soil particles are responsible for an increase in content and retention time of organic carbon (OC) in subsoils on a sandy tenosol in the NSW Southern Highlands. Total OC content and radiocarbon concentration were measured on 3 particle-size fractions (PSFs) ("macro": 2000–200 μm , "micro": 200–60 μm , and "mineral-associated OC, MAOC": < 60 μm) at 4 depths (surface to bedrock). OC content declined with depth for all PSFs, to which an exponential decay curve was fitted. MAOC had the smallest decay constant, and macro the largest. The OC enrichment factor ($E_f = \%C \text{ fraction} / \%C_{\text{bulk soil}}$) was lowest in the macro and highest in the MAOC-fraction, almost doubling in the micro and MAOM fractions from topsoil to bedrock. Radiocarbon dating revealed macro-OC to be youngest for depths to 1 m. In the topsoil MAOC was oldest, but in intermediate depths (30–100 cm) radiocarbon ages were oldest within the micro-fraction, being 1.5 – 2.7 times older than the other fractions. However, at bedrock (100–120 cm) OC content was very low (0.1 – 0.3%) with no significant difference between C14 ages of the three PSFs (all were about 1270 years BP). Our results indicate that although finer particles retain more OC than larger ones, and stabilise SOC in top and intermediate soil layers, they do not increase the mean residence time of SOC at depths close to bedrock in this soil: other mechanisms must be responsible for the stabilisation of OC near bedrock, which will be presented.



S07.05-P -6

DOCUMENTING AND MODELING THE ACCRETION OF SURFACE AND SUBSOIL ORGANIC CARBON IN AGRICULTURAL INCEPTISOLS RECLAIMED FROM MEDITERRANEAN SEA MARSHES IN SARDINIA.

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High input agriculture in productive Inceptisols that were reclaimed from sea marshes offers an opportunity to study the increase of soil organic carbon (SOC) in soils with originally low SOC. A dairy district occupying 3,500 ha in the western shore of Sardinia exhibits an agro-ecosystem with integrated animal, forage and vegetable production. The site has irrigated sandy soils, with high annual primary productivity (> 20 Mg dry biomass ha⁻¹ yr⁻¹). Soil processes are controlled by seasonal dynamics of the water table. We documented the current SOC content and its distribution with depth for several soil profiles. The SOC in the top 0.5 m of the soil profiles ranged from 47 to 192 Mg ha⁻¹, with 62% (range 35% to 74%) of SOC in the plowed layer (0.3 m). Modeling studies reproducing the historic management to estimate the annual C input via roots, residues, manure and the level of mechanical soil disturbance indicate that the rate of C accumulation was substantial in the past and might be decreasing in the last years due to reduced manure applications following the Nitrate Directive 91/676/CEE. Policy oriented to limit nitrate leaching may cause reduced C input rates and could cause a slow but steady decrease in SOC if C input rates are insufficient to sustain current SOC levels. Future work will address technologies to prevent soil C loss and study the effect of the water table on soil organic matter and the nitrogen cycle.



S07.05-P -7

**EFFECTS OF LAND-USE, WOOD HARVEST INTENSITY, AND RECENT CLIMATE CHANGE
ON SOIL ORGANIC MATTER STOCKS IN DIFFERENT SOILS OF THE BAVARIAN ALPS**

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^[1]Chair of Soil Science ~ Department Ecology and Ecosystem Management, TU Munich ~ Freising-Weihenstephan ~ Germany

Soil organic matter (SOM) stocks in – mostly shallow – mountain soils are a crucial ecosystem factor due to their function as rooting zone, nutrient supply, and water storage pool. However, SOM stocks in many mountainous regions are endangered by non-sustainable land use and climate change. The aims of the presented study were (i) to survey SOM stocks for a large set of soils in the Bavarian Alps, comprising different site conditions (parent material, climate, elevation, pedogenesis) and land use intensities (forest with different levels of wood harvest intensity, pasture). Additionally, we (ii) quantified changes of SOM stocks due to climate change during the most recent three decades at long-term soil monitoring plots. We investigated more than 200 soil profiles and additional core drillings. For all soil horizons or depth increments, we collected homogenized samples for chemical analysis as well as volume-representative samples to calculate SOM stocks. Total C and N were analyzed using an Elementar VarioEL analyzer. For calcareous soils, additionally inorganic C (carbonate) was quantified according to Scheibler (addition of HCl, volumetric measurement of liberated CO₂). For a selection of samples from different long-term soil monitoring sites, a SOM was carried out to distinguish mineral-associated, physically protected, and free labile SOM. First results indicate that both regular forest management (moderate wood harvest intensity, no clearcut) as well as the recent climate change result in significant SOM decreases. Even larger long-term SOM decreases have been observed after land-use change from forest to pasture.



S07.05-P -8

EVOLUTION OF SOIL ORGANIC MATTER WITH DEPTH UNDER DIFFERENT FORESTRY AND AGRICULTURE MANAGERMENTS MONITORED BY CALORIMETRY AND THERMAL ANALYSIS.

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Thermal analysis and calorimetry constitute two emerging methods to assess easily and fast the SOM nature and biodegradability. Their application in soil science is increasing due to the necessity to improve the knowledge about the impact of soil management on SOM composition further than on SOM quantity. The SOM evolution with depth was studied in four plots of lands under similar climatic and environmental conditions to test the sensitivity of these techniques to monitor changes in the SOM composition and degradability that can be assigned to different forest species and agriculture managements from the soil surface to 20 cm depth. A total of 12 samples were studied by differential scanning calorimetry (DSC), thermogravimetry (TG) and isothermal calorimetry to monitor the soil basal metabolism in terms of the energy exchange. DSC and TG results showed different trends that permitted to interpret the vertical variations of SOM thermal fractions. The observed changes in the SOM composition could be assigned to different trends in the metabolic indicators recorded by calorimetry which indicated depletion of the active biomass with depth in all the stands due to increasing thermal recalcitrance and to the decay of thermal labile SOM fractions. Although it was a general trend in all the plots, differences in the quantitative parameters were observed among the samples under different managements and among the soil samples under different forest types.



S07.05-P -9

IMPACT OF FOREST REGENERATION METHOD ON ACCUMULATION OF CARBON IN LITTER IN SCOTS PINE (*PINUS SYLVESTRIS* L.) STAND

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The scope of forest regeneration is preserving of qualities and quantities of forest resources. Benefits of artificial regeneration are reduction of the regeneration cycle, formation of desirable stands and utilization of improved planting material. Preparation of soil secures better conditions for plantings in case of artificial regeneration. Soil treatment might also increase emissions of CO₂ from litter due to better aeration and mixing of soil. The scope of the study is to compare forest regeneration methods (natural regeneration, natural regeneration with soil treatment and artificial regeneration) in pine stand on poor sandy soil according their to effect on carbon stock in litter. The experiment was established in 1997, soil was prepared by trencher. Litter samples were taken in 12 repetitions (whole depth, 20 x 20 cm samples). In plots with treated soil half of samples were taken from treated, half – from untreated area. Bulk density and organic carbon was determined. Carbon stock in litter layer in case of natural regeneration, natural regeneration with soil treatment and artificial regeneration was, respectively, 20,7 ± 2,8, 29,8 ± 1,5 and 24,0 ± 4,3 tons ha⁻¹. Carbon stock in litter was considerably higher ($p < 0,05$) in both cases with soil treatment, which means that soil treatment don't have negative effect on this carbon pool, but leads to increase of carbon stock in litter. Carbon stock in litter correlated with above-ground biomass of trees, which means that the main factor affecting carbon stock in specified conditions is growth of trees.



S07.05-P -10

**INCORPORATION OF ROOT AND RHIZOMICROBIAL ORGANIC MATTER IN SUBSOIL –
ASSESSED BY N-ALKANE MOLECULAR PROXIES**

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^[1]University of Bayreuth ~ Department of Agroecosystem Research ~ Bayreuth ~ Germany ^[2]University of Göttingen ~ Department of Soil Sciences of Temperate and Boreal Ecosystems ~ Göttingen ~ Germany

Organic carbon (Corg) content in deep subsoil is commonly low (e.g. 0.1 mg Corg g⁻¹ in loess). Initial organic matter (OM) in loess is supposed to derive from aboveground biomass. However, recent studies show that significant portions of loess OM can derive from roots and associated microbial biomass. This study aims to assess the rhizosphere extension in subsoil. Calcified roots (rhizoliths) providing an insight into residues of rhizosphere processes, which have accumulated during the lifespan of former roots, were sampled at Nussloch (SW Germany). In addition to root-free loess, rhizoliths and surrounding loess (rhizoloess) up to a distance of 10 cm were sampled separately. Samples were analysed for Corg and lipid composition. While Corg did not increase significantly from root-free loess towards the rhizolith, alkane molecular proxies revealed the influence of the former rhizosphere. High alkane contents in rhizoloess, exceeding those of the former root and reference loess, showed the incorporation of considerable amounts of root and rhizomicrobial OM during the lifespan of the former root, as well as improved preservation of these remains. Former rhizosphere processes were indicated by further proxies like average chain length and carbon preference index of n-alkanes. The rhizosphere effect was not restricted to few mm around the former root, but visible up to distances of 8 cm and more. Regarding the high rhizolith density (up to 190 m⁻² at ~1 m below present soil) at Nussloch, root and rhizomicrobial OM in subsoil likely plays an important role for the SOC pool and dynamics.



S07.05-P -11

MEASURING BELOW-GROUND CARBON INPUTS USING THE ^{13}C NATURAL ABUNDANCE METHOD: COMPARISONS BETWEEN DIFFERENT LAND USE TYPES

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Quantifying temporal changes in C storage is challenging due to the large quantity of C present in topsoils relative to the amount of plant C inputs and CO₂ outputs. Traditional methods for quantifying soil C changes are limited due to: (1) their inability to detect small changes in C stocks given their insensitivity; and (2) the inherent spatial variability associated with soils. Alternative methods are required to quantify soil C changes in soil-plant systems. The ^{13}C natural abundance method is based on the premise that during CO₂ fixation, plants discriminate between C isotopes (^{13}C and ^{12}C), and thus contain a smaller proportion of ^{13}C ($\delta^{13}\text{C}$ -26‰) compared to atmospheric CO₂ ($\delta^{13}\text{C}$ -7‰). Furthermore, different plant species (C₃ and C₄) discriminate between C isotopes differently, which is reflected in the isotopic composition of SOM. This provides an 'in-situ' method by which to calculate the relative contribution of new C in soil-plant systems where the ^{13}C signal of the C input is different to the native SOM. We used this method to quantify differences in below-ground C inputs in four different land use types: forest, grassland, apple orchard, and vineyard. The fraction of new C (f_{new}) inputs following one year of incubation of a C₄ soil were calculated for both surface (0-15cm) and deeper (15-30cm) soil layers. Changes in $\delta^{13}\text{C}$ in soil and roots, root biomass, %C, %N, were also analyzed. Results, presented in this paper, indicate differences within and between sites. The value of this relatively new method is discussed.



S07.05-P -12

ROLE OF CLIMATIC SINGLE EVENTS AND PEDOHYDRAULIC FACTORS IN THE MOBILIZATION AND THE TRANSPORT OF MOBILE ORGANIC PARTICULATE SUBSTANCES IN AN ARABLE SOIL

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Soils are the largest terrestrial pool for organic carbon. To improve our understanding of local and global carbon cycles, factors and conditions that effect release, redistribution and transport of organic carbon should be known. Besides dissolved organic substances, organic particles with sizes up to several micrometers are mobile in soils. The aim of this work is to investigate the impact of external factors (climatic, anthropogenic) and pedohydraulic conditions on the mobilization of mobile organic particulate substances (MOPS). We monitored spatially resolved water and carbon fluxes at an agricultural site with wheat and maize cultivation. Climatic and pedohydraulic boundary conditions were measured continuously with a climate station and a soilhydraulic monitoring pit. The seepage water has been collected in two depths (plough horizon and subsoil) with sixteen tension lysimeters. The results from one year observation suggest that release of MOPS is mainly triggered by single events like heavy rain and snowmelt. The pedohydraulic data support that preferential flow along biopores plays a major role for the MOPS release during these events. The translocation of dissolved and particulate organic substances depends on the cultivation type. Under maize, higher water and carbon fluxes into the subsoil were observed. Owing to preferential flow, less MOPS were detected in the seepage water collected below the plough pan than in the deeper subsoil's seepage water. With regard to probably increasing occurrence of extreme events as a consequence of the climatic change, the influence of MOPS translocation should be considered in future balances of carbon cycling.



S07.05-P -13

SOIL ORGANIC MATTER ACCUMULATION, FRACTIONATION AND ASSOCIATED MICROBIOCOMUNITY IN TWO CHRONOSEQUENCES ON POSTMINING SITES

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Carbon accumulation in post mainingsites near Sokolov(Czech Republik) was studied on two chronosequences (naturally regrowed unreclaimed sites and alder plantations) covering age from 0 to 50 years of developement. In all chronosequences no topsoil was supplied and soil formation become de novo. Carbon accumulation was fastest in alder plantation, where most of the carbon in these chronosequence was accumulated in mineral soil. In natural regrowth the carbon accumulation was slower and larger portion of carbon accumulated aboveground as a undecomposed litter or fermentation layer. However in unreclaimed sites larger accumulation of carbon was observed in older sites. This pattern corresponds with worms colonisation and the intesnity of bioturbation. The ammount of carbon bound inside macroaggregates as well corresponds with degree of bioturbation and the biggest value was found in alder plantation. PLFA of microbiocomunity in bulk soil clearly distinguished individual chronosequences. Hoewer when we evaluated free LF and bounded SOM fraction inside soil aggregates we recognized that position of soil carbon is more important and affect the microbiocomunity more than chronosequences themself. This indicates that differences betewen chronosequences are in large extend couosed by various degree of incorporation of organic matter.



S07.05-P -14

SOILS WITH HIGH ORGANIC CARBON STORAGE CAPACITY IN DEPTH

Lorenzetti Romina^[1], Barbetti Roberto^[2], Fantappiè Maria^[3], Costantini Edoardo A.^[4]

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^[4]CRA-ABP ~ CNCP ~ Firenze ~ Italy

Most studies about soil organic carbon (OC) stock focus on the topsoil storage capacity, however, it has been proved that OC can reach relatively high values also in depth. The aim of this work was a preliminary investigation of the soil types with a high OC content in depth and the relationship with the main pedogenetic factors. The dataset was the 1,414 Italian National Soil Typologies (STU). The selected attributes were: mean value of OC in the superficial functional horizon (L1); weighted average value between 50 and 100 cm (L2) and under 100 cm (L3); WRB classification; main lithology, morphology and land-use. About 92% of typologies had more than 0.58% of OC in L1, about 30% in L2, and 10% in L3. The highest OC contents were in L2 of Histosols, Umbrisols, Podzols, Vertisols, Andosols, and in L3 of Vertisols, Andosols, Fluvisols. STU on volcanic rocks, slope and residual deposits showed relatively higher accumulation in L2; soils on delta plane, lacustrine and alluvial deposits, both in L2 and L3. STU on upland plains, transitional areas with plateau in the mountain, high gradient mountains and low plains, showed higher OC content. Land-use was not significantly connected with OC content in depth. About 65% of the studied territory (47% of Italian surface) had a relatively high CO content in L2, and about 2% in L3. The main processes connected to soil CO storage capacity in depth were morphological, namely colluvium and alluvium, as well as pedological, in particular, podzolization and andisolization.



S07.05-P -15

SPATIAL VARIATION OF SUBSOIL ORGANIC CARBON CONCENTRATION AND THERMAL FRACTIONS UNDER AGRICULTURAL LANDSCAPES OF CENTRAL ENGLAND

Rawlins Barry^{*[1]}, Barker Monica^[2], Lark Murray^[1], Kemp Simon^[1], Wagner Doris^[1]

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In previous research the variance components of topsoil carbon concentration, determined by loss on ignition, were estimated across a substantial area of the UK. Variance increased by an order of magnitude in steps from i) analytical plus subsampling, to ii) short-scale (20 metre: paired samples), to iii) medium-scale (>1000m). There is little comparable information on subsoil (35 to 50 cm depth) organic carbon (SSOC) concentrations – and their biogeochemical fractions. We measured total SSOC concentration by combustion of soil samples from 122 grassland or arable sites. We measured soil properties (total Ca, pH and dithionite iron (Fe(d)) concentrations, clay) for each sample which may account – through various mechanisms – for preservation of SSOC. We subjected half of the paired samples to thermal analysis. Variance of SSOC components i) and ii) were of the same magnitude; the difference from topsoil is likely due to the quantity of subsample used in the two analytical methods. As in topsoil, variance in SSOC increased by an order of magnitude between components ii) and iii). Soil Group accounted for a statistically significant component of the variance in SSOC, as did the measured properties other than clay. The correlation of log SSOC concentration between paired sites was substantially weaker ($r=0.39$) than the correlation between those sites of two thermal fractions ($r=0.62$). This has implications for understanding SSOC turnover and sequestration; it suggests that the thermal fractions are less spatially variable reflecting local soil conditions that influence SOC stabilization.



S07.06-P - MECHANISMS OF C STABILIZATION AND SEQUESTRATION IN SOILS

Friday 06 July 2012 from 17:00 to 18:30. Room Poster Areas

S07.06-P -1

ADDING CLAY TO SANDS TO INCREASE CARBON STORAGE

Richard Bell, Murdoch - Australia

S07.06-P -2

AN OPTIMIZED METHOD FOR THE FRACTIONATION OF SOIL ORGANIC MATTER INTO POOLS NOT PROTECTED AND PROTECTED FROM DECOMPOSITION BY PHYSICAL AND CHEMICAL MECHANISMS

César Plaza, Madrid - Spain

S07.06-P -3

ASSESSING NATURAL OR ANTHROPOGENIC IMPACT ON FOREST MEDITERRANEAN SOILS BY HUMIC MATTER CHARACTERIZATION.

Alessandra Trinchera, Rome - Italy

S07.06-P -4

CANOPY GAPS IN A MIXED BEECH STAND OF NORTHERN IRAN: EFFECT ON SOIL C STOCK

Yahya Kooch, Noor - Iran, Islamic Republic of

S07.06-P -5

CARBON ACCUMULATION AND TURNOVER AT ALLEY-CROPPING SYSTEMS PRESENTED BY BLACK LOCUST, POPLAR AND MAIZE IN BRANDENBURG, EASTERN GERMANY

Tetiana Medinski, Cottbus - Germany

S07.06-P -6

CARBON RETENTION CAPACITY AND QUALITY OF ORGANIC MATTER IN SILT AND CLAY FRACTIONS OF BRAZILIAN OXISOLS UNDER DIFFERENT SOIL MANAGEMENT SYSTEMS

Deborah Pinheiro Dick, Porto Alegre - Brazil

S07.06-P -7

DEPTH DISTRIBUTION OF SOM IN SOILS OF VOLCANIC ORIGIN OF TENERIFE (CANARY ISLANDS, SPAIN)

Cecilia María Armas-Herrera, La Laguna - Spain



S07.06-P -8

EFFECT OF MANAGEMENT PRACTICES ON PHYSICAL-CHEMICAL STABILIZATION MECHANISMS OF ORGANIC CARBON IN SEMIARID SOILS

Noelia Garcia Franco, Murcia - Spain

S07.06-P -9

EFFECT OF PERMAFROST ON THE FORMATION OF ORGANIC CARBON POOLS, THEIR PHYSICAL-CHEMICAL PROPERTIES AND EROSION RATES IN THE EASTERN SWISS ALPS

Barbara Pichler, Zurich - Switzerland

S07.06-P -10

EFFECT OF SOIL PARTICLES ON ORGANIC CARBON CONTENT OF THE LOESS-DERIVED SOILS OF GOLESTAN PROVINCE, NORTHERN IRAN

Farhad Khormali, Gorgan - Iran, Islamic Republic of

S07.06-P -11

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Tünde Nyilas, Szeged - Hungary



S07.06-P -1

ADDING CLAY TO SANDS TO INCREASE CARBON STORAGE

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Carbon storage in natural soils is positively related to clay content provided other factors are relatively similar across sites. For example, in a dryland farming area (300 mm/year annual rainfall) of Western Australia, carbon storage increased linearly with increasing clay content. Carbon storage in the surface 0.1 m was 42.5 Mg CO₂-e/ha in soils with 1.7 % clay compared to 99.1 Mg CO₂-e/ha for soils with 9.1 % clay. Clays are often added to sands to overcome water repellency or to reduce nutrient losses by leaching, but are not considered as a carbon management tool. We investigated whether soil carbon storage could be enhanced in sands by adding clay. Bauxite processing residue (10 % clay) had been applied in 1982 to deep sands (1 % clay) at different rates in an area with 760 mm/year annual rainfall. Application of 25 Mg clay/ha resulted in an increase in soil carbon content of 47.7 Mg CO₂-e/ha. Soils were sampled to a depth of 0.3 m, with most (65%) of the increase being in the surface 0.1 m. Other examples of increased carbon storage following clay enhancement will be discussed. Globally, there are large areas of prospective soils for clay enhancement namely those with moderate to deep surface sand horizons. In this presentation we describe the implications of clay enhancement of sands for increasing the carbon storage in such soils, review some of the co-benefits of clay addition (for nutrient retention and crop productivity) and suggest areas for further investigation.



S07.06-P -2

AN OPTIMIZED METHOD FOR THE FRACTIONATION OF SOIL ORGANIC MATTER INTO POOLS NOT PROTECTED AND PROTECTED FROM DECOMPOSITION BY PHYSICAL AND CHEMICAL MECHANISMS

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The objective of this work was to describe an optimized procedure, based on the method developed by Plaza et al. (2012, CLEAN-Soil Air Water, in press), for the fractionation of soil organic matter (SOM) into unprotected SOM (i.e., free SOM located between aggregates), SOM weakly and strongly stabilized by physical mechanisms (i.e., SOM occluded within macro and microaggregates, respectively), and SOM protected by chemical mechanisms (i.e., mineral-associated SOM). Similar to the fractionation scheme described by Plaza et al. (2012), free SOM is isolated by density with sodium polytungstate (SPT); in a second step, macroaggregates in the heavy fraction are broken up into microaggregates and intra-macroaggregate SOM, and the latter is separated by density with the filtrate from the first step (SPT solution); and, in a third step, intra-microaggregate SOM is isolated from mineral-associated SOM by density with the filtrate from the second step after ultrasonic disruption. In this work, we optimized the volume of SPT and centrifugation conditions to improve the effectiveness and efficiency of the density separations. We found that a ratio of whole soil to SPT of 1:4 (20 mg of whole soil and 80 mL of SPT in a 100-mL centrifuge tube) and a relative centrifugal force of 2500 × g for 30, 45, and 60 min in the first, second, and third density separations, respectively, improve the separation of light and heavy fractions while reducing costs.



S07.06-P -3

ASSESSING NATURAL OR ANTHROPOGENIC IMPACT ON FOREST MEDITERRANEAN SOILS BY HUMIC MATTER CHARACTERIZATION.

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Some soil parameters, as C/N and humified organic matter content, are considered key-factors in order to detect disturbance in forest systems. The humus form, content and characteristics result from a sequence of evolutionary processes: stages of degradation, resynthesis and transformation of OM from litter, strongly affected by external factors as climate change, anthropogenic impact, etc. The study of the different humic fractions in organic soil horizons can provide important knowledge about the processes of litter degradation/OM synthesis, and thus on biological and biochemical soil fertility. The objective of this research was to evaluate the soil humic matter evolution in relation to different ground cover, therefore to detect natural and/or anthropogenic impacts occurred. On 14 sites of the Castelporziano Reserved Area (Rome) with different Mediterranean vegetal coverage, TOC%, C/N, TEC%, CHA% and CFA% were determined for each diagnostic horizon. Besides, DH%, CHA/CFA and the related indexes DHA% and DFA% were calculated. Information allowed to compare: i) the OM input to soil (typology of litter); ii) the soil attitude to sustain humification processes; iii) the loss of soil organic profile due to the increase of mineralization activity (reduction of C-sink). The obtained results evidenced the importance to monitor particularly the Quercus cerris L. forest systems: actually, even if at different extent, they showed a tendency to rapidly degrade soil OM, which affects soil fertility on medium-long term and thus the capability to sustain the forest stand. Keywords: soil, forest litter, organic matter, humic acids, fulvic acids.



S07.06-P -4

CANOPY GAPS IN A MIXED BEECH STAND OF NORTHERN IRAN: EFFECT ON SOIL C STOCK

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Forest soil is important in sequestering atmospheric CO₂ and emitting trace gases that are active and enhance the greenhouse effect. The present study aimed to examine the impacts of small (85.12 m²), medium (325.21 m²), large (512.11 m²) and very large (723.85 m²) gaps on soil organic carbon sequestration (SOCS) in a mixed beech - hornbeam stand of northern Iran. Soil samples were taken from 0 - 15, 15 - 30 and 30 - 45 cm depths and gap center, edge and closed canopy positions. Some of soil physico - chemical characters were measured in the laboratory. The following formula was used to calculate C accumulation at different soil depths: $SOCSL = C \times Bd \times e \times 0.1$ where the SOCSL is the organic C sequestration at each soil layer (Mg ha⁻¹); C is the organic C content (g kg⁻¹); Bd is the bulk density (g cm⁻³), e is the thickness of the layers (cm), and 0.1 is a conversion factor. Carbon accumulation showed significantly increasing trend from small gaps to very large gaps. This trend is mainly caused by litter's decomposition rate. It was found that gap position had a profound effect on carbon stock as the most values observed in gap center. According to the results, soil upper layers devoted in more carbon accumulation compare to deeper soils. Our results suggest that gaps created by windthrow should be considered as an effective factor on soil dynamics that are tied to forest ecology.



S07.06-P -5

CARBON ACCUMULATION AND TURNOVER AT ALLEY-CROPPING SYSTEMS PRESENTED BY BLACK LOCUST, POPLAR AND MAIZE IN BRANDENBURG, EASTERN GERMANY

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Alley-cropping system is seen as a viable land-use practice for carbon sequestration. The extent to which the C is sequestered in soil varies between ecosystems, and depends on tree species and on the extent of physical protection of soil organic C within soil aggregates. The objective of this study was to investigate soil C storage and turnover at alley-cropping systems presented by short rotation tree species (black locust, poplar) and maize in Brandenburg, Eastern Germany. At each treatment composite soil samples were collected with auger from 6 replicate plots at 0-10cm and 10-30cm depth layers. Soil samples were 2 mm sieved and separated by wet-sieving into size-fractions: macro (>250 μm), micro (53-250 μm) and clay + silt (<53 μm). Organic carbon and nitrogen were determined for the above fractions by gas-chromatography. Soil samples were also analysed for the total C&N content, cold-water extractable OC, microbial C, soil particle size, and pH. The results showed no differences for the total and stable OC fraction (clay+silt, <53 μm), while cold water-extractable OC was significantly higher in maize treatment compared to black locust. This may indicate faster turnover of organic matter in maize treatment due to tillage, and as a result greater incorporation of plant residues into the soil, greater soil respiration and microbial activity.



S07.06-P -6

CARBON RETENTION CAPACITY AND QUALITY OF ORGANIC MATTER IN SILT AND CLAY FRACTIONS OF BRAZILIAN OXISOLS UNDER DIFFERENT SOIL MANAGEMENT SYSTEMS

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Recent studies indicated that C retention capacity of soils is finite and the C stocks increase does not correspond linearly to C additions over time, due to a saturation of the sorption sites. So far little is known about subtropical soils. The aim of this study was to investigate the influence of soil management system on C retention capacity and quality of soil organic matter (SOM) in silt and clay fractions in subtropical Brown Oxisol and Red Oxisol cultivated for 30 years under no-tillage (NT) and conventional tillage (CT). Soil was sampled in profile (0-100 cm) from each site and from a neighboring area under native forest (NF), the reference for the original carbon content.. After removal of particulate organic matter, the suspension (<53 µm) was sonicated and silt and clay fractions were separated according to Stokes' law. Carbon content of whole soil and fractions was determined by dry combustion and SOM was investigated by means of FTIR spectroscopy. In both soils, NT showed a higher C saturation limit in comparison to CT. Moreover, C content increase in silt and clay fractions under NT occurred mainly in topsoil. This effect is greater in the Brown Oxisol, and that is probably due to the occurrence of goethite e gibbsite in this soil. Preservation of SOM in both fractions under NT occurs by organo-mineral interaction and organic self-assembly, while in CT soil disturbance favors the decomposition of SOM by microorganisms.



S07.06-P -7

DEPTH DISTRIBUTION OF SOM IN SOILS OF VOLCANIC ORIGIN OF TENERIFE (CANARY ISLANDS, SPAIN)

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The amount and distribution of SOM through soil depth are subjects of growing interest in the context of ongoing global change. Volcanic soils, particularly Andosols, often contain large amounts of SOM in the form of Al-humus complexes and allophane-humus, and/or physically protected inside soil aggregates. We investigated the vertical distribution of SOM in soils of volcanic origin under natural vegetation in Tenerife Island (Canary Islands, Spain). We analyzed a total of 214 soil profiles covering 15 WRB reference soil groups and representing the main vegetation types and soil landscapes. SOM was determined using the Walkley-Black method, and recalculated on a volume basis for standardized 20 cm depth intervals. Furthermore we selected ten representative soil profiles for a more detailed study, aimed to assess the main sources of organic matter (litterfall, roots) and relate them to the SOM contents. Alisols, Andosols, Cambisols, Luvisols, Phaeozems and Umbrisols showed total SOM stock values of 30-35 kg m⁻². Soils included in these groups exhibited around 35, 60, 80, 95 and 98% of their total SOM stocks in the first 20, 40, 60, 80 and 100 cm depth, respectively. In most cases, depth distribution of SOM was better fitted by a quadratic model than the exponential model usually assumed. The distribution of root biomass and SOM appeared closely interrelated, suggesting a major role of roots in the supply of organic matter, except for soils under pine forests, which showed a pronounced enrichment in SOM in their surficial layers due to accumulation of slowly-decomposable plant residues.



S07.06-P -8

**EFFECT OF MANAGEMENT PRACTICES ON PHYSICAL-CHEMICAL STABILIZATION
MECHANISMS OF ORGANIC CARBON IN SEMIARID SOILS**

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*The study of different soil organic carbon (SOC) stabilization mechanisms under different land uses and management practices is of a great importance to advance in the knowledge of atmospheric CO₂ sequestration in the soil. Although there are several studies describing these mechanisms in template areas, no long-term studies exist about it in reforested ecosystems in semiarid environments. The aim of this study was to assess the effects of different reforestation techniques on physical-chemical stabilization mechanisms of soil organic matter. The reforestation treatments were: a) mechanical terracing + *Pinus halepensis* with soil organic amendment (ROA), and b) mechanical terracing + *Pinus halepensis* without organic amendment (R). A mediterranean shrubland next to these reforested areas were considered as a control. After 20 years soil samples were taken at: 0-5 cm, 5-20 cm and >20cm depths. Three SOC pools corresponding to different chemical and physical stabilization mechanisms were obtained in each depth: two sensible pools (POC and DOC), two slow pools (carbon associated to clay and silt particles or stabilized in aggregates) and one passive pool (oxidation-resistant carbon). Terracing had a negative effect in the stock of SOC in the top soil with respect to the control area, whereas in ROA treatment occurred a significant increase of the stock of SOC determined basically by an increase in the sensible OC pool (as a result of an increase in biomass); together with an increase of the slow OC pool (as the result of a increase in aggregates formation) compared to the control.*



S07.06-P -9

EFFECT OF PERMAFROST ON THE FORMATION OF ORGANIC CARBON POOLS, THEIR PHYSICAL-CHEMICAL PROPERTIES AND EROSION RATES IN THE EASTERN SWISS ALPS

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Permafrost soils accumulate labile organic matter (OM) that may become a potential C-source as a result of global warming. The expected changes in thermal and hydrological conditions will not only influence OM degradation processes within the soil. Especially in alpine regions, soil erosion might be affected and potentially promote the mineralization of OM. However, the knowledge about the biogeochemistry and OM-stabilization processes and rates in permafrost soils is scarce, which makes it difficult to predict climate-carbon feedbacks. Our aim is to determine and compare the quantity, allocation and mean residence time of OM and the erosion rates in permafrost soils and adjacent unfrozen soils in the Eastern Swiss Alps. Bulk soil and separated fractions (stable-H₂O₂-resistant-, density-fractionation-OM) were analyzed for their C-content, ¹⁴C dated and characterized using DRIFT. This approach has been applied for the first time in high alpine regions. Erosion processes have been qualitatively assessed by relating the OM-¹³C values of degraded soil profiles to non-disturbed reference profiles. This method is now cross-checked by measuring the ¹³⁷Cs inventory in soils, which is a potential quantifiable tracer for soil erosion. First results show that the total amount of OM is rather high in both soils (permafrost/non-permafrost), leading to the assumption that these soils developed under different (warmer) climate. However, permafrost soils are expected to hold considerable amounts of labile SOM, as it is shown for north-exposed soils in the Alps. Erosion processes are influencing alpine soil characteristics. One difficulty in determining physical erosion in permafrost-affected soils is due to cryoturbation.



S07.06-P -10

EFFECT OF SOIL PARTICLES ON ORGANIC CARBON CONTENT OF THE LOESS-DERIVED SOILS OF GOLESTAN PROVINCE, NORTHERN IRAN

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Organic matter has important roles in agriculture and applying appropriate management practices to serve carbon in the soil as a sink to reduce CO₂ emission is of prime importance. Investigations on the dynamics and interrelations of organic matter and the soil mineral phases therefore are highly necessary. The loess-derived soils of Golestan province, northern Iran were selected to examine the preservation of soil organic carbon by mineral phases. Studying the relationship between mineral and organic phases showed that organic carbon had strong correlation with (silt+clay) content (<20 µm fraction) including as an average of 75.98 ± 6.92% of the total organic carbon. In contrast, sand had no significant correlation with organic carbon content of the soils.



S07.06-P -11

EFFECT OF TOPOGRAPHY ON LOCAL-SCALE SPATIAL VARIABILITY OF SOIL ORGANIC CARBON (SOC) IN STEEP SLOPES IN TOSHAN REGION LOCATED IN GOLESTAN PROVINCE

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Soil organic carbon (SOC) has an important influence on the chemical and physical properties of soil and can release its contained nutrients through mineralization in forms available to plants. Thus one of the key components for assessing soil quality is SOC appraisal. The aim of this research was to determine the spatial heterogeneity and variability of SOC in relation to topography in loess hillslope using three different geostatistical methods such as Kriging, Cokriging and Inverse Distance Weighted (IDW) in Toshan region located in Golestan Province. Hence, 234 soil samples at regular grid were collected from whole part of a loess hillslope. The experimental variogram of SOC was best-fitted by a Stable model. In this research, the evaluation criteria were Mean Error and Root Mean Square Error with the Cross Validation method. The results showed that Ordinary Cokriging method with clay covariate estimated better result in evaluation of SOC in whole part of the hillslope with Root Mean Square Error values of 0.2552 compared to the Kriging and IDW methods. Spatial correlation ratio of SOC was different in various slope positions and these patterns were closely related to the structure of topography



S07.06-P -12

EFFECTS OF PODZOLISATION INTENSITY AND ORGANIC MATTER STABILISATION ON SURFACE PROPERTIES OF B HORIZONS

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The interaction of organic C with Al and Fe (oxy)hydroxides and the formation of metallorganic complexes is one of the mechanisms enhancing the stabilisation of organic matter (OM) in soil. This mechanism is crucial in Spodosols where, typically, the contents of illuviated Al, Fe and OM increase in the B horizons with the ongoing of the pedogenic process, probably leading to sharp modifications of the soil surface properties. Furthermore, if the increase in concentration is associated to an enhanced interaction between the organic and mineral phases, a decrease in the proportion of the most labile organic pools should occur. In this work we selected the B horizons of soils showing increasing intensity of podzolisation (from the Bw of a Spodic Dystrudept to the Bsm of a Placic Cryaquod), evaluated the proportion of labile OM pools through oxidation with NaClO and characterised surface properties with N₂ adsorption. The intensity of podzolisation sharply affected surface properties, with higher SSA and microporosity in the most developed B horizons. The large amount of micropores also affected the surface affinity for N₂, with a clear trend in the CBET. The proportion of easily oxidised OM decreased from the Bw to the Bsm and, after elimination of the labile pool, an increase in SSA and in porosity was observed. The parallel increase in the CBET upon oxidation was probably caused both by the removal of a low affinity OM phase and by the increase in uncovered, organic-free mineral surfaces.



S07.06-P -13

HOW MANY C IS "RECALCITRANT" THROUGHOUT A PEAT BOG PROFILE?

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Peatlands play an important role in the C cycle and could provide a significant positive feedback for climate change. Unfortunately, when drained (for forestry, agriculture and/or peat extraction for energy), peatlands become a threat to the environment, as they might change from a net C sink to a large C source (CO₂ and CH₄). In this work, we followed the evolution of bulk peat and its HA fraction along an ombrotrophic profile, using several spectroscopic methods (Ft-IR, UV-Vis, DSC, Fluorescence), elemental analysis (CHNS-O), and isotopic signatures (d¹³C, d¹⁸O and d¹⁵N). Briefly, the superficial zone is characterized by oxidative processes and decomposition phenomena of plant tissues occurring in the top horizons. Here, the HA fraction accounts for 6.6-15.4% of the bulk peat, thus meaning that 7.8-17.3% of total C present in peat is stored in the recalcitrant and stable HA fraction, and thus most of the C stock could be easily mineralized. On the opposite, the bottom zone, in which molecules with high molar mass and high degree of condensation are observed, is characterized by uniform and permanent anoxic conditions. In this section, the HA fraction accounts for 20.0-32.7% of the bulk peat, representing 25.1-37.1% of total C in peat. The variability in the depth of the water table has generated also a "transition" zone, characterized by the highest ash content (4.9%) and by the occurrence of less humified molecules. In this part of the profile, the HA fraction represents 24.3% of total C present in bulk peat.



S07.06-P -14

HUMIC SUBSTANCES AS INDICATORS OF SOIL CARBON STABILIZATION IN ALFISOLS DEVELOPED UNDER MEDITERRANEAN CLIMATE.

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The relationship between soil structure and the ability of soil to stabilize soil organic matter (SOM) is a key element in soil carbon (C) dynamics. In particular, SOM and its humified fractions, the humic substances (HS), are universally recognized to be among the most reactive soil components that contribute substantially in soil carbon (C) stabilization. The aim of this work is to contribute to the characterization of Alfisols developed under Mediterranean climate in Italy by isolating their Humic acids (HAs) components and investigating their compositional, structural, and functional properties and potential chemical reactivity. Thus, SOM in terms of HAs along Alfisols profiles in Apulia region (southern Italy) were characterized by using chemical methods and spectroscopic techniques, including Fourier transform infrared (FT IR) and fluorescence. In addition, soil samples from different horizons were also analyzed for the dissolved organic matter (DOM). Soil analyses were carried out following internationally recommended procedures. Preliminary results indicate that FT-IR spectra of HA extracted from the upper horizons showed a higher aliphatic character, whereas HA extracted from the lower horizons had a higher content of aromatic structures and polysaccharides. Moreover, the fluorescence index of the HA (HIX_{flu}) showed a higher degree of aromatic polycondensation in the subsoils. These results suggest reduced carbon availability in deep horizons where HA structures resulted in complex and more stable molecules.



S07.06-P -15

INTERACTION OF SOIL RESPIRATION AND AGGREGATE SIZE DISTRIBUTION RESULTING FROM DIFFERENT TILLAGE PRACTICES IN A SWEDISH CLAY SOIL

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Soil management practices affect aggregate size distribution in soils and thereby nutrient cycling and soil biological activity. Previous studies have shown differing effects of tillage practices on soil structure depending on the initial conditions, mainly in relation to soil water content. Our aim was to study these changes in aggregate size distribution due to different tillage operations in the field and how these relate to soil respiration. Secondly, we wanted to quantify soil respiration from aggregates formed in different tillage operations in a laboratory study. The field study was conducted on clay soil in Sweden with three tillage intensities conducted in early or late autumn 2010: mouldboard ploughing (MP), deep cultivation (DC) and shallow cultivation (SC). Soil respiration was determined during 45 days and aggregate size distribution was quantified with a dry sieving method. We found a significant difference in aggregate size distribution in MP compared to the DC and SC regardless of tillage timing. The highest amount of clods (>64mm) was produced in MP and the highest amount of small aggregates (<4mm) was produced in DC and SC. Soil respiration was highest in SC and decreased in the order SC>CD>MP after the early tillage, though only the difference between SC and MP was statistically significant ($p<0.05$). Later tillage showed similar results but treatments did not differ significantly. The field study indicated that the higher amount of clods in MP was causing lower respiration rates compared to the other treatments. The results from laboratory study will be presented and discussed.



S07.06-P -16

ISOLATING THE EFFECT OF MINERAL-ORGANIC INTERACTIONS ON THE RESPIRATION OF RECALCITRANT ORGANIC SOIL CARBON

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Recalcitrant soil carbon is a poorly understood component of soil organic matter (SOM). Although the turnover rate of the recalcitrant fraction is slow, long-lived SOM may become a large CO₂ source to the atmosphere as global temperatures rise. Several studies have shown that the oldest SOM fractions tend to associate with the smallest mineral particles, making its analysis difficult. We created synthetic soils to imitate the association between clay surfaces and biomolecules based on the hypothesis that clays with greater surface area and charge will more tightly bond certain biomolecules, protecting them from degradation. The samples were composed of one biomolecule and one clay. We reacted dissolved glucose or vanillic acid with bleach-cleaned kaolinite, montmorillonite, and quartz sand, inoculated with natural soil water to introduce microbes, and purged the vials with CO₂ free air before incubating. We analyzed the air inside the vials via mass spectrometry to find the concentration and $\delta^{13}\text{C}$ values of respired CO₂. The vanillic acid samples had higher respiration rates than glucose samples, a surprising result since glucose is more labile. The montmorillonite had the lowest respiration rates. The large surface area and charge of montmorillonite better protected the OM from oxidation. The $\delta^{13}\text{C}$ values of respired CO₂ consistently decreased in the order sand, kaolinite, montmorillonite with $\delta^{13}\text{C}$ values of -7.81‰, -17.99‰, and -24.93‰ for vanillic acid and -9.59‰, -11.99‰, and -13.36‰ for glucose, respectively. The isotopic depletion is likely from preferential desorption of lighter isotopes in samples with higher surface area and charge.



S07.06-P -17

LAND USE AND AMENDMENT EFFECTS ON SOIL AGGREGATION AND ORGANIC CARBON IN ACID SOILS OF SW SPAIN

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Soils of the "Raña" in SW Spain are Acrisols characterized by high OC content, strong acidity and high content of Al^{3+} . The quality of these soils decreased due to traditional tillage so that alternative uses and managements are needed to improve it. The objective of this study was to evaluate the effect of a Ca-amendment and different land uses on the stabilization of OC in soil aggregates. The land uses were natural pasture (NP), improved pasture (IP) and a traditionally tilled forage crop (FC). Samples were taken at 0-5 and 5-15 cm depths and analysed for pH, total organic carbon (TOC), particulate organic carbon (POC), total nitrogen (TN), aggregate-size distribution through wet-sieving, and C and N associated to each aggregate-size class. Amendment did not influence aggregate-size distribution. Tilled forage crop (FC) reduced large macroaggregates ($>2mm$) and increased microaggregates ($250-1000\mu m$) when compared to pastures. While NP increased large macroaggregates on top layer, these were higher in the deeper layer for IP. Small macroaggregates ($1-2mm$) and fraction $<53\mu m$ were not affected in any case. The aggregate associated-C was influenced by depth, land use and aggregate size. Improved pasture increased OC on large macroaggregates and fraction $<53\mu m$ for both layers. The fraction $<53\mu m$ was the size containing more OC (11.6%) while microaggregates showed the lowest concentration (5.9%) compared with small (6.9%) and large macroaggregates (9.1%). In conclusion, traditional tillage reduced aggregate-size distribution and OC content in the largest and the smallest aggregates while pastures preferentially stored OC in the large macroaggregates.



S07.06-P -18

OPTIMISING DENSITY CUT-OFF AND DISPERSION FOR DENSITY FRACTIONATION OF SOIL ORGANIC MATTER

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Density fractionation is widely used to separate organic matter (OM) fractions, operationally defined by density cut-off and sonication intensity. Three fractions can be obtained: (1) a free light fraction (F-LF), representing OM floating in a dense solution; (2) a occluded light fraction (O-LF), which is OM floating in the dense solution after the application of ultrasound; (3) a heavy fraction (HF), comprising the OM associated with non-floating, heavy mineral material. The use of an appropriately dense solution is crucial to ensure that the floating material is dominantly organic debris and contains as little as possible mineral particles. Application of sufficient dispersive energy input to achieve complete disruption of aggregates and recovery of the organic debris fractions is crucial to correctly isolate O-LF; the sonication intensity, thus, varies with aggregate stability. Low energy input bears the risk to underestimate O-LF and to overestimate HF, excessive energy input may cause "contamination" the O-LF by dispersion of heavier, mineral-dominated material. We tested various soils to find optimum density cut-offs and sonication intensities that give a maximum of organic material with minimum contamination by minerals. Density of 1.6 g cm⁻³ gave best results for all tested soils. In contrast, the required intensity of dispersion is strictly related to the type of soil, and has to be assessed for soils individually. This can be done in pre-experiments where the same sample is fractionated at different sonication levels. Yields and organic carbon content of the obtained O-LF indicate the appropriate dispersion intensity.



S07.06-P -19

ORGANIC MATTER CONTENT AND HUMIFICATION RATE IN THE SOILS OF FOREST LANDS OF DIFFERENT AGES IN LATVIA

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Over the last several years increasing attention has been paid to the carbon accumulation in different environments, including soil. In Latvia abandonment of agricultural lands and their gradual afforestation occurs. In this context, to clarify the impact of afforestation on the carbon sequestration in soil, the study was conducted in the forest lands of different age, where tree growing stocks have colonized the former agricultural lands. Soil samples were analyzed for properties of base-extractable fraction of organic matter: organic carbon (OC) concentration (mg g⁻¹), CHA:CFA ratio and humification index (HIX - the ratio of fluorescence intensities at a longer (510 nm) and a shorter wavelength (460 nm)). The results showed that in the soils (Luvisols, Albeluvisols, Stagnosols) formed on glacial till (sandy loam, loam) deposit OC concentration in the A horizon increase in 70 years from the beginning of afforestation. After this period, the concentration becomes stable or slightly decreases. In the soils formed on sand deposit (Cambisols, Arenosols) OC concentration in A horizon gradually increases with age of the forest land. CHA:CFA ratio in agricultural lands A horizons was 1.24 (Luvisols) and 1.67 (Cambisols). In the forest land soils ratio varied from 0.16 to 0.65, it didn't depend on the age of the forest land. The highest HIX was in soil A horizons, HIX slightly decreased with soil depth. In the soils formed on sand deposit (Cambisols, Arenosols) HIX increased in soil E horizons. In studied soils HIX in A horizons increased with age of the forest land.



S07.06-P -20

RELEASE AND TRANSPORT OF MOBILE PARTICULATE ORGANIC SUBSTANCES STUDIED BY TWO-LAYER COLUMN EXPERIMENTS

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The relocation and redistribution of mobile organic particulate substances (MOPS), e.g., biocolloids, affect the initial formation and depth propagation of biogeochemical interfaces (BGI). We hypothesize that MOPS (i) accumulate during pore water stagnation, (ii) are mobilized at the onset of flow, (iii) are variably retained depending on the actual sorbent and (iv) are retarded in immobile regions. We compared the fate of MOPS in experiments with single-layer and two-layer soil columns that were operated under water-unsaturated conditions. The latter contained an organic source layer (SL) that released MOPS, which were transported into the subjacent reception layer (RL), which contained typical soil constituents. The single-layer soil columns contained the SL only. The concentration maxima of organic carbon (OC) were significantly delayed in the two-layer experiments. This retardation was caused by diffusion into immobile pore spaces and adsorption on pristine mineral surfaces in the RL. The decreased effluent OC-concentrations after flow interruptions pointed to a rate-limited immobilization of MOPS due to extended contact times during periods of water stagnation. The filtration of larger particles during passage through the RL led to a close ratio of DOC/TOC. Visual browning of the RL section next to the SL supports this finding. Concluding, MOPS transport is controlled by filtration, straining and adsorption. Thus, non-equilibrium interactions with surfaces and the pore network govern the fate of MOPS. MOPS will affect the pore network and the properties of soil interfaces, contributing decisively to the formation and maturation of BGI in soils.



S07.06-P -21

RESIDUE MANAGEMENT OF SUGARCANE AND ITS EFFECT ON SOIL CARBON SEQUESTRATION ESTIMATED BY CENTURY AND CQESTR MODELS IN NORTHEASTERN BRAZIL

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The traditional sugarcane cropping system, based on the burning residues, reduces soil organic matter levels and increases the GHG emission. Therefore, there is a need for identifying sustainable cropping systems associated to the maintenance of sugarcane residue on the soil, increasing soil organic carbon (SOC) stocks and mitigating climate change. This research aimed to estimate carbon sequestration rate in a Fluvic Neossol under different sugarcane residue management using CENTURY and CQESTR models in Northeastern Brazil. The experiment was installed in 2010 and the treatments consisted of different sugarcane residue proportions maintained on the soil (0, 25, 50, 75 and 100 %) and a control (burning residue). In 2011, soil samples were collected in the 0-20 cm depth, to determine SOC stocks using a wet digestion procedure with potassium dichromate and sulfuric acid under heating. CENTURY and CQESTR simulated SOC dynamic for the period 1995–2009, representing the conversion from native forest to traditional sugarcane production and for 2010-2050, considering future scenarios with the applied treatments. The models underestimated SOC stocks especially in the treatments with high sugarcane residue proportion (75 and 100 %). However, measured and simulated values (0-20 cm) were strongly correlated (CENTURY: R^2 : 0.93, $p < 0.01$; CQESTR: R^2 : 0.89, $p < 0.05$). In 2050, high soil carbon sequestration rates (0.5 and 0.72 Mg ha⁻¹ year⁻¹), were observed for the 75 and 100 % treatments, respectively. These results indicate that the maintenance of sugarcane residue on the soil may be an excellent strategy to improve soil quality and to mitigate climate change.



S07.06-P -22

SOIL CARBON AND LANDSCAPE FUNCTION: THE EFFECT OF GRAZING ON SOIL PROCESSES AND PROPERTIES

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Grasslands are one of the world's major ecosystems with grazing of domestic animals an important land use. However, land degradation in many regions has resulted in loss of soil carbon and reduced grasslands' capacity to provide ecosystem services from primary productivity and climate moderation to social and aesthetic values. Degradation has also reduced resilience making grasslands more vulnerable and less able to adapt to the impacts of climate change. Restoring degraded land and building soil carbon levels offers multiple co-benefits, increasing primary productivity and water use efficiency while potentially providing a climate change mitigation option and improving adaptive capacity. While inappropriate grazing practices has contributed to historical loss of soil carbon, there is strong anecdotal evidence of innovative grazing practices regenerating degraded land and soil carbon through increased perenniality in pastures. However, grazing practices are highly variable and operating across a wide range of landscapes and climates, making it important to understand the effect of grazing on soil processes and properties as mechanisms for soil carbon stabilisation and to enable development of appropriate adaptive management strategies. This paper presents the results of a grazing experiment in south-eastern Australia (600 mm mean average rainfall) on soil physical, chemical and biological properties and the implications for enhanced soil carbon sequestration.



S07.06-P -23

SOIL CARBON DISTRIBUTION AND STABILITY IN SEMI-ARID, SUCCULENT-THICKET ECOSYSTEM FROM SOUTH AFRICA

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^[1]University of Stellenbosch ~ Soil Science ~ Stellenbosch ~ South Africa

Soils of semi-arid regions usually have low organic matter contents, yet, the succulent Spekboom Thicket (semi-arid Eastern Cape region, South Africa) accumulates large amounts of soil carbon (22-71 tC/ha). To further understand this remarkable accumulation, we carried out a detailed investigation of the soil carbon directly beneath spekboom (*Portulacaria afra*) and other “non-spekboom” species in intact thicket, and also compared soils from open degraded (over-grazed) thicket sites. We studied the vertical distribution of organic carbon (OC) and inorganic carbon (IC), and general soil properties. Density fractionation was used to isolate the particulate OC from the stable, mineral-bound OC. The relationships between mineral-bound OC and selected soil chemical and physical properties were examined in order to elucidate OC stabilization mechanisms. Organic C accounted for most (78-95%) of the soil C. Degraded open sites displayed a significant decline in hydrophobicity, aggregate stability and OC. Mineral-bound OC accounted for the largest fraction (60-66%) of OC at all sites. Similar to previous semi-arid studies, no strong correlations were found between stable OC and other soil properties, suggesting that vegetation chemistry plays an important role in stabilization. The particulate and mineral-bound OC stocks in the intact thicket soils are about three times higher than values previously reported for other semi-arid ecosystems. Remarkably, the mineral-bound OC stocks remain high (17 gC/kg) in the degraded open soils, potentially indicating the stability of the OC derived from the original Thicket vegetation. Our findings confirm the importance of restoring and preserving the Spekboom Thicket ecosystem for promoting soil C sequestration.



S07.06-P -24

SOIL CARBON DYNAMICS AFTER PRIMARY FOREST CLEARING WITH CHOP AND MULCH METHOD IN FRENCH GUIANA

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*Land use change, especially forest conversion to cropland under tropical and equatorial climate, may decrease soil organic matter content. High organic inputs deforestation method as an alternative to slash and burn could improve agroecosystems sustainability. We assessed the fate of soil organic carbon (SOC) in French Guiana after forest clearing by “chop and mulch” method and cropland establishment. At the experimental site of Combi, primary forest was cut down in October 2008; woody biomass was chopped and incorporated to soil surface (0-15 cm). Soil was amended with aglime and NPK fertilizer. After one year of legume and grass cover, three land managements (four replicates) were studied: grassland (*Brachiaria ruziziensis*), maize/soybean crop rotation with surface tillage and mulch-based soybean/maize rotation with direct seeding. Carbon cycle compartments (soil, water, gas) were followed during 2,5 years after deforestation. SOC stocks were calculated up to 30 cm depth for initial forest and then for agricultural treatments, after each crop cycle. Organic carbon inputs (large woody chips, crop residues, root biomass) were estimated. Soil percolation water was collected at a depth of 60 cm with passive capillary samplers, allowing water organic carbon losses assessment. CO₂ fluxes measurements were obtained with the non-steady-state chambers technique. We observed a seventy percent loss of large woody chips mass. SOC stocks increased significantly. Carbon losses through water were negligible. CO₂ emissions were similar under forest and direct seeding, and higher under grassland and surface tillage.*



S07.06-P -25

SOIL CARBON POOLS AND THEIR DYNAMICS ALONG A SOIL BIOSEQUENCE DEVELOPED ON CARBONATE-RICH SANDS

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^[1]University of Bologna - Alma Mater Studiorum ~ DISTA ~ Bologna ~ Italy ^[2]University of Bologna - Alma Mater Studiorum ~ DCA ~ Bologna ~ Italy

*Primary or lithogenic inorganic C (SIC) in soils originates from carbonate-rich parent material. It can affect organic C (SOC) preservation by the presence of Ca, which can interact with the most reactive functional groups of organic matter. On the other hand, increases in SOC result in increased dissolution of carbonates, and in extremely drained sandy soils CO₂ translocation from soil to atmosphere and Ca²⁺ leaching from soil to water occur. Higher soil acidification and mineral weathering have been shown in conifer compared to deciduous stands, therefore a soil biosequence developed in a coastal plain in Northwestern Italy has been selected to better understand the distribution of soil C and the stabilisation mechanisms of soil organic matter under different vegetation cover on carbonate-rich parent material. The quality of soil organic matter differed along the biosequence, with higher amounts of low molecular weight organic acids and more complex fulvic acids in the pure *Pinus pinaster* and *Quercus ilex* stands than in the mixed broadleaf forest. The results shown that soil profiles were CaCO₃-depleted at the surface, where SIC was almost totally lost. The intensity of the decalcification process increased from *Pinus* to mixed broadleaf forest, as well as the exchangeable Ca leaching, while SOC abundance decreased. Fe and Al fractionation data however suggested that the formation of organo-metallic complexes could contribute to the organic matter stabilisation, as a relation between organic C and Na-pirophosphate extractable fraction of Fe or Al existed, dependent on the intensity of decalcification process and organic matter quality.*



S07.06-P -26

SOIL ORGANIC MATTER (SOM) DENSITY FRACTIONATION OF ANDIC HORIZONS FROM THE SOUTH OF ITALY

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The soil function in the C sequestration is widely acknowledged and processes of SOM stabilization are partially due to interaction of SOM with the mineral fraction. The mineral phases mostly involved in SOM stabilization have pH dependent charge. In Andosols, the variable charged surfaces (ITM-imogolite type materials) are the main minerals present. Their role in the SOM stabilization is important and has been quantified in recent investigations. The aim of this work is to evaluate, in selected Andosols, the distribution of SOM in the different pools: free (FPOM), occluded (OPOM) and mineral associated (MOM). A physical fractionation, by the use of heavy liquids at variable densities (LST fastfloat), was carried out on two volcanic soil horizons, different for andic properties and organic C content. A method calibration was firstly performed, to define the i) density value to separate the FPOM from the other OM pools and ii) time and intensity of ultrasonication, aimed to destroy the soil aggregates occluding organic matter but preserving the mineral stabilized fraction. FPOM was separated using liquids at 1.6 g ml⁻¹ density, while OPOM was recovered after soil sonication at 600 J ml⁻¹. MOM was then treated with increasing density liquids (from 1.8 to 2.6 g ml⁻¹) in order to separate the mineral components on the base of their densities. The mineralogical composition of the separated density fractions was defined by XRD, FT-IR spectroscopy and solid state NMR and the associated C content measured by Elemental Analyzer. Keywords: SOM stabilization, Andosols, density fractionation, imogolite type materials



S07.06-P -27

SOIL ORGANIC MATTER AS AFFECTED BY PINUS AFFORESTATION IN SOUTH BRAZIL

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The influence of Pinus afforestation of grassland lands on the composition and content of soils organic matter (SOM) of a Cambisol under subtropical climate was investigated. Soil samples were collected from three soil layers (0-5, 5-10 and 10-15cm) from: native pasture (NP); 10 years old (P10) and 14 years old (P14) Pinus taeda monoculture. Additionally, grass material and pine needle litter were collected. Particulate organic matter (POM) was removed and the extractable non-humic substances (CW) were determined. Demineralization of whole soil (SOMHF) and of POM-free samples was achieved by 10 % HF treatment. C and N contents were determined by dry combustion and SOMHF was analyzed by ¹³C NMR VACP/MAS. The soil under the older Pinus plantation (P14) presented greater soil C stock in the 0-5 cm layer when compared to P10 and NP, whereas in the deeper layers no difference of CT was observed. Similarly, PM-free C stocks in the surface layer increased in the order NP to P10 to P14, indicating that soil C accumulation following afforestation occurred both as particulate as humified SOM. All analyzed SOMHF samples showed a higher proportion of C-O alkyl (35 to 44%) in comparison to the other C groups. Under NP, the proportion decreased in the order C alkyl > aromatic C > carboxylic C, whereas in pine environments C-alkyl and aromatic C varied around 22%. Pinus afforestation caused an increase of the hydrophobic character of the SOM and a decrease of more labile structures when compared to the SOM under NP.



S07.06-P -28

**SPATIAL DISTRIBUTION AND STABILIZATION OF ORGANIC CARBON WITHIN
MACROAGGREGATES FROM ARABLE LUVISOLS UNDER DIFFERENT SOIL MANAGEMENT**

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The relation between soil organic carbon (SOC) and structure formation is of main importance for understanding carbon sequestration processes by physical protection from microbial decomposition. How far soil management (crop rotation, tillage systems) affects the stabilization of SOC inside aggregates, has been investigated for macroaggregates of different size classes (5-8, 8-12, 12-20 mm aggregate diameter), which are most sensitive to tillage practices due to their lower stability. Intact air dried single aggregates obtained from German and Danish Luvisols from loess and glacial till were peeled by rotating in single erosion chambers into three separated concentric layers of equal solid mass ratio (%) representing the exterior, transitional and interior region. In addition to organic carbon contents mechanical stabilities of single layers were determined from the abrasive forces, which were required for peeling the aggregates from the outside to the inside. For most of the aggregates we found a gradient of decreasing SOC from outer to inner regions, but the variation differed depending on aggregate size, tillage intensity and preceding crop. Furthermore, a higher physical stabilization potential could be derived for the more stable aggregates, which tend to higher carbon retention in inner aggregate regions. The impacts of structure formation were analyzed at greater detail using non-invasive μ CT imaging for improving the understanding of interactions between mechanical stabilities, pore space characteristics and carbon dynamics in aggregated soils.



S07.06-P -29

THE IMPORTANCE OF ECTOMYCORRHIZAL FUNGI FOR CARBON SEQUESTRATION IN FOREST SOIL

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A major part of the carbon fixed by forest trees is allocated belowground to the ectomycorrhizal (EM) fungi that form symbiosis with tree roots. These fungi form extensive mycelial networks, which distribute the fixed carbon in the soil. They have a potential to contribute significantly to the buildup of soil organic matter, but not much is known about the turnover rate of EM residues. One approach to quantify sequestration of carbon through EM mycelia is to use the different carbon isotopic signatures of C3 and C4 plants. We added maize compost (C4 carbon) to mesh bags with sand that were incubated in forest soil for up to three years. The isotopic shift that occurred through ingrowth of EM fungi (C3 carbon) was used to quantify the amount of carbon that was sequestered in the mesh bags over the three year period. Fertilized and unfertilized Norway spruce forests were compared at two locations in Sweden. The amount of sequestered carbon was compared to the fungal biomass in the mesh bags over the experimental period. We found that up to three times more carbon was sequestered in the mesh bags than what could be explained by the fungal biomass in the mesh bags. This suggests that EM fungal necromass and precipitates accumulate and make up a significant part of the organic matter in forest soil. The composition of the carbon compounds in the mesh bags are being analyzed by pyrolysis-MS and will be presented at the conference.



S07.06-P -30

THE ROLE OF MINERAL-BOUND FUNGAL LACCASES IN SYNTHESIS AND STABILIZATION OF HUMIC ACIDS IN SOILS

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Adsorption complexes of humic substances with soil minerals comprise the bulk of organic matter in humus horizons of cold and temperate soils. They represent the most stable Corg fraction in soils with mean residence time of 102-103 years. A considerable fraction of adsorbed organic matter is represented by high molecular weight humic acid-like polymers. The concept of sorptive preservation cannot explain the origin of such polymers on mineral surfaces, because their migration to adsorption sites should be limited by low solubility. It can be suggested that high molecular weight humic acid-like polymers are formed in situ in mineral soil horizons. A possible mechanism is heterophase (surface) polymerization of low molecular weight and thus soluble precursor material in presence of catalytically active solid phases. Thus, adsorptive stabilization and synthesis of humic substances occur simultaneously. We are going to present our experimental data supporting this concept and provide an evidence for the key role of immobilized fungal phenol oxidases and solid matrix in accelerating humic acid formation-stabilization process.



S07.06-P -31

VARIATIONS IN COMPOSITION AND QUALITY OF SOIL ORGANIC MATTER WITH RESPECT TO ENVIRONMENTAL CONDITIONS

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The soil organic matter (SOM) has a great impact on the weathering of rocks and pedogenetic processes. This work was performed as part of a project aiming at the geochemical characterization of the SOM stored in the major soil types of Hungary. Our aims were to investigate organic geochemical characteristics of soil of slope sediment came from a calcic chernozem (CCH), red clay rendzina (RCR), a typical meadow soil (TMS), a podzol brown forest soil (PBF), a sandy soil (S) and a marsh soil (M) (according to the Hungarian Soil Taxonomy) on the basis of organic matter characterization by Rock-Eval pyrolysis and humic/fulvic ratio measured by UV-VIS spectrophotometry. Besides the results of the traditional measurements (ignition loss, destruction by chrome sulphuric acid, E4/E6 etc.) these methods give us further information about the SOM. Our results suggest that the proportion of the SOM with different quality in RCR could be a consequence of both warm subtropical and temperate climatic conditions, as well as acid pH. In CCH, developed under temperate climatic conditions, major part of the SOM became stable as Ca-humates. While in TMS, M and S the SOM composition is mainly due to hydrological conditions, in PBF the acid pH and the temperate climate played also important role. UV-VIS spectrophotometry method was tested on samples came from a karst lake. The project was supported by the Hungarian Scientific Research Found through grant K 81181, the Hungary-Romania Cross-Border Co-operation Programme of the European Union (HURO/0901/207/2.2.2), and TECH-09-A4-2009-0133, BDREVAM2.



S07.07-P - LONG-TERM EFFECTS OF AGRONOMIC PRACTICES ON SOIL ORGANIC MATTER AND CROP PRODUCTIVITY

Friday 06 July 2012 from 17:00 to 18:30. Room Poster Areas

S07.07-P -1

APPLICATION OF ROTH C CARBON MODEL OVER 50 YEARS UNDER A ROTATION TOMATO-MAIZE ON A SILTY-LOAM SOIL.

Claudio Baffi, Piacenza - Italy

S07.07-P -2

ASSESSMENT OF SOIL ORGANIC CARBON STOCKS IN SERBIA

Maja Manojlovic, Novi Sad - Serbia

S07.07-P -3

ASSESSMENT OF SOIL ORGANIC MATTER CHANGES FOR FARM FIELDS

Uwe Franko, Halle - Germany

S07.07-P -4

AVAILABLE TOOLS FOR THE ASSESSMENT OF SOM REPRODUCTION ON ARABLE FIELDS

Uwe Franko, Halle - Germany

S07.07-P -5

CAN CURRENT STICS MODEL BE AN EFFICIENT TOOL TO VALIDATE NITROGEN DYNAMIC OF A LONG TERM EXPERIMENT?

Ahmed Karim Dhaouadi, Grignon - France

S07.07-P -6

CARBON (C) AND NITROGEN (N) CONTENT UNDER SEVERAL YEARS OLD EUCALYPTUS PLANTS AND LAND USE TREATED SOILS

Ibrahim Ortas, Balcalı, Adana - Turkey

S07.07-P -7

CEREAL AND FORAGE CROPPING IN THE LOMBARDY PLAIN. YIELD AND EVOLUTION OF SOIL FERTILITY IN THE 24-YR OF TRIAL.

Lamberto Borrelli, Lodi - Italy



S07.07-P -8

CHANGES IN SOC AND NITROGEN AS RELATED TO CROPPING AND SOIL EROSION IN A SMALL SCALE AGRICULTURAL LANDSCAPE

Jianhui Zhang, Chengdu - China

S07.07-P -9

CONTRIBUTION OF SEDIMENTARY AND FRESH ORGANIC MATTER TO SOIL STRUCTURAL STABILITY: INSIGHT FROM A FIELD STUDY IN SLOVENIAN ORCHARD DEVELOPED ON MARLS

Pierre Curmi, Dijon - France

S07.07-P -10

DYNAMICS OF SOIL CARBON IN A LONG TERM CROP ROTATION EXPERIMENT IN APULIA, ITALY

Roberta Farina, Rome - Italy

S07.07-P -11

EFFECT OF MANURE MANAGEMENT SYSTEMS ON SOIL ORGANIC CARBON (SOM)

Lamberto Borrelli, Lodi - Italy

S07.07-P -12

EFFECTS OF OLIVE GROVE MANAGEMENT ON CARBON SEQUESTRATION AND CHEMICAL AND MICROBIOLOGICAL SOIL PARAMETERS IN SOUTH OF ITALY

Adriano Sofo, Potenza - Italy

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Alessandra Cardinali, Legnaro (PD) - Italy

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Reza Karimi, Shahrekord - Iran, Islamic Republic of

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Mohsen Sheklabadi, Hamedan - Iran, Islamic Republic of

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THE HUMUS BALANCE MODEL HU-MOD – METHODOLOGY AND SCOPE

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TILLAGE AND COVER CROP SPECIES AFFECTS SOIL ORGANIC CARBON IN ANDOSOL, KANTO, JAPAN

Tatsuya Higashi, Ibaraki - Japan

S07.07-P -46

TOPSOIL CARBON CONTENT IN FINNISH CULTIVATED LAND PREDICTED BY SOIL TYPE, CULTIVATION HISTORY AND REGION

Jaakko Heikkinen, Jokioinen - Finland

S07.07-P -47

TRENDS IN SOIL ORGANIC CARBON CONCENTRATION AND CROP YIELDS DEPENDING ON LONG-TERM FERTILISATION

Alar Astover, Tartu - Estonia



S07.07-P -1

APPLICATION OF ROTHC CARBON MODEL OVER 50 YEARS UNDER A ROTATION TOMATO-MAIZE ON A SILTY-LOAM SOIL.

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Starting from the management data from 10 ten years of fertilization practices on a silty-loam soil where RothC model proved to be suitable to simulate SOC dynamics (see Symposium 7.8), the model was applied to simulate the SOC trend over 50 years, on the same soil type under a baseline climate generated with LarsWG5, assuming a biennial rotation tomato-maize with additions of 50 t ha⁻¹ and 40 t ha⁻¹ of FYM respectively. Since the behaviour of SOC in RothC is affected mainly by the clay content, four clay classes were identified to verify the effectiveness of the proposed rotation for SOC increase: clay10 (<10%clay); clay15 (10-15% clay); clay 20 (15-20% clay); clay 25 (20-25% clay). For clay 10 a significant decrease of SOC was observed (-6.0 ± 2.2 t ha⁻¹); for clay 15 a nearly steady-state (-1.1 ± 0.9 t ha⁻¹); for clay 20 ($+5.2 \pm 2.2$ t ha⁻¹) and clay 25 ($+10.8 \pm 4.7$ t ha⁻¹) a significant increase of total C. Results have shown that under these specific pedoclimatic conditions, the proposed rotation has increased the SOC levels only at higher clay contents in comparison with the traditional rotation (including maize, tomato and alfalfa with and without organic inputs).



S07.07-P -2

ASSESSMENT OF SOIL ORGANIC CARBON STOCKS IN SERBIA

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The aims of this study were to quantify soil organic carbon (SOC) stocks in the main soil types in Serbia as well as total SOC storage in Serbian's soils. SOC stocks for the layers 0-30 cm and 0-100 cm were estimated using results from a national soil database (n=1141). This dataset was built in Serbian Environmental Protection Agency from data obtained through previous soil surveys (1962-2010). Bulk density values were obtained using pedotransfer functions for the region of Central Serbia and using measured values for the Vojvodina region. Estimations showed significant differences in SOC stocks between soil types. The highest SOC stocks were estimated for Leptosol (151 t ha⁻¹ at 0-30 cm and 179 t ha⁻¹ at 0-100 cm) and the lowest were estimated for Arenosol (41.8 t ha⁻¹ for 0-30 cm and 96.0 t ha⁻¹ at 0-100 cm). Estimations for Chernozem and Cambisol, the most distributed soil types in Serbia, were 73.8 t ha⁻¹ and 89.8 t ha⁻¹ for 0-30 cm and 168 t ha⁻¹ and 127 t ha⁻¹ for 0-100 cm, respectively. Total SOC storage in Serbian's soils of 0.69 Pg was estimated for topsoil (0-30 cm) while that in the 0-100 cm soil depth was estimated to be 1.13 Pg. SOC density in Serbian's soils were 89.6 t ha⁻¹ in the surface layer (0-30 cm) and 146 t ha⁻¹ within the 0-100 cm depth.



S07.07-P -3

ASSESSMENT OF SOIL ORGANIC MATTER CHANGES FOR FARM FIELDS

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Soil organic matter (SOM) is a very important component of agroecosystems and usually characterized by the carbon content of top soil. Knowledge about carbon dynamics is widely required in order to get predictions about effects of changes in climate and land management.. Despite simple models with low requirements of input data may neglect some important processes but they are the only alternative for use on agricultural farms. The CANDY model has shown a very good performance in a comparison of different models that have been applied to datasets from a number of long term experiments. Recently a strictly simplified version of the SOM module in CANDY has been published as Candy Carbon Balance or shortly CCB. CCB has been validated successfully with a number of datasets mostly from central Europe covering a temperature range from 5.2 °C to 11.1°C (annual mean air temperature) and annual rainfall from 354mm to 831mm and with a typical management with one main crop per year. Beside this process based approach the STAND model has been developed strictly based statistical analyses and using easily available parameters from farming records as independent variables. Both models aiming at the prediction of SOM changes due to land management and site conditions will be described concerning their main components and the validation results will be compared together with conclusions for practical applications.



S07.07-P -4

AVAILABLE TOOLS FOR THE ASSESSMENT OF SOM REPRODUCTION ON ARABLE FIELDS

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Soil organic matter (SOM) is one of the most important components of soil and its proper reproduction is the precondition for a sustainable use. The optimal control of SOM reproduction requires an assessment of the current and the predicted SOM level because it is well known that too much of SOM may lead to environmental problems in terms of nitrogen leaching and trace gas emissions. Furthermore, the growing demand of bio-energy and crop based raw materials requires an assessment of a reasonable amount of OM that is necessary for SOM reproduction and cannot be allowed to leave the soil-plant system. Methods for the assessment of SOM reproduction are available on different levels: 1) the dynamic SOM model CCB and the assessment tools STAND and SALCA may all be used to predict changes of SOM storage and related matter fluxes 2) the model HUMOD can be used to select a management scenario without changes in SOM reproductions compared to the current state 3) the assessment tools VDLUFA and HE have been develop to assess SOM reproduction in terms of proper yields, low environmental impacts and prevention of SOM depletion All three types of methods have to be validated. The presentation will describe the methods, gives examples for the application and will discuss possibilities to validate the claimed objectives of each method.



S07.07-P -5

CAN CURRENT STICS MODEL BE AN EFFICIENT TOOL TO VALIDATE NITROGEN DYNAMIC OF A LONG TERM EXPERIMENT?

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The recycling of organic wastes on cultivated soils could make possible the substitution of mineral N fertilizers. To prevent N stress for crops, simulation models are useful tools to predict the dynamic of N mineralization coming from organic waste products and calculate the additional mineral N fertilizer when necessary, without adverse environmental impacts such as nitrate leaching. Stics, a crop model developed by INRA (France), simulates crop growth, soil water and nitrogen balances governed by daily climatic data. The STICS model has been parameterized to simulate N dynamics when organic waste products are applied on crops based on a long term experiment started in 1998, located in Ile de France and cultivated with a maize-wheat rotation. Four organic amendments are used in these experiments to study, among others, soil C and N dynamics. The aim of this study was to stall STICS model and compared simulated results to available experimental data. Our tested criteria were the observed crop yields, N and water balances. The N dynamics of the organic wastes varied with their nature and their biochemical composition. For one type of compost, the N dynamics also differed between years because of variability of composition. STICS correctly simulated nitrogen dynamic in soil without organic amendments (soil organic matter, crop residues and organic waste products). For organic waste products, the calculation of dynamic parameters used for crop residues and based on C/N ratio had to be modified to get good simulations of field results...



S07.07-P -6

CARBON (C) AND NITROGEN (N) CONTENT UNDER SEVERAL YEARS OLD EUCALYPTUS PLANTS AND LAND USE TREATED SOILS

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The research has been carried out on three different age groups 5, 7 and 10 years old Eucalyptus (E.camaldulensis) plantations. There were three different treatments such as (SI) shaved the three plants from soil surface and plowed, (SII) shaved without plowing, (SIII) control without shaved the tree plants. Also agricultural treated and natural habitats also were used as control treatments. The results are shown that SOC content ranged from 1.12 % to 6.56 %. The SOC content significantly decreased with plow soil. The highest C content was found in 5 years old Eucalyptus plantation. In first measurement in 0-20 cm depth high SOC 2,93% was found in 5 years old plantation in SII treatment. The lowest SOC 1.62 % was measured in agricultural area. Soil management treatments, also affected the SOC content, with higher values in 0-20 cm than 20-40 cm depth. In 0-20 cm depth, SOC was 4.70 % in 10 years old and SI treated. Similar trends were observed in the soil nitrogen content. In first measurement, the N content ranged from 0.33 % N in 5 years SIII treatment and 0.12 % in 7 years and SII treatment. The results are shown that with time SOC and N content decreased in shaved and plowed, (SI) and shaved and without plowing treated plots (SII). The results are revealed that in order to keep more C in soil it is necessary to cover soil surface with vegetation



S07.07-P -7

CEREAL AND FORAGE CROPPING IN THE LOMBARDY PLAIN. YIELD AND EVOLUTION OF SOIL FERTILITY IN THE 24-YR OF TRIAL.

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In the last few decades a change of the Italian agriculture has been taken place, in particular way in those zones where the pedo-climatic conditions have allowed an elevated intensification of the agricultural activity with possible environmental risk. The trial is lead, since 1985, at Lodi is articulated in 2 cropping systems type: R1 = 1-yr continuous monoculture of Italian ryegrass + silage maize and MM = grain maize grown in continuous monoculture. Each rotation was submitted to two crop management practices (input): A (optimal) and B (70% of A), including levels of nutrients, weed control and soil tillage methods. In this work are shown the results of the average annual Milk Feed Units (MFU) yield and evolution of the soil fertility (N-OM) during 24-yr period (1986-09). The most efficient rotation in terms of MFU for a farming system dedicated to dairy cattle, is the annual rotation of Italian ryegrass followed by silage maize as the second crop (R1) with 23,000 MFU yield in a year for hectare whereas MM yields 11,000 MFU for year and hectare. The results evidenced that, cereal-forage rotation was the best cropping system able to integrate the fertility of soil both in terms of MFU production and in maintaining a higher carbon level in soil. Rotations of forage crops, also short, in comparison to continuous cultivation, were able to confer greater yield and maintain stable the fertility of soil.



S07.07-P -8

CHANGES IN SOC AND NITROGEN AS RELATED TO CROPPING AND SOIL EROSION IN A SMALL SCALE AGRICULTURAL LANDSCAPE

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Soil samples from cultivated land were collected in different landscape positions of the toposequence and different parts of hilly areas of the Sichuan Basin, China to examine effects of cropping and soil erosion on SOC and total nitrogen (TN) losses in agricultural landscapes, in comparison with uncultivated soils. Soil layer thickness was similar between uncultivated land and the depositional area of cultivated land, while it was significantly smaller in erosional areas of the cultivated land than on the uncultivated land. SOC and total N concentrations in the till layer were largely higher on uncultivated land than on cultivated land. In particular, the 0-5 cm surface layer of uncultivated soils had 1.3-, 1.7-, and 2.3-fold, respectively, higher SOC concentrations than that of the depositional, weak erosional, and strong erosional areas in cultivated soils, while no significant differences in SOC and total N concentrations in subsoil layers were observed between cultivated land and uncultivated land, suggesting that cropping is one of the factors causing SOC and N losses. In all the cultivated soils, SOC, total N concentrations of the surface soil horizon and SOC, total N inventories were closely associated with ¹³⁷Cs inventories, suggesting that soil erosion exerts an important impact on SOC and N dynamics in the cultivated soil landscape. Soil erosion was estimated to account for 78.2% and 69.6% of the SOC and N losses, respectively, suggesting that soil erosion dominates over the SOC and N losses in a long-term agricultural practice.



S07.07-P -9

CONTRIBUTION OF SEDIMENTARY AND FRESH ORGANIC MATTER TO SOIL STRUCTURAL STABILITY: INSIGHT FROM A FIELD STUDY IN SLOVENIAN ORCHARD DEVELOPED ON MARLS

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*The impact of slope and drip irrigation on water stable aggregates (WSA) was studied in soil from an apple (*Malus domestica* Borkh.) orchard. A two-years field study was carried out on a hilly (15 % slope) terrain in NE Slovenia, comparing irrigated (IRR) and non-irrigated (NIR) situations at three slope positions (upslope, midslope and downslope). The WSA content was measured at three different soil depths (0-5, 5-15 and 15-30 cm), for two different seasons (October 2004 and May 2005). WSA was higher upslope (compared to midslope and downslope) and in the deeper soil layers (5-15 and 15-30 cm). WSA was positively correlated to total CaCO₃. The positive effect of soil organic matter (SOM) on structural stability was hidden the abundance of CaCO₃ whose variations according to slope and depth were inverse. SOM content and Structural stability were both higher in NIR soil, showing that SOM improves structural stability. To understand the composition and origin of SOM, physical organic matter fractionation was performed on three size fractions: fraction A (>200 µm), fraction B (200-50 µm) and fraction C (<50 µm). A d¹³C analysis was performed to ascertain the existence of two different types of organic matter in these soils: fresh and sedimentary SOM inherited from the marl bedrock. Using a mixing model with d¹³C of marl and d¹³C of fresh OC, we were able to quantify the distribution of sedimentary and fresh OC in the soil and their relations with WSA.*



S07.07-P -10

DYNAMICS OF SOIL CARBON IN A LONG TERM CROP ROTATION EXPERIMENT IN APULIA, ITALY

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*Adoption of intensive and non-conservative farming practices represents the most important issue in Mediterranean areas, generating a severe reduction of soil organic C, the main component of soil organic matter (SOM), with major side effects on soil functioning and CO₂ emissions to atmosphere. The purpose of our research was to evaluate the effect of rotations commonly used in Southern Italy on the dynamics of soil organic carbon. The rotation experiment was carried out since 1992 in Foggia (Apulia, Italy) at the experimental farm of the Cereal Research Centre in a clayey vertisol. Here we report results concerning three rotations: continuous durum wheat (*Triticum durum* Desf.) without (CWN0), and with nitrogen (CWN1), and wheat-wheat-irrigated tomato (WT) (*Lycopersicon esculentum* L.). Results showed a negative trend of soil C in all rotations. In 18 years the C lost from soils was: 0.50, 0.34 and 0.34 t C ha⁻¹ year⁻¹ for CWN0, CWN1 and WT, respectively. Apparently, performances of CWN1 and WWT were of the same magnitude. However, estimated inputs to soil (Kong et al., 2005 and Bolinder et al., 2007) were 3.30 and 1.88 t C ha⁻¹ year⁻¹ for WWT and CWN1 respectively, and estimated total C lost from WWT was almost the double compared to CWN1, i.e. 2.96 versus 1.54 t C ha⁻¹ year⁻¹ (10.86 versus 5.65 t CO₂ ha⁻¹ year⁻¹). Therefore, in Mediterranean semiarid areas, the combination of high temperature and soil water availability in irrigated systems may represent a source of CO₂ emissions from soils to atmosphere.*



S07.07-P -11

EFFECT OF MANURE MANAGEMENT SYSTEMS ON SOIL ORGANIC CARBON (SOM)

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A long-term field experiment was established in 1995 at the CRA-FLC farm, located in Lodi, Northern Italy. The experiment compares two types of manure, farmyard manure (FYM) and semi-liquid manure (SLM) (without straw) combined with two nitrogen levels on a 1-year rotation (Italian ryegrass + silage maize). The crop system has received 66 t ha⁻¹ of FYM and 100 m³ ha⁻¹ of SLM annually and soils were sampled on autumn 2006-2008 for the layers 0-0.3 m. The aim of this study was to determine the long-term effects on soil C content of application of different types of manure on forage rotations and on the yields obtained. The effects of the organic manure on yields were also considered: an increase in yields has been found where the FYM was applied, with a stronger effect in silage maize where the yields increased of 30% with respect to the FYM treated plots. Different soil properties have been considered as the total organic content, the pH, the microbic carbon content, the basal soil respiration and the humification rate (HR). From all these parameters results clear that the FYM supply had a better impact on the soil fertility; as a matter of fact the plots treated with FYM present an higher organic carbon content (15 g kg⁻¹) compared to the SLM (10 g kg⁻¹). The FYM application showed a higher efficiency in increasing the organic matter soil content and the biological soil properties compare to the ones obtained by using SLM.



S07.07-P -12

EFFECTS OF OLIVE GROVE MANAGEMENT ON CARBON SEQUESTRATION AND CHEMICAL AND MICROBIOLOGICAL SOIL PARAMETERS IN SOUTH OF ITALY

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Agricultural practices can play an important role in carbon (C) sequestration. The C stock can be viewed as measure of the relative contribution to biomass to the C cycle. The capacity to store organic carbon depends to a great extent upon climate and soil properties, although in agricultural soils the cultivation system also plays a considerable part. Olives are one of the most important and extensive crops in the Mediterranean region where soil erosion and loss of fertility are frequent phenomena. The objective of this paper is to discuss some of the agricultural management practices that can be used to reduce atmospheric CO₂ via increased C sequestration in soils and modify the chemical and microbiological soil parameters. We restrict our discussion to arable land. Further, we only discuss C sequestration, although we recognize that management may have a positive effect on CO₂ emissions while this is counterbalanced by negative effects on other greenhouse gases. The process of the recovery of soil quality parameters in the abandoned olive grove, triggered by the absence of soil and plant management, was evident. The activities of some enzymes involved in the carbon cycle were found to be significantly different in the two systems. The study of the carbon substrate utilization profiles using Biolog® method, revealed significant differences between the two systems for some metabolic indices of the soil microbiota. In general, the abandoned system showed a higher microbial diversity and complexity.



S07.07-P -13

EVALUATION OF SOME CROP SPECIES FOR REMEDIATION OF LEAD (PB) IN CONTAMINATED SOILS UNDER GREENHOUSE CONDITION

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The factors were Pb doses into soil at three levels 0, 450 and 900 (mg Pb/kg.dw soil) and Crop species at three levels, Alfalfa (*Medicago rigidula*), Hairy vetch (*Vicia villosa*) and Canola (*Barassica napus*). Results showed that Crop species and Pb doses into soil had significant effect on all of Experiment characteristics. Alfalfa and Hairy vetch with 206.12 and 52.32 (mg/kg.dw) were highest and lowest Pb concentration in Shoot parts, respectively. 900 and 0 (mg Pb/kg.dw soil) doses with 293.36 and 3.19 (mg/kg.dw) were highest and lowest Pb concentration in Shoot parts, respectively. Between Crop species, highest amount of Chlorophyll a, b and a+b Contents with 3.90, 3.88 and 7.74 (mg/g.Fw) respectively related to Hairy vetch, and lowest of this triats with 3.19, 3.23 and 6.38 (mg/g.Fw) respectively related to Alfalfa. Between Pb doses, highest amount of Chlorophyll a, b and a+b with 3.98, 3.76 and 7.95 (mg/g.Fw) respectively related to 0 (mg Pb/kg.dw soil) dose, and lowest of this triats with 2.76, 2.74 and 5.46 (mg/g.Fw) respectively related to 900 (mg Pb/kg.dw soil) dose. Alfalfa with 65.96 (μMol/g.Fw) and Hairy vetch with 38.60 (μMol/g.Fw) were highest and lowest Malondialdehyde (MDA) Contents, respectively. 900 and 0 (mg Pb/kg.dw Soil) doses with 81.44 28.74 (μMol/g.Fw) were highest and lowest MDA Contents, respectively. Hairy vetch and Alfalfa with 66.10 and 44.53 (U/mg.protein) were highest and lowest SOD enzyme Contents, respectively. 0 and 900 (mg Pb/kg.dw Soil) doses with 76.24 and 33.36 (U/mg.protein) were highest and lowest SOD enzyme Contents, respectively.



S07.07-P -14

EVALUATION OF THE EFFECT OF FERTILIZATION IN P FRACTIONS AND THEIR RELATION WITH THE ORGANIC MATTER IN AN ANDISOL

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In Chile, soils derived from volcanic ashes (Andisol) represents about 50-60% of the total arable hectares in the country, which are mostly used for livestock and cereal production. The Andisol formation is based on the existence of volcanic glass, resulting in a colloidal fraction dominated by non-crystalline materials, giving several properties such as variable charge, high cation exchange capacity, high phosphorus (P) fixation capacity and high organic matter content. The high P retention capacity is a limiting aspect in crop nutrition in these soils. For the above, is necessary to apply periodically high amounts of phosphorus fertilizer to the soils. However, more than 90% of P applied to the soil is not uptake by crops, being mostly accumulated in soil organic fractions. Several studies have demonstrated a strong correlation between organic carbon and P, thus the organic matter seems to play an important role in organic phosphorus retention through the formation of stable complexes. For this reason, the aim of this work was to develop a new fractionation methodology that allow evaluate the effect of fertilization in P fractions and their relation with the organic matter in an Andisol. For this purpose P was fractionated according to Hedley fractionation methodology and this results were compared with a new fractionation methodology purpose. The results allowed to determine the fertilization effect over the phosphorus fractions associated to organic matter. In P fertilized soils was present a more organic matter associated to this element than in no fertilized soils.



S07.07-P -15

EXTENDED HUMUS BALANCE METHOD OF NEYROUD – DESCRIPTION AND VALIDATION

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Humus balances are simple mathematical tools used by farmers for assessing the overall performance of their management in terms of soil organic matter turnover. Dynamic C-simulation models, on the other hand, are typically complex and need more detailed input data; they are designed to calculate the time course of soil carbon content. The original humus balance method of Neyroud (Neyroud, 1997) was extended with respect to humus reproduction data for additional crops and organic fertilizers (Oberholzer et al., 2006). This method calculates soil organic matter loss depending on soil properties (clay content and pH value) and on soil tillage intensity; the latter is determined depending on crop rotation. Organic matter inputs are crop residues organic fertilizers. The quantity of humus reproduction is calculated as fixed amount per crop and a fertilizers typical proportion of the applied quantity. The humus balance method of Neyroud is used in professional formation of farmers in Switzerland. We validated the method by comparing its calculated results with real changes in carbon stocks; this was done in treatments of three long term field. The method was able to distinguish systematic management effects on soil organic carbon content on a relative basis but failed to predict measured stock changes quantitatively. Because the results of humus balance methods are strongly depended on the parameterization of the humus reproduction factor of organic fertilizers and crop residues, our results stress the need for more detailed and harmonized data bases for humus reproduction factors of organic fertilizers and crop residues.



S07.07-P -16

IMPACT OF PREVIOUS FERTILIZER INPUT HISTORY ON APPARENT NITROGEN RECOVERY FROM RECENTLY APPLIED SOLID CATTLE MANURE TO GRASSLANDS

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Long-term application of solid cattle manure (SCM) usually not only builds up soil organic matter but also soil mineral nitrogen (N) supply. However, within this context it is not clear yet whether fertilization history of grasslands affects the N dynamics of recently applied SCM and therefore its short-term apparent-N recovery (ANR). To test this, we selected two dairy farms on peat soil which differed in type of home-produced and applied cattle manure, and the use of artificial fertilizer. Already for a number of decades, farm A is characterized by application of slurry and artificial N fertilizer whereas on farm B only organic N-rich slurry and partly composted SCM are being used. We measured on both farms herbage ANR of SCM from farm B after surface spreading in spring (200 and 400 kg N ha⁻¹). Besides, soil pH, bacterial biomass and its activity were monitored. Remarkably, on farm A herbage ANR was not different from zero at both application rates, whereas on home-farm B, ANR values were 27% of the applied N_{total}. This observation was accompanied by a decreased soil pH-KCl (down to 4.4), and a much lower bacterial biomass and activity on farm A. This can be attributed to N immobilization of recently applied SCM from farm B on farm A. At soil pH below 4.5 the bacterial activity was hampered and thus N mineralization of SCM. Our study clearly demonstrates that fertilizer input history indeed affects the herbage ANR by influencing the soil pH and soil biota activity.



S07.07-P -17

INFLUENCE OF LONG-TERM FERTILIZATION AND CROPING SYSTEM ON SOIL PROPERTIES UNDER CORN PRODUCTION

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Objective of this study was to examine the effect of long-term fertilization and cropping sequences of corn (continuous corn and corn/barley rotation) on soil quality and plant nutrient availability. The trial was established from 1965 year at experiment field of Institute of Field and Vegetable Crops, Novi Sad, Serbia. The trial included six variants. Four origin from corn mono-culture system production and two variants from crop rotation corn/barley. In the trial are represented several treatments with the use of mineral fertilizers (NPK), manure and there combination. Soil samples were collected in October 2009, from three different depths. All samples from treatments were analyzed for routine soil test analyses-fertility status. The analysis also included soil texture, organic carbon, total nitrogen and total phosphorous. Distinct differences between fertilization treatments were observed in total P, available P and K, organic C, humus content. The highest amount of those soil parameters were determined in corn/barley rotation variant one with mineral fertilizers an manure together and other with manure respectively. Significant positive correlations were found among the total P, available P and K, organic C, humus content and total N as opposite to negative correlation those parameters with soil pH, content of CaCO₃ and clay. The results of this paper are directed to one of the extremely pertinent agricultural issue, development of sustainable soil management and crop production systems. Key words: long-term fertilization, chemical properties, soil fertility, cropping system.



S07.07-P -18

INFLUENCE OF MANAGEMENT PRACTICES ON SOIL STRUCTURE AND ORGANIC CARBON IN A SEMIARID AREA OF SOUTH EAST SPAIN.

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To evaluate the effects of different management practices on soil physical properties and its implications on soil C sequestration, an experiment was conducted in a semiarid rainfed almond cropland located in South East Spain on a hypercalcid calcisol of silt loam texture. Four management practices were applied: i) conservation tillage (CT), ii) conservation tillage plus compost addition (CTC), iii) conservation tillage plus green cover (CTG) and, iv) no tillage (NT). The experimental design consisted of 12 plots in a randomized-block design with three replicates for each treatment. Soil samples were taken at depths of 0-5, 5-15 cm and 15-30 cm. After three years, NT treatments displayed significant higher values of penetration resistance in the first 15 cm of the soil than the rest of tillage treatments leading to lower values of infiltration in soil under this treatment. No significant differences were observed in the rest of soil physical properties tested (bulk density, soil aggregate distribution, MWD) although the CTG treatment displayed the lowest BD and the highest soil aggregate stability at all depths (measured by MWD). Total and particulate organic C (POC) were significantly affected by management, tillage treatments (CTG>CT>CTC) displaying higher soil organic carbon content than no tillage treatments at 0- 5 cm depth. These results suggest that conservation tillage plus green cover improves soil structure and increase soil organic carbon in a short-term in these semiarid areas



S07.07-P -19

INFLUENCE OF PERIODICAL APPLICATION OF DIFFERENT ORGANIC MATTERS OVER TEN YEARS ON SOIL FERTILITY AT A CALCAREOUS VINEYARD SOIL IN FRANCONIA/GERMANY

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Vineyard soils are often stony and superficial. Application of organic matter as bark mulch, straw, horse manure or as fermented compost can improve water and air storing capacity, biomass activity, mineral availability and finally grape quality. An extensive field experiment over more than 10 years with 6 different organic substrates with 4 replications showed a significant increase of humus content and mineral availability. The content of heavy metals was not significantly concentrated. The application of organic compost was strongly related with higher activity of the microbiological biomass and CO₂-liberation. The abundance and activity of the ear worms were accelerated by organic horse manure and decreased by application of organic compost and straw. Wine quality was not directly significant influenced by application of mineral rich organic matter, but grape quality was strongly negative affected by higher percentage of berry rot. The application of organic matter shows mainly in very dry seasons clear positive effects on grape yield and must quality.



S07.07-P -20

LONG TERM SIMULATION OF WHEAT YIELD AND SOIL ORGANIC CARBON CONTENT WITH DIFFERENT CROP RESIDUE MANAGEMENT

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The amount of organic carbon in agricultural soils is a key indicator for agrosystems productivity and for their long-term conservation. The central aim of this work was to analyze the consequences, on soil organic carbon and yield, of different crop residue managements in durum wheat cultivation. Field data collected in the experimental farm of CRA-SCA in Foggia (Southern Italy), were used in a simulation study with EPIC (Environmental Policy Integrated Climate) model. Three theses were compared: burning of crop residue (Thesis 1), burial of crop residue with spreading of urea (Thesis 2), burial of crop residue with spreading of urea and water (Thesis 3). The EPIC model was calibrated and validated using 15 years of yield and soil organic carbon content (SOC) experimental data. The model was calibrated using the Thesis 3 and validated using the remaining two dataset, successively long-term simulations (35 years) were performed. The results showed that the EPIC model was able to simulate, in the investigated study area, wheat yield with good accuracy, but less for SOC. The long-term simulations results showed that for durum wheat yield there were two trends: a slight decrease for Thesis 1 and a slight increase for the other two theses where the residue incorporation was implemented. For SOC a decreasing trend was observed for the three theses but with less evidence in Thesis 3. The spreading of urea and water could generate an improvement of residue mineralization and, of consequence, a higher content of SOC, simulated by the model effectively.



S07.07-P -21

LONG-TERM EFFECTS OF AGRONOMICAL PRACTICES ON SOIL HYDRAULIC PROPERTIES

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The maintenance or the improvement soil quality of farms can only be achieved through sustainable agronomic practices. The long-term impacts of agronomical practices on soil quality can be determined only with long-term experiments in which continuous treatments are carried out for many years. The main objective of this work was to evaluate, under semi-arid Mediterranean conditions of Southern Italy, the effects of crop residue management (burning, B and ploughing in, P) on the soil hydraulic properties in a long-term research (over 20 years), regarding a cultivation of winter durum wheat. Hydraulic conductivity (K), air capacity (AC), macroporosity (P_{mac}), plant available water capacity (PAWC) and relative field capacity (RFC) were determined for three consecutive years. The differences of near-saturated hydraulic conductivity values between B and P were always not statistically significant, varying in the range 128-182 and 11-17 cm d⁻¹, (respectively at h=-1 and -10 cm). In general, AC and P_{mac} corresponding to B were generally higher than P (B = P), varying in the range 0.10-0.26 and 0.05-0.09 cm³ cm⁻³, respectively for AC and P_{mac}, whereas we detected an opposite result both for PAWC and RFC (B = P), varying in the range 0.08-0.15 and 0.52-0.78 cm³ cm⁻³. According to existing references of literature, the soil physical quality of the considered soil was generally good, for about 75% of considered cases.



S07.07-P -22

LONG-TERM LAND USE CHANGE EFFECTS ON DENSITY FRACTIONS OF SOIL ORGANIC C MANAGEMENT INDEX IN ZREBAR LAKE WATERSHED

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Physical fractionation of soil organic C can be suitable procedures to determine land degradation, and carbon management index (CMI) in soils. Long-term management and land use change severely affect carbon pools of soil. Native lands of Zrebar Lake Watershed, in the west of Iran, have experienced severe land use changes, especially conversion of forest and wetland to vineyard and cultivated respectively. However, the effects of such a long-term environmental disturbance on soil organic C pools and CMI have not investigated in this region. The aim of this work was to survey of long-term changes in carbon pools and CMI. Five major land use types in the lake marginal lands were selected: wetlands around the lake, and wetland to wheat and alfalfa cultivations, forest, converted forest to vineyard. Soil samples were collected from the depth of 0-30, 30-60, and 60-90 cm in each land use. Soil organic C fractionation was applied on samples. Results showed that the higher amount of light fraction (8.78 gr C/kg Soil) has been obtained in surface layer of forest land use and higher heavy fraction was in surface layer of wetland (42.22 gr C/kg Soil). Carbon pool index (CPI) was lower in vineyard compared with forest by ??30%. In addition, carbon management index was decreased by 37% during land use change. ?Carbon management index in alfalfa and wheat system was decreased 50 and 60%. CMI in ?wheat system (44.9%) was rather than alfalfa (66.7%).



S07.07-P -23

LONG-TERM TEMPORAL VARIATIONS IN SOIL ORGANIC MATTER UNDER DIFFERENT TILLAGE INTENSITIES

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Tillage management plays a key role in soil C storage and microbial abundance, by affecting degradation of organic residues, soil organic matter (SOM) transformation, nutrients mineralization and immobilization, as well as stabilization of soil aggregates. In particular, soil physical disturbance by tillage stimulates SOM decomposition, as a result of soil aggregate disruption and consequent exposure of the previously protected SOM to biological activity. The work aimed to compare SOM content and main characteristics in soils cultivated with maize under different tillage intensities, after 5 and 18 years from the beginning of treatments. In particular, our approach allowed assessing the impact of different tillage treatments on SOM quantity and quality over the long term and its evolution with time. Treatments were replicated three times and included conventional tillage (CT) by mould-board ploughing to 40 cm depth, ripper sub-soiling (RP) to 40-45 cm, superficial tillage by mould-board ploughing to 20 cm depth (SP) and minimum tillage to 10-15 cm with disk harrowing (MT). Soils were sampled in 1999 and 2011 at 0-10, 10-20 and 20-40 cm depths and analyzed for total organic C, SOM properties by means of chemical fractionation, total nitrogen and soil bulk density. C mineralization potential and aggregation status were also determined on samples collected after 18 years of treatments. Results showed a generalized reduction of SOM induced by tillage after 18 years, whose extent varied with tillage intensity.



S07.07-P -24

METHODOLOGY OF THE GERMAN STANDARD METHOD FOR HUMUS BALANCING BY VDLUFA

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The poster describes the actual German standard method for soil organic matter balancing by VDLUFA (2004). Aim of this method is to describe the demand for compensation of mineralized soil organic matter in arable soils in order to maintain adequate soil organic matter levels at an optimal yield level of agricultural crops with regard to yield amount and fertilizer nitrogen use efficiency. Coefficients applied in balance calculation are based on two different methodical approaches for coefficient generation: "Black-Box-derivation" from long-term field experiments on crop rotation and fertilization effects (Asmus and Herrmann 1977), and, on the other hand, theoretical calculation of the absorption of nitrogen from soil organic matter mineralization by arable crops (Rauhe and Schönmeier 1966, Leithold 1991). However, the insufficient validation of the model and the missing inclusion of a standardized method for the reproducible calculation of balance coefficients are major drawbacks that have to be addressed in the further development of the tool. References Asmus F, Herrmann V (1977), Reproduktion der organischen Substanz des Bodens und Humusreproduktion. Fortschrittsberichte für die Landwirtschaft und Nahrungsgüterwirtschaft 15 No. 11. Leithold G (1991), Zur Herleitung der Gleichung der „horizontalen“ Stickstoffbilanz. Wissenschaftliche Zeitschrift der Universität Halle XXXX'91 M 6,139-145. Rauhe K, Schönmeier H (1966), Über die Bedeutung des Humusersatzes beim Übergang zu industriemäßigen Pflanzenproduktionsmethoden. Wissenschaftliche Zeitschrift der Karl-Marx-Universität Leipzig, Math.-Nat. Reihe 15, 1-5. VDLUFA (2004), Humusbilanzierung. Standpunkt of VDLUFA. VDLUFA publication, Speyer.



S07.07-P -25

N AND C STOCKS IN SOILS IS MODIFIED BY CROPPING SYSTEMS MANAGEMENT: LONG TERM FIELD AND MODELLING APPROACHES

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Maize-based cropping systems, typical of livestock farms, are widespread in intensively-cultivated Po Plain (Northern Italy) and maize is the crop that receives that largest manure input and produces the largest N surplus. Soil C and N stocks are consequently modified. This study is based on experimental data from the Tetto Frati long-term trial (Turin, NW Italy). The trial was established in 1992 on a deep loamy soil to compare 38 maize-based cropping systems. Systems differ for N fertilizer type and amount, crop rotation and C addition through organic fertilizers and crop residue management. The trial is included in a network of platforms for ecosystem monitoring within the EXPEER FP7 project. The objective of this study was to assess the impact of high-yielding, maize-based cropping systems and to propose viable management options capable of reducing environmental impact and improving soil quality. Two approaches were used: a) N use efficiency and loss indicators based on field data; b) long-term simulation modelling using Daisy, parameterized using a wide set of field data to adapt to local conditions, fertilizers and crops. Results from both approaches were combined to evaluate management options: entire plant removal (reduced N leaching, but also C sequestration); maize-Italian ryegrass double cropping (improved efficiency of organic fertilizers and reduced leaching); rotation with grass ley (reduced N impact when fertilized with urea); fertilization using slurry and manure (SOM build-up and reduced N leaching). This study showed that farmers in NW Italy have several opportunities to continue cultivate maize thus accomplishing agri-environmental legislation.



S07.07-P -26

NITROGEN CONTRIBUTION FROM WINTER CROPS TO SUBSEQUENT MAIZE CROP USING NITROGEN - 15

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Estimating the amount of N supplied by winter crops to subsequent crops is current interest in sustainable agricultural systems in Brazil. This study was carried out to quantify the N credits from winter crops (maize and soybean labeled with 15N) to a subsequent maize crop (summer crop). The N balance in the soil-plant (shoot + root) system also was evaluated. The experiment was conducted in a clayey soil (Typic Acrustox), under no-tillage, in Jaboticabal, SP (Brazil). The dried and chopped up 15N-enriched maize and soybean plants (shoot + root) were applied on the surface soil (field microplots) at rates equivalent to 139 and 149 kg ha⁻¹ N, respectively. The N utilization by maize of the winter crops was low: 7.8% (10.8 kg ha⁻¹ N) and 13.1% (19.5 kg ha⁻¹ N) were recovered of maize and soybean, respectively. There was more 15N from winter crops remaining in soil than recovered by maize crop (summer crop). Total recovery (soil + maize) was about 80% of the N initial input.



S07.07-P -27

NITROGEN FERTILIZATION MANAGEMENT AND NITROGEN (^{15}N) UTILIZATION BY MAIZE CROP UNDER NO-TILLAGE WITH DIFFERENT WINTER CROPS

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The utilization of N by maize grown on a no-tillage (NT) system depends on the quality of the residue of the winter crop, which may cause differences on the nitrogen fertilizer efficiency due to the time in which it is performed. Thus, this study aimed the evaluation of N application strategies and winter crops on N fertilizer use efficiency (NFUE) and the grain yield of maize grown in a clayey soil (Typic Acrustox), under NT, in Jaboticabal, SP (Brazil). The N application strategies (150 kg ha⁻¹ of N - ^{15}N labeled urea) were: (0 - 0 - 0), (20 - 80 -50), (50 - 80 - 20), (150 - 0 - 0) and (0 - 80 - 70), where the first number corresponds to the N rate applied on preplanting and the second and third ones correspond to the rate applied on top dressing when the plant presented, respectively, V4 and V8 stage. The winter crops were soybean and maize. The N application increased the productivity of maize; these effects were more expressive when the winter crop was soybean. With regard to the grain production, the N application strategies were equivalent. The greatest NFUE by maize was verified when the total N rate was applied on preplanting (NFUE = 38%). Regardless the N application strategy and the winter crop, the non recovered N from the applied urea on the soil-plant system, was on average of 46% (69 kg ha⁻¹ of N).



S07.07-P -28

NO TILLAGE INCREASED SOIL ORGANIC CARBON AND BIOLOGICAL ACTIVITY IN A MEDITERRANEAN VERTISOL IN APULIA, ITALY

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Enzymes catalyze all biochemical reactions and are involved in nutrient cycling in soil. Thus, soil enzyme activity is useful for detecting effects of agronomic practices, including rotation and tillage techniques. A two-year rotation, tick bean (TB) (*Vicia faba* L., var. minor)- (*Triticum durum* Desf.; DW), was introduced in 2009 on a field trial where continuous DW had been grown for 13 years. The soil was a vertisol under both no tillage (NT) and conventional tillage (CT) and was located at the experimental farm of the Cereal Research Center (Foggia, Apulia, Italy). Soil enzyme activity (arylsulfatase, β -glucosidase, leucine-aminopeptidase, esterase, alkaline phosphatase, chitinase) total organic C (TOC), total nitrogen (Ntot), and total DNA were determined on soil samples collected in march 2011 when all experimental plots were under DW. . We detected 30 to 50% higher values for esterase, Corg, Ntot, DNA and from 70 to 90% higher for arylsulfatase, β -glucosidase, leucine-aminopeptidase, alkaline phosphatase, chitinase in the first 0-30 cm of NT treatment ($0.001 < P < 0.01$). These differences were mostly driven by the change in properties in the first 5 cm of NT plots, where the concentrations were from 49% of TOC up to 400% of β -glucosidase higher with respect to the beneath 5-30 cm layer. So far, there was no effect of rotation on measured soil properties. Results showed that NT improved biological activity, accumulation of TOC and Ntot in a semiarid Mediterranean region and thus represents a promising practice for soil management.



S07.07-P -29

PROTECTION OF SOIL ORGANIC MATTER IS PROTECTION OF LIFE

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Abstract: The main and active part of soil organic matter (SOM) are humic substances (HS) which emerged with producing of first organic molecules on earth and constituted a stable and active base for emerging the first cells.(1) These complete materials could provide the primary cells with organic molecules, minerals, water, and energy ... and protect them from UV, PH, and temperature fluctuation. Surely these ubiquitous materials are the “missed ring” which can connect the non-living to living things conveniently. All elements that contributed to life process are those that can cooperate with HS smoothly. There are many evidences that refer to HS as the main chairal and elemental selector for life.(2,3) Without the great affinity and conservative effects of HS for nitrogenic compounds, rare primary organic molecules which came from the atmosphere would decomposed quickly and had no opportunity for accumulation, polymerization, and evolution(4). The most prominent service from HS is to help plants and other creatures to receive “balanced minerals” from environment. Unfortunately modern agricultural practices during the last decades deprived the soils from HS and beneficial micro organisms, which are the best natural mineral balancers and could insure balanced food for plant, animal, and human. Any mineral deficiency or toxicity causes sickness. Many somatic and behavioral disorders, above all, drug addiction, delusional thinking, and epidemic violence are mainly related to mineral nutrient imbalance(5,6,7). Only healthy soil with enough HS has both filtering and complementary capacity simultaneously and may guarantee a balanced and appropriate food, body, and mind.



S07.07-P -30

REFINING THE LOSS ON IGNITION METHOD: THE EFFECT OF SAMPLE WEIGHT

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A literature review of 26 studies that assessed organic matter (OM) in sediments and soils using the Loss-on-Ignition (LOI) method revealed that the average sample weight used was 4.8 g (variation: 0.5-20 g). Overall, sample weights in the order of 4 g showed large differences between LOI values of pseudo replicates. We questioned if those differences could be attributed to a non-homogeneous distribution of OM in such a small subsample. Bulk soil samples (0-30 cm depth) were taken from a sandy and clayey field. Samples were dried at 105°C, crushed, sieved (1 mm mesh size) and then thoroughly mixed. Seven different sample weights ranging from 4 to 40 g were taken from each bulk sample to analyse OM. Each weight amount was replicated four times. The ignition conditions were 4 hours at 500°C. A muffle furnace (Carbolite-CWF) was used. Clayey and sandy samples were analysed separately. We found that variation between pseudo replicates decreased with sample weight. Despite all samples were well mixed, it was concluded that OM was not homogeneously distributed in subsamples with a weight of 4 g. However, for both soils the average LOI value stabilised from 20 g onwards and the variation was minimised. Therefore, a sample weight of 20 g should be recommended to obtain the highest precision.



S07.07-P -31

SOIL CARBON STOCKS UNDER OIL PALM PLANTATIONS IN BAHIA STATE, BRAZIL

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*The production of oilseeds is increasing due to the growing demand of raw material for biodiesel production. The oil palm (*Elaeis guineensis* Jacq.) is a perennial plant of African origin which came to Brazil in the sixteenth century and has adapted to the southern coast of Bahia State. Brazilian Atlantic coast has about 850,000 hectares of potential area for oil palm cultivation, that can be found within agroforestry system and plantations. Different oil palm cultivations derived from native rain forest can modify the soil carbon (C) dynamics. So, the aim of this study was to evaluate the changes in soil organic carbon (SOC) storage after the conversion of Atlantic forest into oil palm production in Bahia State, Brazil. Soil samples were collected in four areas: Native Atlantic Rain Forest (NARF), Agroforestry System (AGRF), Oil palm cultivated during 23 (OP23) and 35 years (OP34). We found the highest soil C contents in the region next the oil palm base (1.22% in OP23 and 1.49% in OP34), indicating that the increment in soil organic matter must have been largely derived from root material. The soil C stocks were higher in frond piles (1.7 times in OP23 and 2.6 times in OP34) than in the rows due to inputs of soil organic matter by pruned fronds. The soil C stocks were similar in AGRF and NARF. We found SOC storage of 66.6 Mg ha⁻¹ under OP34, indicating an increase of soil C stocks in oil palm plantations over time.*



S07.07-P -32

SOIL ORGANIC CARBON BALANCE IN A BIO-ENERGY CROP

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Short-rotation coppice cultures (SRC) with poplar (*Populus* spp.) for bio-energy production offer a potential for fossil fuel substitution and mitigating increased CO₂ concentrations. But the potential of SRC to store carbon into the soil and to mitigate the rising atmospheric CO₂ concentration is still not well understood. The objectives of this study are (i) to measure all carbon fluxes into and out of the soil to quantify the SOC balance of a SRC with poplar, and (ii) to estimate the long-term effects on the SOC. The studied SRC was established on land that was previously used as cropland or as pasture. Roots are being removed from soil samples taken every two weeks in order to estimate root biomass and root turnover. During the fall leaves are being collected on a monthly basis to estimate carbon input into the soil from the above-ground tree parts. Soil respiration is continuously recorded via automatic soil chamber measurements. Measurements of dissolved organic carbon and the SRC water balance allow to estimate carbon losses from deep carbon drainage. First-rotation results of all carbon fluxes into and out of the soil will be presented. By assessing all pools and fluxes we can simulate the SOC balance and predict future changes. This will allow us to analyze the potential of SRC as a strategy for energy production and SOC sequestration.



S07.07-P -33

SOIL ORGANIC CARBON STOCK AND SOIL STRUCTURE OF CALCIC CHERNOZEM IN THE SEMIARID ENVIRONMENT OF THE PROVINCE OF VOJVODINA

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Soil organic carbon (SOC) and soil structure have an important role in the soil quality performance and ecosystem stability. The degree of soil aggregation and the SOC stock and dynamics are strongly dependent on land use change. After more than a 100 years of ecosystem transformation from natural steppe-forest to present-day intensively tilled soils, structure deterioration and SOC decrease have been observed in the Serbian Province of Vojvodina. The examined soil type was Calcic Chernozem, which has been under conventional tillage system more than a 100 years. Soil samples were taken from each pedogenetic horizon in eighteen soil profiles up to 200 cm depth. The results showed the average SOC stock of 65 Mg C ha⁻¹ in the plow layer (0-30 cm), ranging from 58-76 Mg C ha⁻¹. Within the depth of 0-200 cm the SOC stock varied from 134-308 Mg C ha⁻¹ with the average of 193 Mg C ha⁻¹. Dry and wet mean weight diameters (MWD) were 6.57 and 0.59 mm, respectively. Structure coefficient (Ks) showed high values of 3.88-8.20 (the average of 5.84). Among many determined soil properties, the SOC concentrations and stocks were strongly correlated with CaCO₃, while structure indices were significantly correlated with the soil water retention at 625 and 1500 kPa. These results confirmed the notably lower aggregate stability and SOC concentration in the long-term tilled Calcic Chernozem compared with the same soil under natural vegetation, but it can still be considered as soil with the satisfactory SOC stock and structure.



S07.07-P -34

SOIL ORGANIC MATTER FRACTIONS UNDER LONG-TERM CONSERVATION TILLAGE IN RAINFED ARAGON (NE SPAIN)

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Conservation tillage has been proposed as a management alternative to conventional tillage system to enhance organic carbon (OC) accumulation in the soil surface. This paper assesses the long-term (21 years) effect of tillage on soil OC content and its distribution among different organic matter fractions in a dryland field of semiarid Aragón. Two conservation tillage treatments (reduced tillage, RT, and no-tillage, NT) were compared with conventional tillage (CT) under both continuous cropping and cereal-fallow rotation. A nearby uncultivated land (NAT) was also selected. Soil samples, taken at 3 different depths (0-5, 5-20 and 20-40 cm) were subjected to physical fractionation to obtain 4 organic matter fractions: coarse particulate organic matter (cPOM, >250 μm in size), fine particulate organic matter (fPOM, 250-53 μm), mineral-associated organic matter occluded within stable microaggregates (Min- μagg , <53 μm) and easily dispersed mineral associated fraction (Min-d, <53 μm). The effect of tillage was mostly observed in the first 5 cm of soil depth with the highest OC contents in the NT and NAT soils due to the increase mainly of the cPOM and fPOM under both cropping systems. Soil texture seemed to be a factor influencing the Min fraction since significant relationships were found between silt plus clay content and C-Min or C-Min- μagg at different depths. These results are consistent with other studies carried out in different world regions and indicate that POM (cPOM and fPOM) is the most sensitive fraction to soil management while the Min fraction (more precisely Min- μagg) is also influenced by soil texture.



S07.07-P -35

**SOIL ORGANIC MATTER IN TWO DIFFERENT REGIONS OF THE SAO PAULO STATE –
BRAZILIAN SOUTHEASTERN REGION - ASSESSMENT OF QUALITY**

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The land cover of Bauru and Ipero has experiencing changes since long time ago. Bauru has approximately 673 km² and 350,000 inhabitants. Ipero is smaller, it has 171 km² and 29,000 inhabitants. In Ipero the main region still covered with pristine vegetation is National Forest of Ipanema (Flona National Park). The main land cover observed for both areas is the change from savanna forest (or forest in some cases) to pasture (Brachiaria sp. is the most common grass specie). Nowadays, activities aiming restore degraded environments are urgent by practically all Sao Paulo State. Information about soil quality, especially regarding the organic matter, provides an excellent and not so expansive database for establish priority areas for ecological restoration. In this project we are comparing the quality of soil organic matter, as well as other parameters, from degraded areas in relation to pristine areas, in order to know the level of degradation of the soils. The study is in the stage of soil sampling in pre-defined points along the study areas. The database of soil quality about soil's physic (color, real and bulk density, porosity), chemical and electro-chemical (carbon, nitrogen, organic matter, pH, electric conductivity), and isotopic signature of organic matter (d13C and d15N) will be elaborated shortly. It will indicate the regions whose soils are degraded, helping us to indicate priority areas for forest reconstruction, as well as will help us the chose of the methods for ecological restoration.



S07.07-P -36

**SOIL ORGANIC MATTER STOCK CHANGES IN A CEREAL/LEGUMINOUS CROP ROTATION
MANAGED WITH NO-TILLAGE FOR OVER TWO DECADES**

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Most studies show that the use of tillage strongly influences the soil-plant C dynamics in arable lands. Globally, long-term field experiments contribute to the largest database(s) available for studying the influence of different management practices for the organic matter accumulation capacity of agricultural soils. In Mediterranean areas, low soil organic matter (SOM) content, high evapotranspiration rates, and intensive agricultural practices are the main constraints affecting both the soil fertility and the crop yields. Reduction of tillage intensity can be considered to improve SOM and crop profitability. Thus, a better understanding of the interaction between tillage and SOM is a key issue in this context. Here, we focus on the impact of no-tillage on SOM dynamics in a rainfed cereal/leguminous crop rotation under Mediterranean conditions. The field experiment was set-up in 1986 at the Interdepartmental Centre for Agri-Environmental Research "Enrico Avanzi" - University of Pisa, Italy. The soil was classified as Typic Xero?uvent and climate was typically Mediterranean. The SOM dynamic was evaluated by both measured data and Hénin–Dupuis's model. After 25 years under continuous no-tillage, the SOM pool significantly increased by 21 Mg ha⁻¹. Such increase was related to the C inputs returned to the soil and to the decrease of organic matter decomposition processes in soil, as calculated by Hénin–Dupuis's model. Our findings suggest that in the Mediterranean area, the potential of soils to increase SOM is strongly related to C inputs, tillage intensity, and humification-mineralisation processes.



S07.07-P -37

SOIL QUALITY PARAMETERS IN GRASS AND MIXED VEGETATION BUFFER STRIPS

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Pesticide runoff and erosion loss reduction are well known to be the primary benefits of buffer strip (BS) usage. The presence of permanent vegetation (grass and woody species) also provides indirect environmental benefits such as increasing biodiversity and improving soil quality parameters. Soil chemical properties (organic carbon and nitrogen), humic substances (molecular weight distribution), enzyme activities (urease, protease, FDA and deidrogenase) and microbial biomass content were compared in a maize crop plot (MC), a plot without buffer (WB) and four different BS designs: 3G, 3 metre grass buffer; 3G1R with one tree row; 6G1R 6 metre grass buffer with one tree row; 6G2R, with 2 tree rows. Sampling occurred in April and October 2010, 13 years after BS establishment. As expected maize crop and no buffer plots evidenced the lowest values for all the studied parameters. Sampling period significantly influenced enzyme activities and microbial biomass content with higher mean values in October samples. Collected data were pooled and CDA was performed. The resulting model distinguished four groups of samples: MC and WB; 6G2R; 6G1R and 3G; 3G1R: the most important variables were protease and FDA enzyme activities, low molecular weight humic fraction and organic carbon and nitrogen contents. Establishment of BS improved soil carbon and functional diversity of enzyme activity. Observed chemical and biological improvements may not only help reduce nonpoint source pollution from agricultural lands, but also contribute to the overall quality of the environment.



S07.07-P -38

STUDY OF THE EFFECTS OF LONG-TERM ORGANIC FERTILIZATIONS ON SOIL MACROPOROSITY USING X-RAY MICROTOMOGRAPHY

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In this work we studied the long-term effects of organic and mineral input on soil macroporosity in a three-dimensional approach. Treatments consisted on farmyard manure (F2), liquid manure + residue incorporation (L2+r), mineral (NPK2) and no fertilization (O). A total of 12 undisturbed soil cores (3 replicates; 5 cm diameter, 6 cm length) were collected from the topsoil (5 to 20 cm depth) and scanned with an X-ray microtomography. All samples were scanned with the same technical parameters: 100 kV, 300 μ A and projections collected during a 360° sample rotation at 0.3° angular incremental step. Final pixel resolution was 40 μ m. A stack of 800 images of 750 \times 750 pixels was selected from the reconstructed images and considered representative of each soil core. After image binarization, using a maximum entropy algorithm, we quantified the global 3D pore network by means of total porosity, 3D pore size distribution, degree of anisotropy, volumetric Euler number and 3D fractal dimension. Total porosity was not affected by the different fertilizations, while pore size distribution < 0.16 mm (small macropores) was significantly higher ($p=0.05$) in NPK2 and O than in F2 and L2+r. Besides organic carbon content affected positively the pore connectivity (low Euler number), pore directionality (high degree of anisotropy) and the big macropore class (0.56-1.00 mm). The study a) confirmed the capability of a 3D approach to highlight subtle structural differences between soils and b) emphasised the role of organic fertilizers as they increased the bigger soil macropores and their connectivity.



S07.07-P -39

STUDY ON SOIL ORGANIC MATTER CONTENT AND SOIL PHYSICAL PROPERTIES IN LONG-TERM FIELD EXPERIMENT

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The effect of different organic and mineral fertilizers has a great importance both in crop production and soil properties. These effects express to soil fertility, yield and can influence certain soil physical parameters. For the investigation of these effects, - as part of an international cooperation (International Experiment for investigation the effect of organic and inorganic fertilizers, IOSDV) - a long-time field experiment was set up in 1983 in Keszthely, in western part of Hungary. In this experiment, there is a three-course cereal crop rotation with maize, winter wheat and winter barley. The bifactorial experiment has a split-plot design with 3 replications. The crop rotation is based on three different organic matter supply: inorganic fertilizers only, farmyard manuring in every 3rd year, and stalk or straw and complementary green manure application. The type of the soil is a Ramann-type brown forest soil (WRB: Eutric cambisol). In this paper the results of the investigations of maize in 2011 are reported. There are 5 different N-doses in the experiment included control, two rates were selected (0 and 210 kg N ha⁻¹). Some soil physical analysis (e.g. actual soil water content, bulk density, aggregate stability) and organic matter test (Potassium-dichromate humus content determination) were carried out. The possible relations between soil physical parameters and organic matter content were analysed with statistical methods. SPSS PC 13 statistical software was used to test the statistical significance of the treatments.



S07.07-P -40

SUSTAINABLE MANAGEMENT OF AGRICULTURAL SOILS IN EUROPE FOR ENHANCING CROP PRODUCTION AND CLIMATE CHANGE MITIGATION (SMARTSOIL)

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Farming practices causing declining returns and inputs of carbon (C) to soils pose threats to soil functions by reducing availability of organic matter for soil microbes and by affecting soil structure, and soil C stocks that contribute to regulating greenhouse gas emissions. The EU-FP7 project SmartSOIL focuses on arable and mixed farming systems in Europe and will develop an innovative approach using the soil C flow and stocks concept to assess the impact of C management on crop productivity, soil organic C (SOC) stocks and other ecosystem services. SmartSOIL will identify and develop options to increase C stocks and optimise C flows whilst maintaining sustainable SOC stocks. The flow and stocks concept will delineate short- versus long-term management effects on vital soil functions through meta-analyses of data from European long-term experiments (LTEs), as well as new measurements within LTEs. This will be used to improve existing soil and crop simulation models and test them against independent LTE data. The models will be used to derive a simplified model to estimate the short- and long-term effects of management on crop productivity and SOC storage. Scenarios of management systems in Europe for improved productivity and enhanced SOC sequestration will be evaluated under current and future climate. The cost-effectiveness of alternative options for managing SOC flows and stocks will be assessed. A decision support tool (DST) to enable farmers, advisors and policy makers to discuss and select appropriate and cost-effective practices for particular farming systems, soils and climates will be developed.



S07.07-P -41

THE EFFECTS OF CROPPING TECHNOLOGY ON SOIL CARBON STOCK OF CHERNOZEM SOIL

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Crop management is key factor for the maintenance of soil organic carbon (SOC) stock in arable soils. Changes in SOC stock in different cropping system may occur due to changes in carbon (C) input or C decomposition rates. To assess the SOC stock arable soil samples were collected from the long-term experiments and adjacent land (control) in depth 0-100 cm. The following treatments were analyzed: 4-year rotation with manure 40 t ha⁻¹ (B0); 4-year rotation, manure 40 t ha⁻¹+100 kg N ha⁻¹ (B2); 4-year rotation 200 kg N ha⁻¹ without crop residues (A4); 4-year rotation 200 kg N ha⁻¹ with crop residues (C4); wheat monoculture + 100 kg N ha⁻¹ (MO); 2-year rotation + 100 kg N ha⁻¹ (D2); 3-year rotation + 100 kg N ha⁻¹ (D3), unfertilized 2-year (N2) and 3-year rotation (N3) and native vegetation (NV). P and K were applied according to soil analyses. Differences in SOC stock were associated with the biomass quantity of crops in rotation and fertilization. At the unfertilized plots significant loss of C (94-120 t C ha⁻¹) was observed compared with fertilized treatments (160 t C ha⁻¹) and NV. The addition of manure without crop residue was not sufficient for maintaining the SOC stock. NV was higher in C stock (184 t C ha⁻¹) compared with arable land as a result of C reserves in subsoil layers. This result could contribute to the understanding of C stock change in Chernozem related to the cropping management and could help in preservation of SOC.



S07.07-P -42

THE EFFECTS OF LAND USE CHANGE ON SOME OF SOIL QUALITY PROPERTIES IN THE SAFASHAHR AREA, FARS PROVINCE, IRAN

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^[1]shahrekord university ~ soil science ~ Shahrekord ~ Iran, Islamic Republic of

Land use change could affect many soil quality properties. The purpose of this study was to investigate the effect of cultivation on some soil physical and chemical properties and changes of organic matter in the Safashahr, Fars province, Iran. Thus, four land uses including the rangeland with sparse vegetation, the rangeland converted to agricultural land over 17 years, the agricultural land converted to apple orchard for 4 years and old apple orchard with 40 years old were selected. Samples were taken randomly from each land use from two depths (0-20 and 20-50 cm) and five replications. Acidity (pH), electrical conductivity (EC), texture, calcium carbonate equivalent, total organic matter, organic matter content in different fractions (1-2, 0.25-1, .053-0.25 mm), the particular organic matter (POM) and aggregate stability (MWD) were determined. Results showed that land use change increased significantly POM, total organic matter and MWD in both depths. The trend of organic matter in soil fractions was almost the same as the total soil organic matter. The highest value of O.M. was observed in old apple orchard and the lowest one found in the rangeland. Significant positive correlation between MWD and organic matter indicates the positive effect of cultivation on soil quality indices in the regions with poor vegetation cover.



S07.07-P -43

THE EFFECTS OF LAND USE CHANGES ON SOIL ORGANIC C POOLS AND C STOCKS IN ZREBAR LAKE WATERSHED

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Although change of land use in the Zrebar Lake Watershed had been occurred many years ago, but no information is available on the effects of long-term environmental disturbance on C pools and storage of soil organic C. The objective of this study is to compare the effects of a different land use on soil organic carbon pools and carbon stock. For this aim, Zrebar watershed in western of Iran was selected and five land uses were evaluated as: wetland, wetland changed to alfalfa and wheat, forest, and forest changed to vineyard. Samples were collected from the 0-30, 30-60 and 60-90 cm of each land use. Then particle size (sand and silt-clay size fraction) fractionation of soil organic carbon was analyzed. According to results the wetland and wheat land showed higher and lower sand size fraction (67.0, 24.6 g OC.kg⁻¹ soil, respectively) in 0-30-cm horizon. The silt + clay size fraction OC was highest at wetland (32.8 g OC.kg⁻¹ soil) 0-30-cm depth, beside, no significant difference was obtained in forest (19.6 g OC.kg⁻¹ soil), vineyard (13.9 g OC.kg⁻¹ soil), alfalfa (14.6 g OC.kg⁻¹ soil) and wheat (13.9 g OC.kg⁻¹ soil). Carbon stocks in surface layers of land uses decreased in following order: wetland (341.3 Mg C.h⁻¹) > forest (251.1 Mg C.h⁻¹) > alfalfa (205.2 Mg C.h⁻¹) > wheat (181.3 Mg C.h⁻¹) > vineyard (160.2 Mg C.h⁻¹). Results showed that wetland and forest land were the most efficient types for SOC sequestration.



S07.07-P -44

THE HUMUS BALANCE MODEL HU-MOD – METHODOLOGY AND SCOPE

Brock Christopher*^[1], Hoyer Uta^[2], Leithold Günter^[1], Hülsbergen Kurt-Jürgen^[2]

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The humus balance model HU-MOD (Brock et al., submitted) is designed to assess the impact of management changes in arable farming systems on soil organic matter levels, the latter being a key factor of soil quality with ecological as well as agronomical relevance. To do so, the model calculates so-called “humus reproduction levels” for arable farming systems, referring to a defined spatial unit. In contrast to models on SOM turnover, HU-MOD is supposed to run with easily available management and site data and bypasses the need for any soil sampling in order to achieve applicability as a decision support tool in farming practice. In HU-MOD, SOM levels are assumed to be dependent on the interaction of site and management factors. As site is constant in scenario comparison, the humus reproduction level of the reference management replaces the empirical information on initial SOM levels as a normally crucial parameter in impact assessment. The model has been validated in long-term field experiments, but up to now only with regard to an ordinarily scaled assessment of management change impact on SOM levels. Further development of the method thus focusses on a metric quantification of results. Reference Brock C, Hoyer U, Leithold G, and K.-J. Hülsbergen (submitted), The humus balance model (HU-MOD): A simple tool for the assessment of management change impact on soil organic matter levels. Nutr Cycl Agroecosys



S07.07-P -45

TILLAGE AND COVER CROP SPECIES AFFECTS SOIL ORGANIC CARBON IN ANDOSOL, KANTO, JAPAN

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No-tillage, N fertilization and cover crops are known to play an important role in conserving or increasing SOC but the effects of their interaction are less known, especially in Asian countries. The experiment variants are: moldboard plow/rotary harrow (MP), rotary cultivator (RC), and no-tilled (NT), three cover type in winter (FL: fallow, RY: rye, and HV: hairy vetch) and two nitrogen fertilization rate (0 and 100 kg N ha⁻¹ for field rice and 0 and 20 kg N ha⁻¹ for soybean production). We observed on soil organic carbon and soil carbon storage in the relation to the biomass production of cover crop and summer crops. Vertical distribution at 0-2.5, 2.5-7.5, 7.5-15 and 15-30 cm depths of soil carbon contents and bulk densities were measured each year. From 2003 to 2009, under NT system also increased SOC by 11.00 Mg ha⁻¹ year⁻¹ although under MP and RC system increased by only 8.19 and 8.98Mg ha⁻¹ year⁻¹. Cover crop type also significantly increased SOC by 13.42 and 9.65 Mg ha⁻¹ year⁻¹ for rye and hairy vetch, respectively, although under fallow plot increased SOC only 4.83 Mg ha⁻¹ year⁻¹. Continuous soil management for 8 years enhanced SOC accumulation than initial year. Those results suggest NT system and rye cover crop management contribute to enhance the carbon sequestration.



S07.07-P -46

TOPSOIL CARBON CONTENT IN FINNISH CULTIVATED LAND PREDICTED BY SOIL TYPE, CULTIVATION HISTORY AND REGION

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Soil organic carbon not only affects soil quality, but it also has a role in the global carbon cycle. Therefore it is important to quantify soil carbon pools under different land-use and management practices. The aim of this study was to estimate the soil carbon content in Finnish cultivated land. The study was based on the national soil monitoring data and the geospatial datasets. As a part of the long term soil monitoring of cultivated land, soil samples from 611 sampling points were collected in 2009. Samples were taken from topsoil 20 cm and were analyzed for carbon content, soil texture and bulk density. Cultivation history in each sampling point is known from 1995 onwards. The soil monitoring data was exploited to determine the mean carbon contents in the groups of soil type, cultivation history and region. The areas of Finnish cultivated land in above groups were obtained from geospatial datasets. By combining both information, we were able to estimate the nationwide spatial distribution of soil carbon. Pedotransfer function relating bulk density to carbon content /soil texture was developed allowing us to estimate the total amount of carbon per unit area.



S07.07-P -47

TRENDS IN SOIL ORGANIC CARBON CONCENTRATION AND CROP YIELDS DEPENDING ON LONG-TERM FERTILISATION

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Aim. Soil fertility and productivity are important for the supply of food, feed and fibre. Long-term experiments provide possibility of studying the effects of fertilisation strategies on soil properties and crop yields. Current study is aimed to analyse changes in soil organic carbon (SOC) concentrations and crop yields in IOSDV field experiment (located in Tartu, Estonia) during 20 years. Materials and methods. The field experiment with three-field crop rotation (potato - spring wheat - spring barley) was established in 1989 on Stagnic Albeluvisol. Experimental factors were following: 1) organic fertilisers (without and solid cattle manure) and 2) mineral fertilisers (0, 40, 80, 120 and 160 kg N/ha). SOC concentration was analysed by Tjurin method. Annual change rates (%) of crop yields were found as a crop rotation average for each experimental variant. Linear regression of yield versus time was performed for calculating annual change rate. Results. Initial level of SOC concentration was 1.0%. Mineral fertilisers had no significant effect on SOC concentration, but without organic fertilisers it decreased during 20-year period to 0.8–0.9%. Periodical application of manure increased SOC concentration up to 1.1–1.2%. Spring wheat and barley yield decreased accordingly 1.6% and 1.7% per year on unfertilised areas. Yield decrease was substantially lower in crop rotation with manure (0.6–1.0% annually). The combined use of mineral and organic fertilisers is the appropriate solution for realisation the yield potential of crops and for sustaining SOC status in long-term.



S08.01-P - HYDROPEDOLOGY, INCLUDING APPLICATIONS IN A KARST ENVIRONMENT

Tuesday 03 July 2012 from 17:00 to 18:30. Room Poster Areas

S08.01-P -1

*PROTOZOAN CILIATES FROM THE SULPHIDIC SEDIMENTS OF POZZO DEI CRISTALLI
(FRASSASI CAVES, ITALY)*

Santosh Kumar, Camerino (MC) - Italy

S08.01-P -2

SOIL CATENAS ON THE SLOPES OF SINKHOLES

Maria Smirnova, Moscow - Russian Federation

S08.01-P -3

THE SUBSOIL SHAPING OF KARST SURFACES (SHILIN, CHINA)

Tadej Slabe, Postojna - Slovenia

S08.01-P -4

*CHARACTERISTICS OF THE WATER REGIME OF EUGLEY AMPHIGLEYIC SOIL IN EASTERN
CROATIA*

Dragutin Petosic, Zagreb - Croatia

S08.01-P -5

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LANDSCAPE EVOLUTION AND SOIL HYDROLOGICAL CHANGES AT THE MILLENNIUM SCALE: A CASE STUDY FROM THE CAMPINE AREA, NORTHERN BELGIUM

Koen Beerten, Mol - Belgium



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Giacomo Mele, Ercolano (NA) - Italy

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Bertrand Leterme, Mol - Belgium

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TOWARD INCLUDING MULTI-SCALE SOIL PROPERTIES THAT INFLUENCE HYDROLOGY MODELING

Cristine Morgan, College Station - United States



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*VARIABILITY OF SOIL PROPERTIES AND SOIL WATER CONTENT IN VINEYARD PLOTS
AFFECTED BY LAND LEVELLING: AN OPPORTUNITY FOR PRECISION VITICULTURE*

María Concepción Ramos, Lleida - Spain

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*WATER USE EFFICIENCY OF RED CABBAGE, BROCCOLI, AND HEAD LETTUCE AS
AFFECTED BY GROUND WATER TABLE*

Sujeong Shin, Cheongju - Korea, Republic of



S08.01-P -1

**PROTOZOAN CILIATES FROM THE SULPHIDIC SEDIMENTS OF POZZO DEI CRISTALLI
(FRASSASI CAVES, ITALY)**

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*The sulfide-rich Frasassi cave complex (Genga, AN, Italy) host a still largely uncharacterised microbiota whom study might offers an intriguing view on the solutions adopted by the different species to survive and interact with each others in a such harsh environment. Beside the absence of light and low temperatures (12-13°C), another environmental shaping factors is represented by highly variable sulphide concentrations (from 0 up to 415 μM H_2S). Moreover, up to now, very few study attempted to describe ciliate communities from caves as well as, their fluctuation with respect to environmental factors. In this analysis of the ciliate fauna of Frasassi caves, we focused our attention on a sampling site known as "Pozzo dei Cristalli" which is highly diversified since it include several microhabitats represented by small sulfidic (H_2S -rich) ponds, streams and spring as well as, deep and shallow muddy, stagnant lakes. Periodic sampling was realised from 2009 to 2011 in the form of water-sediments, picked up by scraping the surface. A total of 31 species were identified; belonging to 9 classes, 15 orders and 23 genera. It was observed that some species e.g. *Urocentrum turbo*, *Coleps hirtus*, *Euplotes* sp, showed adaptation for the cave environment (high sulphur tolerance, Photo-sensitivity, feeding behaviour). Our future goal will be to study spatio-temporal variations in the ciliate communities employing cultivation-independent, molecular profiling assay (T-RFLP). Finally, integrating taxonomy and molecular data to obtain a more rigorous and detailed picture of the ciliate diversity in cave sediments.*



S08.01-P -2

SOIL CATENAS ON THE SLOPES OF SINKHOLES

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The aim of this work is a comprehensive analysis of soil-forming process on the slopes of sinkholes. The research is based on morphological, physical, chemical soil studies of 24 soil catenas on the slopes of different sinkholes in Belomor-Kuloy plateau and the Middle and Southern Urals. It was shown that the thickness of humus horizon increases and the content of organic matter decreases from the top to the bottom of sinkhole slope. Textural and metamorphic horizons lose their morphological properties such as structure and texture from top to bottom of sinkhole slope. Soils from the bottom of the slopes have more in common rather than soils from the top of the slopes regardless of landscape and morphological properties of sinkholes. Soils in sandy soil catenas are more contrast among each other than soils in loamy and clay soil catenas.



S08.01-P -3

THE SUBSOIL SHAPING OF KARST SURFACES (SHILIN, CHINA)

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Martin Knez, Hong Liu, Tadej Slabe The karst surface is uniquely formed under the sediment and soil that completely or partly cover it. Subsoil rock forms develop that are distinctly indicative traces of the processes shaping karst surfaces and of their development. Soil dictates the subsoil formation of karren and the origin of characteristic subsoil rock forms with their smooth surfaces and as a rule accelerates corrosion. Subsoil shaping is also decisive in the development of the Lunan stone forests (shilin), producing characteristic networks of subsoil rock forms. To a large extent, the subsoil shaping of the rock also leads to their transformation by rainwater. The subsoil corrosion of rock is most distinct at the level of soil and along water-conducting paths that accelerate the corrosion process on carbonate rock at the contact with the sediment on which the soil develops.



S08.01-P -4

CHARACTERISTICS OF THE WATER REGIME OF EUGLEY AMPHIGLEYIC SOIL IN EASTERN CROATIA

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The studied region covers an area of 249.100 ha, or about 2.500 km², and is situated in Eastern Croatia. The total area of pedological units is 174.019,6 ha. According to the soil map in scale 1:200.000, 24 soil mapping units were separated in the region. Nine units with an area of 73.477,3 ha, or 42 %, were allotted to the division of hydromorphic soils. Eugley amphigleyic soil is prevalent and covers 31.669,0 ha. Monitoring of the water regime of gley amphigley soil, focused on groundwater dynamics, was conducted in the period from 2001. to 2009. on 40 locations. Groundwater level was monitored three times a month in hydropedological piezometers of 4,0 m depth. During the investigation period (2001.-2009.), frequent occurrence of very shallow to shallow groundwater level was observed on over 90 % studied locations. Maximum values fluctuated within the range from 0,2 to 0,5 m, measured from ground level. These values were especially marked during humid years (2001., 2004. and 2007.) and winter-spring periods (December, January, February, March, April). From April toward the summer period, an average drop in groundwater levels was observed. Lowest values were determined at the beginning of autumn and amounted to ca. 4,0 m below ground level. In dry years (2003., 2006. and 2009.), groundwater level was below 4,0 m depth. In summary, in the monitoring period (2001.-2009.) of groundwater level dynamics in Eugley amphigleyic soil in Eastern Croatia, its seasonal fluctuation ranging from 0,20 to over 4,00 m depth from ground level was established.



S08.01-P -5

CHERNOZEM AND CHESTNUT SOILS OF SOUTH RUSSIA LONG-TERM CHANGE UNDER IRRIGATION

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The long-term irrigation of chernozem and chestnut soils of South Russia causes deep change of properties of these soils. In irrigation period of 30 years the increase of quantity of oozy particles in arable horizon of chernozem due to the clay formation and profile distribution of silt is observed. In arable horizon of chernozem the humus losses have made 15 % (irrigation with stale water from river Don) and 22-23 % (irrigation with mineralized water from Veselovsky storage lake) accordingly. In chestnut complexes of soils a total soil salinization amplifies and geochemical scope of a landscape grows up to 4-10 times from 0,6-0,8 m to 3-5 m. Chernozems and chestnut soils complexes being irrigated become locally hydromorphic. Structure of soil cover variability strengthens. At high humidity of soil under irrigation an intensive free convective flow of water and salts appears. Hydro-geological conditions, caused by application of standard ways of irrigation renders an adverse influence on soil salinization degree of chernozems and chestnut soils. Therefore irrigation compaction, salinization, humus loss are the system internal defect of laterally uniform soil moistening. Vertical convection-diffusion water salt transfer in soil under watering and washing out of soil continuum is to be changed to overcome the disadvantages of actual irrigation concept.



S08.01-P -6

ECOHYDROLOGICAL IMPORTANCE OF GROUND WATER LEVEL

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The ecohydrology of rain fed ecosystems generally disregards the impact of saturated groundwater on the ecosystem. Often, groundwater affects the water and solute supply of the root zone, by capillary rise. This impact can be assessed to describe the dynamics of root zone moisture and is a revitalization of soil physics in a stochastic framework of meteorological forcing of rainfall and evapotranspiration. Innovative of minimalist modeling of ecohydrology is, that a wealth of solid, mathematical physical understanding of soil science is confronted with erratic weather and with feedbacks between soil and vegetation. For a range of soils, it can be shown that the impact of groundwater on rootzone wetness decreases rapidly if groundwater levels fall from 2.5 to 3.5 m below rootzone. The impact on water supply, as well as the relevance for developing rootzone salinity appears to be a complex function of different factors. However, using minimalist modeling, it is also feasible to make the relative importance of climate, soil, ecohydrological and vegetation properties on rootzone water dynamics explicit. More complex is the issue of salt accumulation in case of poor quality ground water. Opposing effects are due to the impact of rainfall on rootzone wetness and leaching, and the capillary rise of brackish groundwater towards the rootzone, which brings salts into the rootzone, but also wets the rootzone and induces leaching. With relatively simple overall water balance term comparisons, it is possible to distinguish major trends, though. Perspectives for further research are presented.



S08.01-P -7

ECOSYSTEM'S FRAGILITY UNDER THE Laterally Uniform Continuous Methods of IRRIGATION

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Under the subsoil and drip methods of water delivering to soil the continuum non-uniformity watering is: subsoil – 0,5-1,0 m (the distance between subsoil dampeners), drip – 0,2-0,6 m (distance between droppers). System lack of the subsoil and drip watering is superfluous continuous humidifying of soil. This cause is a base hydrophysical soil characteristic (BHC), the thermodynamic approach to characterize the water-salt transfer into soil. BHC defines the relation between moisture, water conductivity and thermodynamic potential of soil water. In consequent of BHC the local non uniformity of soil's preferable internal water transfer appears. According water conductivity and thermodynamic potential of soil water, it causes the local over moistening of soil continuum, lateral water transfer expenditure of irrigation water between adjoining soils of soil cover structure (SCS) and its loss to subsoil waters. The system defect of the present-day irrigation concept is its imitating approach – a technical reproduction of a natural mode of water inflow in ground from top to down or from below upwards by means of a gravitation field or capillary forces in all known ways of watering. Synthesis of a discrete artificial mode of humidifying of a soil continuum according to the aim of SCS steadiness is needed.



S08.01-P -8

EXPERIMENTAL DESIGNS TO EVALUATE THE IMPACTS OF INNOVATING CROPPING SYSTEMS ON SOIL TRANSFER PROPERTIES

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The reduction of chemical inputs in cropping systems requires to set up alternative agricultural practices which interact with the soil hydrous status and may modify soil properties and water transfer. Our study's aim is to evaluate pesticides losses in 5 cropping systems with different herbicides pressure, the experimental design (Dijon, France) being set up in 2001. The physical and chemical properties were undertaken for the different drained plots of the site. First results show a great variability of the description parameters for the different plots. While, soil properties were initially relatively comparable for the soil of the different plots, significant differences between plots are now observed for physical properties (bulk density, electrical resistivity...). Except pedoclimatic context which may explain some of these differences, others are clearly influenced by the some agricultural practices like tillage (ploughing vs. no till). The determination of hydrous reserve and soil hydraulic conductivity allowed to calculate water balances. Elsewhere, the soil mapping layer of the plots was performed by using in situ continuous electrical resistivity measurements to provide the information on soil heterogeneity for the first soil layers. During autumn-winter 2011, the experimental site will be equipped with lysimeter plates and suction cups in order to quantify drainage and pesticides content in drained water. All these data will be finally used to parameterize and validate of soil transfer models (e.g. Agriflux, Hydrus or Pestdrain) and evaluate pesticides losses from the different cropping systems.



S08.01-P -9

**FACILITATING INTERPRETATION OF THE CATHEDRAL PEAK VI CATCHMENT
HYDROGRAPH USING SOIL DRAINAGE CURVES**

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It was hypothesized that, with regard to subsurface flow from the cathedral Peak VI catchment: (a) a defined change in the slope of the hydrograph during a prolonged almost rain free period reflects the onset of outflow from a particular water storage zone of the catchment; (b) reliable soil (upper vadose zone) drainage curve data can help to interpret outflow from that particular water storage zone. To test the hypothesis, measured hydrograph and soil water data from previous studies in the Cathedral Peak VI catchment were used. Drainage curves were derived for the main soils during the rain free autumn periods of four years 1991 to 1994 and the relevant hydrograph were subdivided into appropriate logical regions. The contribution of the soils (upper vadose zone) to streamflow was estimated using the soil drainage curves from selected sites together with the areas of the catchment that they represented. The estimations were compared to estimations done using data from measured streamflow values for the equivalent periods of the hydrographs. The results obtained by the two estimates were as follows, with measurement year, then hydrograph and soil drainage curve estimates (m³), respectively: 1991, 24841, 20061; 1992, 39048, 16528; 1993, 29967, 28448; 1994, 15703, 20809. Apart from the results for 1992, for which a logical explanation is provided, it is concluded that the hypothesis is valid.



S08.01-P -10

FITTING PERFORMANCE OF PARTICLE SIZE DISTRIBUTION MODELS FOR SOILS OF THE HUMID TROPICS

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Detailed soil particle size distribution (PSD) is required in the development of hydraulic pedotransfer functions based on the physical-conceptual approach. Several mathematical models have been proposed to accurately represent PSD of soils. Previous studies evaluated the performance of these models to describe the PSD of soils from temperate regions. To our knowledge, no published studies of this kind have been conducted based on a large dataset of soils from the humid tropics. Therefore, this study aims at evaluating the performance of well-known models for describing PSD of soils from the humid tropics. Ten PSD models with 1 to 4 fitting parameters were selected: Jaky, Logarithmic, Exponential, Log-Exponential, van Genuchten-type1, van Genuchten-type2, Fredlund, Gompertz-type1, Gompertz-type2 and Andersson. A large dataset of 1412 soil samples from the humid tropics was used. The fitting performance of the PSD models was evaluated by four statistical indices: the adjusted coefficient of determination, the Akaike information criterion, the Schwarz's Bayesian information criterion and the relative error. Clustered columns and box-plots were also used to get more insights. Some models like Jaky, Logarithmic, Exponential and Log-Exponential models were not suitable to describe PSD of soils in the humid tropics. On the other hand, Andersson and Fredlund models showed outstanding fitting performance. The Fredlund model which requires only 3 fitting parameters was the best model and it is recommended to get a better description of the PSD of soils in the humid tropics. Moreover, the fitting performance of the PSD models seemed to be affected by textural class.



S08.01-P -11

HYDROBOD – A HYDROLOGICAL SOIL CLASSIFICATION SYSTEM TO ACCOUNT FOR DIFFERENT FLOW GENERATION PROCESSES

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Generation of floods is a complex process of interaction between rainfall and different landscape forming factors and their spatial variability. Geomorphology, vegetation, land use, soil and geology determine the different processes of flow generation and the pathways of water flow in a landscape. Within this complex system of interdependent landscape factors soil plays a dominant role because of its intermediate position between rain as a driving force and the impacting flood in a river. A quantitative description of hydrological soil behaviour to rainstorm events needs i) a common database which is able to describe basic hydrological parameters of soils across different land uses and ii) a method to quantify the different runoff processes that may be dominant within a catchment. Main challenge to generate a common database of basic soil physical parameters for the main land use units (agriculture, forestry) were the completely different sets of surveys and existing data. Therefore basic soil properties had to be regionalised before being used as input in various pedotransfer functions which calculated hydrological relevant soil characteristics. Based on these results a model – HydroBod - was developed to identify dominant runoff pathways. This enables to identify the relative importance of the runoff processes overland flow, subsurface flow, groundwater supply as well as the determination of soil storage. Applying HydroBod it is possible for the first time to use a homogenous data set including an estimation of accuracy of both input and output parameters in Austria.



S08.01-P -12

HYDROLOGICAL RESPONSE MODEL OF A COMPLEX SOILSCAPE IN THE WEATHERLEY CATCHMENT, SOUTH AFRICA

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The hydrological response of a hillslope (soilscape) is critical in hydrological modelling. Soilscape response is mainly controlled by soil (upper vadose zone) and its relationship with the properties of the lower vadose zone. The control mechanisms, flowpaths and storage mechanisms are grafted in the soils as signatures of pedogenesis. A soilscape in the Weatherley catchment was selected. Soil observations were made in a transect consisting of with three soil profiles with chemical, tension and daily neutron water meter data and 15 auger observations. The lithology is sedimentary rocks. Four steps were used to identify the factors (mechanisms) and processes (flowpaths and storage) controlling hillslope hydrology. (i) Interpret soil morphology, (ii) interpret soil chemistry to improve the model, (iii) interpret data of long-term soil water measurements (iv) predict the hillslope response for selected rain events using Hydrus. The hydrology of the soilscape is controlled by potential recharge in the red apedal soils of the crest, interflow in the bedding planes of the sedimentary rocks with returnflow to the subsoil in the midslope, storage of interflow water behind a dyke feeding gleyed soil bodies on the footslope. Although designed by ancient soil morphology the conceptual hydrological response model was confirmed by active soil chemistry and hydrometrics.



S08.01-P -13

INTEGRATION OF SOIL AND AGROGEOLOGICAL DATABASES FOR THE COMPILATION OF 3D SOIL PHYSICAL DATASETS

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Modeling water movement in the unsaturated zone, soil physical data on main hydraulic properties as input parameters are required concerning the water retention curve and the hydraulic conductivity function. Direct measurement of the hydraulic parameters is really cumbersome and time-consuming; the estimation of them can be an alternative, which is most commonly based on the particle-size distribution or texture classes. In Hungary the top layers of the vadose zone are described pedologically while the deeper layers are investigated by agrogeological methods. As a consequence, the available information on hydrophysical features also differs significantly for the various layers of the unsaturated zone. On the other hand the existing pedo- and agrogeological databases are not able to serve separately the information requirements of modeling, their appropriate integration should be carried out. In our paper we present an approach for the compilation of 3D, regional scale, spatial datasets based on the thematic, horizontal and vertical harmonization, fitting and interpolation of hydrophysical parameters originating from standardized pedo- and agrogeological databases. The resultant datasets provide information on the physical properties and stratification of the formations to the depth of the permanent groundwater level. Based on the elaborated method the unsaturated zone is described in a standardized manner. The integrated 3D databases serve coupled (deterministic - stochastic) model simulation based analysis of regional water management problems like drought, flood and inland inundation in pilot areas with various physiographical features in the Great Hungarian Plain.



S08.01-P -14

ISOTOPIC AND CHEMICAL EVIDENCE ON THE TRANSITION UNSATURATED – SATURATED ZONE: FROM THE LYSIMETER TO GROUNDWATER BODY SCALE

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Isotopic behaviour, hydrochemical exchange and transport velocities in the unsaturated zone and at the transition unsaturated and saturated zone is still relatively unknown in many groundwater bodies. At the lysimeter station Wagna (Leibnitzer Feld, Styria, Austria) a dense depth-profile (n=24) over the transition unsaturated and saturated zone was sampled 6 month after an unusual wet summer. On all samples oxygen and hydrogen isotopes as well as major ions were analysed. Tritium was measured at the top and the bottom of the saturated zone. The heavier isotopes and the smaller ion-concentration in the water of the unsaturated zone approach the surface of the saturated zone with a gradient. This gradient continues in a steep form over the depth of the saturated zone. The tritium content on top of the saturated zone is significantly higher than at the bottom of the zone (11 and 8 TU). All the major ions are less concentrated in the unsaturated zone with the exception of nitrate. The summer precipitation seem to have arrived quicker than normal at the saturated zone in the depth from 2.3 m and mix with the thin aquifer of 2.x meter. Isotope data of 20 monitoring sites in the groundwater body around the lysimeter allow to unravel the timing and the equal importance of the summer precipitation for the groundwater recharge in unconfined aquifers in humid climates.



S08.01-P -15

LANDSCAPE EVOLUTION AND SOIL HYDROLOGICAL CHANGES AT THE MILLENNIUM SCALE: A CASE STUDY FROM THE CAMPINE AREA, NORTHERN BELGIUM

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Hydrological properties of sediments and soils as they can be measured today may differ according to their environmental context during development. Linking soil profile development with hydrological changes of particular soil horizons over time scales of several hundreds to thousands of years is a typical example of emerging hydropedological research and is the subject of the current study. For this purpose, a dry podzol profile buried under younger drift sands was investigated. The principal results suggest that during the last 10000 years, geomorphological and pedological processes have induced changes in saturated hydraulic conductivity values (Ksat) across the podzol profile resulting in present-day differences of up to four orders of magnitude. The highest values (Ksat ~ 10⁻³ m/s) are found in ~ 200 year old drift sand deposits without soil formation, while low values are typical for the illuviation horizon (Bh) of podzol soils that developed in Weichselian cover sands (Ksat ~ 10⁻⁷ m/s). Detailed investigations show that landscape stabilisation and podzolisation in such sandy substrates under pine and/or heather may lower Ksat-values by an order of magnitude in less than 100 years while higher order changes may take several 1000 years. It is concluded that soil hydrological properties display large spatial variability even within the same soil profile; this variation was shown to have a strong correlation with the development stage and thus age of the soil horizon. The established relationships may help explain past hydrological changes and improve predictions of future hydrological changes of soils in the Campine area.



S08.01-P -16

MAPPING SOIL WATER REGIME AT FARM SCALE: COULD FARMERS HELP SCIENTISTS?

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Water regime of soil corresponds to the time variation of soil water status. It is an integrative parameter combining hydrological processes at the landscape scale and local factors like soil characteristics or hydraulic managements. Mapping such a complex parameter at the farm scale may be relevant to model some processes related to farming systems, which occurred in the context of global change studies. If hydrological models may give predictions on soil water regime at the watershed scale, it is difficult to apply them at the farm scale. Parcels of the farm are often spatially disconnected, and distance between them may be high. In the context of semi-mountain, parcels of one farm may be spread along an altitudinal gradient, combined with a gradient of precipitations, and over several geological substrates. Hypothesis of the present work was that farmers have empiric knowledge of the water regime of their soils for few contrasting hydrologic years. Thus, they may help scientists to map such integrative parameter. A qualitative and relative method is exposed, based on farmer interviews. Validation was done by the way of soil prospection and laboratory analyses. Soil water regime is decomposed by the way of two variables: hydric trend and drying kinetic. Four farmers were interviewed. Data about soil and natural environment were surveyed over a subset of 51 fields. Results show that hydric trend may be related to pedologic criterion (type of soil, texture, available water) and to rainfall and topographic localisation.



S08.01-P -17

MICROMORPHOLOGICAL MEASUREMENT OF CORRELATION AND TORTUOSITY FACTORS IN UNSATURATED HYDRAULIC CONDUCTIVITY.

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Many models (e.g. Burdine, Mualem) predict unsaturated hydraulic conductivity applying water flow laws on parallel - or series-parallel - bundle capillary tubes described by the pore-size distribution (PoSD). The latter is generally inferred by applying capillarity law on the water retention curve. A critical point of these models is the estimation of the tortuosity and connectivity correction factors expressed as exponent of the effective saturation S_e . They are jointly fixed to an empirical fitted or to a literature-derived value. In this paper we use direct micromorphological measurements to estimate separately the tortuosity and the partial correlation correction factors in the Mualem model of unsaturated hydraulic conductivity. Then, a re-evaluation of its original physical meaning will be provided. On the same 4 soil samples used for deducing water retention and hydraulic conductivity (applying the Wind's method), pore geometry measurements were performed by coupling high resolution X ray microtomography (SKYSCAN 1172) and 3D image analysis procedures. The "pore-granulometry" algorithm from mathematical morphology and the pore-throat analysis based on the medial-axis transform were applied leading to the direct measure of PoSD, tortuosity and connectivity factors. The tortuosity factor was calculated as the ratio of the effective length of flow to the apparent length in the main direction of flow. The correlation factor has been expressed, for each pore-class, by the range of the experimental variogram. Results show as the negative values of the correlation factor lead to increase the hydraulic conductivity calculated assuming pores independence while the opposite stand for the tortuosity factor.



S08.01-P -18

POTENTIAL IMPACT OF PODZOLISATION ON LONG TERM GROUNDWATER RECHARGE

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The Belgian Agency for Radioactive Waste and Enriched Fissile Materials (ONDRAF/NIRAS) aims to develop a surface disposal facility for L/ILW in Dessel (North-East of Belgium). The objective of this study is to estimate the possible impact of soil podzolisation on long term (next few millenia) groundwater recharge in the vicinity of the Dessel site. Simulations are performed with Hydrus-1D using time series of daily measured precipitation and calculated evapotranspiration for current climate conditions. Calculated soil hydraulic properties for two typical podzols are combined with vegetation data representative for the dominant land uses of the study area. The hydraulic barrier of the two podzols is the Bh horizon with a Ksat of $\sim 5 \times 10^{-6}$ m/s. Results show that the average groundwater recharge is affected ($\sim 25\%$) if the Ksat of the Bh horizon is decreased by three orders of magnitude ($\sim 5 \times 10^{-9}$ m/s), an outcome that can be related to the average precipitation of the Dessel site, about 900 mm/y or $\sim 3 \times 10^{-8}$ m/s. Recent landscape and soil evolution studies in the vicinity of the site have shown that cemented podzols may develop in several thousands of years with Ksat values as low as $\sim 1 \times 10^{-7}$ m/s, which is almost three orders of magnitudes lower than the parent material. This study thus shows that under certain circumstances the development of a hydraulic barrier in the Bh horizon resulting from soil podzolisation can have a strong impact on long term groundwater recharge and should be considered together with other long term changes (climate, land use, vegetation).



S08.01-P -19

RELATIONSHIP BETWEEN SPATIAL RESOLUTION AND ACCURACY OF PREDICTIVE MAPS ON STREAM FLOW COMPARING AGGREGATED POLYGON AND RASTER CONTINUOUS MAPS DERIVED FROM TERRAIN ATTRIBUTES

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GlobalSoilMap.net Project objective is to create raster soil property maps at 90m resolution for texture, organic carbon, pH, etc. The goal of this research is to explore relationships between pixel resolution and accuracy of predictive soil property maps and their influence on stream flow predictions. Raster property maps were created from gridding polygon maps and raster continuous maps from Terrain Attribute Soil Mapping. Approximately 127 geo-referenced points were used to validate the predictive soil depth maps by two methods. The mean difference between measured and predicted depths to lithic/paralithic for TASM was only 26 cm and significantly lower (p -values <0.0001) compared to SSURGO with 57 cm. Similar results were found for the 10m pixel resolution, while 30 and especially 90m pixel resolution generated less accurate predictions. TASM was found to be a better predictor of soil properties than SSURGO at all resolutions. The Distributed Hydrology Soil Vegetation Model (DHSVM) predicted streamflow without calibration demonstrating the benefits of using the correct soil input information. TASM predicted continuous soil depth maps provided a better performance for the DHSVM predicted streamflow compared to SSURGO soil maps, especially for 90 m pixel resolution.



S08.01-P -20

SOIL CONTROL ON THE SPATIAL VARIABILITY OF DOC CONCENTRATION IN HEADWATER CATCHMENTS

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A large spatial variability of mean annual Dissolved Organic Carbon concentration ([DOC]) is observed in headwater catchments, even under similar substrate, climate and landuses. The origin of this variability is still unknown, although high [DOC] alters quality of natural waters. A survey of this spatial variability in Western France showed a positive correlation between mean annual and base-flow [DOC], suggesting a possible control of the thickness of the soil organo-mineral horizons (i.e. higher thicknesses in catchment having high mean annual [DOC]). To test this hypothesis, a simple DOC model based on TopModel was applied in two contrasted catchments in Western France: Kervidy-Naizin (low mean annual, low baseflow [DOC], gentle slopes, low rainfall) and Yar (high mean annual, high baseflow [DOC], steep slopes, high rainfall). Climatic and hydrologic data (1995- 2008) were used as input data, and daily [DOC] was used as reference data to assess model results. Much higher soil [DOC] and organo-mineral soil horizon thicknesses must be input in the Yar catchment as compared to Kervidy-Naizin, to allow modeled and measured stream [DOC] to fit each other satisfactorily. The transposition of the modeled soil profile of Yar to the Kervidy-Naizin case without changes in topography and rainfall resulted in simulated stream [DOC] for Kervidy-Naizin similar to modeled Yar values. These results suggest that a spatial variation in the thickness of organo-mineral soil horizons must exist in Western France headwater catchments and that this variation is very likely the cause of the spatial variability of mean annual [DOC].



S08.01-P -21

SPATIAL AND TEMPORAL PATTERNS REGARDING WATER STORAGE CAPACITY IN SOILS AROUND MOUNT KILIMANJARO

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Soils of tropical mountain ecosystems provide important ecosystem services like water and carbon storage, water filtration and erosion control. As these ecosystems are threatened by global warming and the conversion of natural to human-modified landscapes, it is important to understand the implications of these changes. Within the DFG Research Unit "Kilimanjaro ecosystems under global change: Linking biodiversity, biotic interactions and biogeochemical ecosystem processes", we study the ecosystem water use and water fluxes in soils at Mt. Kilimanjaro. In order to quantify the changes in water budgets, we are identifying the water storage availability of soils for different land use systems. In the savannah zone at the foot of Mt. Kilimanjaro, maize fields are compared to natural savannah ecosystems. In the lower montane forest zone, coffee plantations, traditional home gardens, grasslands and natural forests are studied. We will provide a basic characterization of soils with respect to soil hydrology. Small scale physical heterogeneity within soil profiles is determined via Vis/Nir-Spectroscopy to detect typical flow patterns and preferential pathways in soils. Spatial variability of soil texture and bulk density are determined at different scales. Hydraulic conductivity characteristics and water retention curve are then determined via pedotransfer functions. Furthermore time dependent changes in water content and soil matric potentials are monitored continuously. Spatial variability of soil properties and thus the water storage availability differ within these ecosystems and are influenced mainly by the land use system.



S08.01-P -22

THE NEW INTRASOIL PULSE DISCRETE CONCEPT OF IRRIGATION

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System defect of a hydrological mode of biosphere in general and, in particular, of the operating imitating gravitational frontal concept of irrigation, consists in the frontal continuous scheme of water inflow into the soil, not corresponding to ideal scheme of water dissipation in disperse system of soil. Under this concept it is impossible to overcome a phenomenon of basic hydrophysical characteristic of soil. The method of intrasoil pulse discrete watering of plants is proposed. The method includes water delivery on an irrigation site and its distribution, provides water delivery inside the ground by means of injector element in consecutive step-by-step pulse injection under pressure in discrete portions immersing the bottom end of an injector element into ground on depth of 0,05-0,15 m step-by-step along a direction of movement of the chassis through 0,1-0,15 m. At the way of watering proposed there is no more necessity to protect the landscape from irrigation. An amount of water consumption for irrigation is 4-5 times less than in conditions of standard way. Fresh water preservation as a global problem under the climate change threats is provided. The major advantage of the intrasoil pulse discrete concept of irrigation offered is avoiding of landscape unguided effect of irrigation and basic exception of drainage. It permits to reduce sharply the cost, stability and productivity of irrigation.



S08.01-P -23

TOWARD INCLUDING MULTI-SCALE SOIL PROPERTIES THAT INFLUENCE HYDROLOGY MODELING

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Soil-water processes that affect water infiltration, redistribution, and runoff over a landscape are determined by soil and surface properties that occur at different spatial scales. For example, at the millimeter scale, macro- and meso- pores influence infiltration, while local, meter-scale topography influences surface runoff. Moreover, high-clay soils that shrink and crack upon drying, exemplify the effect of scale on hydrology modeling because of temporally variable surface cracking and microtopography features. Our overall objective is to propose a method of accounting for the effect of spatial and temporal soil variability on watershed-scale hydrology by using landscape survey sensors, soil morphology, and a grid-based hydrology model. We are adapting the Precision Agricultural-Landscape Modeling System (PALMS) to meet the need for a model that can accurately predict water flow where macropores, mesopores and microtopography features are key factors in hydrology modeling. PALMS is well designed to include these phenomena that are important to modeling retention of storm water. PALMS contains two modules that are essential for simulation of surface hydrology on cracking soils. First, PALMS has a module that addresses separation of mesopore and matrix infiltration. This module can be modified to simulating cracking and infiltration. Second, PALMS has a kinematic wave module for simulation of water runoff and ponding of water in closed depressions. PALMS is tested on a small watershed containing circular gilgai where soil water and runoff measurements can be compared to simulation results.



S08.01-P -24

**VARIABILITY OF SOIL PROPERTIES AND SOIL WATER CONTENT IN VINEYARD PLOTS
AFFECTED BY LAND LEVELLING: AN OPPORTUNITY FOR PRECISION VITICULTURE**

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The variability observed within a levelled plot in a rainfed mechanised vineyard of the DO Penedès (Spain) and its effects on soil water and grape yield were analysed. A soil survey was carried out at three areas of the plot (15 points in each area in a regular pattern of 10 x 10 m), and analysed for texture, organic matter, water retention capacity at different potentials, soil depth and bulk density. Soil moisture was analysed at each area from 10 to 90 cm every 20 cm, using TDF probes during 18 months. Soil water available for crop development as well as wine grape yield were analysed at each position. The results show that land levelling created heterogeneity of soil properties in different parts of the plot. Soil water content was lower in the upper part of the slope, with shallow soils, with greater variability within the profile. However, in the middle and in the lower part of the slope, soil moisture was greater as well as the water retention capacity, with higher uniformity within the profile. Precisely, the lower part of the slope was the most affected by land levelling, with outcrop of unconsolidated non-saline marls. Nevertheless, despite the fact that the steady infiltration rate is lower, these soils provide the best conditions for available water retention capacity for crop development, as it is demonstrated by the yield. In this respect, the different soil conditions created after levelling justify the opportunity of differential management under a precision viticulture approach.



S08.01-P -25

WATER USE EFFICIENCY OF RED CABBAGE, BROCCOLI, AND HEAD LETTUCE AS AFFECTED BY GROUND WATER TABLE

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Lysimeters controlled with 3 depths of ground water table(GWT); 25, 50, and 75cm were as made by PVCpipe with 30cm diameter to investigate crop biomass, water use efficiency, and soil moisture changes of cabbage, broccoli, and lettuce. All the lysimeters randomized with five replication were filled up with soils and were adjusted to the constant bulk density. Seedlings of cabbage, broccoli, and lettuce were planted on May 6 and harvested on June 27, 2011. Evaporation from lysimeters without crop and evapotranspiration from lysimeters with crop were measured everyday by amount of water consumption in water supplying bottle. So transpiration was calculated by difference between evapotranspiration and evaporation. Dry weight of above ground part was the highest in the 50cm GWT for red cabbage and in the 25cm GWT for both crop, broccoli and head lettuce. Evapotranspiration of red cabbage and head lettuce was the highest in the 25 cm GWT while no difference affected by the GWT in broccoli. Evaporation from lysimeter without crop increased as decrease GWT. Evapotranspiration ratio which is evapotranspiration that need for produce 1g of dry weight of above ground part was the lowest at 75cm GWT for all the crops showing the best water use efficiency. Compared crops the evapotranspiration ratio of broccoli was the highest suggesting this crop compared with red cabbage and head lettuce has the lowest water use efficiency. GWT for maximum amount of evapotranspiration were estimated by 31.2cm, 52.4cm, and 55.8cm for red cabbage, broccoli, and head lettuce, respectively.



S08.02-P - SOIL AND WATER INTERACTIONS AS ONE OF MAJOR DRIVING FORCES IN ENVIRONMENT

Wednesday 04 July 2012 from 17:00 to 18:30. Room Poster Areas

S08.02-P -1

A NEW APPROACH FOR GROUNDWATER STUDIES IN ARID REGIONS USING AN ELECTROMAGNETIC-BASED METHOD AND APPARATUS

Seyed Mehdi Emadi, Sari - Iran, Islamic Republic of

S08.02-P -2

ASSESSMENT OF THE SIMPLIFIED FALLING HEAD TECHNIQUE TO MEASURE THE FIELD SATURATED SOIL HYDRAULIC CONDUCTIVITY

Vincenzo Bagarello, Palermo - Italy

S08.02-P -3

CHANGES IN SOIL WATER INFILTRATION PARAMETERS AFTER FIRE IN SEMI STEPPE RANGELANDS USING MULTI VARIATION ANALYSIS

Jalal Heidary, Shahrekord - Iran, Islamic Republic of

S08.02-P -4

EFFECT OF SOIL SOLUTION SALINITY ON WATER RETENTION OF SELECTED SUPERABSORBENTS IN THE PROCESS OF WATER DESORPTION.

Jaroslawn Kaszubkiewicz, Wroclaw - Poland

S08.02-P -5

ELECTRICAL IMPEDANCE SPECTROSCOPY (EIS) METHOD TO DETERMINE WATER CONTENT AND PHISICAL PROPERTIES IN THE ROCKS

Rita Masciale, Bari - Italy

S08.02-P -6

EVALUATION OF SOIL PARAMETERS EFFECTS ON THE YIELD CROP UNDER DROUGHT CONDITION

Najmeh Khalili, Mashhad - Iran, Islamic Republic of



S08.02-P -7

EXPERIMENTAL STUDY OF SPATIAL VARIABILITY OF STRUCTURAL UNITS IN A SMALL CATCHMENT IN THE NEGEV HIGHLANDS, ISRAEL

Nikolaus J. Kuhn, Basel - Switzerland

S08.02-P -8

INFILTRATION RATES AS AFFECTED BY SOIL TEXTURE, PLANT COMMUNITY COMPOSITION AND EARTHWORMS IN A GRASSLAND PLANT DIVERSITY EXPERIMENT

Christine Fischer, Jena - Germany

S08.02-P -9

INFLUENCE OF BIOLOGICAL SOIL CRUSTS ON SOIL WATER BALANCE COMPONENTS

Yolanda Canton, Almeria - Spain

S08.02-P -10

IRRIGATION IMPACTS ON SOIL TRACE ELEMENTS – THE CASE STUDY OF CAIA IRRIGATION PERIMETER, PORTUGAL.

José Manuel Rato Nunes, Lisboa - Portugal

S08.02-P -11

MERGING MEASUREMENTS OF RECHARGE AND EVAPOTRANSPIRATION IN A SOIL WATER BALANCE MODEL

Vicente Vásquez, Tjele - Denmark

S08.02-P -12

OPTIMISING SOIL DESIGN TO MAXIMISE THE REHABILITATION SUCCESS AT POST-MINING LANDSCAPES

Thomas Baumgartl, Brisbane - Australia

S08.02-P -13

RANDOMISED MOVING PLOTS TO EVALUATE SIMULATED SPATIO-TEMPORAL DYNAMICS SOIL MOISTURE

Yvonne Morgenstern, Freiburg - Germany

S08.02-P -14

SHRINKAGE CAPACITY AS AFFECTED BY SOIL PERTURBATION IN ANDOSOLS AND ANDIC SOILS

Jose M. Hernandez-Moreno, La Laguna - Spain



S08.02-P -15

**SOIL MOISTURE REGIME OF UPLAND SOILS: RELATIONSHIP WITH ZERO TENSION
LYSIMETERS**

Nikki Baggaley, Aberdeen - United Kingdom

S08.02-P -16

**SOIL WATER CONTENT DYNAMICS IN THE TOPSOILS UNDER DIFFERENT WAY OF
TREATMENT**

Maxim Poltoradnev, Moscow - Russian Federation

S08.02-P -17

**SPATIAL AND TEMPORAL VARIABILITY OF SOIL MOISTURE IN AGRICULTURALLY USED
TOPSOILS WITH CONSTANT CROP ROTATION AND DIFFERENT TILLAGE INTENSITY IN
TWO SOIL MOISTURE NETWORKS OF PAK346**

Maxim Poltoradnev, Stuttgart - Germany

S08.02-P -18

**SPATIAL VARIABILITY OF DRIED SOIL LAYERS AND RELATED FACTORS AT A REGIONAL
SCALE**

Yunqiang Wang, Beijing - China

S08.02-P -19

THE MAP OF NATURAL WATER HOLDING CAPACITY OF EUROPEAN SOILS

Beata Houskova, Bratislava - Slovakia

S08.02-P -20

**USING FLUORESCENCE MATRICES TO DETERMINE THE IMPACT OF RISING SOIL
TEMPERATURES ON CARBON COMPOSITION IN DRAINAGE WATER INFLUENCING
SHALLOW LAKE ECOSYSTEMS.**

Nils Meyer, Berlin - Germany

S08.02-P -21

**WATER INFILTRATION AND DISCHARGE DURING SNOWMELT PERIODS FOR A SMALL
CATCHMENT IN NORWAY**

Jannes Stolte, Ås - Norway



S08.02-P -1

A NEW APPROACH FOR GROUNDWATER STUDIES IN ARID REGIONS USING AN ELECTROMAGNETIC-BASED METHOD AND APPARATUS

Emadi Seyed Mehdi^[1], Nikravesh Fatemeh^[2], Emadi Seyed Mostafa^[3]

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Precise identification of groundwater reservoirs and characteristics in landscapes especially in arid regions will provide a good opportunity for decision makers to implement the site-specific land use management for sustainable agricultural production as well as de-desertification. Therefore, an electromagnetic-based method and apparatus is objectively patented to conduct the groundwater quantitative and qualitative studies in aquifers of alluvial, karstic and coastal areas. At this technique, there isn't any need to send harmfully electromagnetic waves and to utilize the large equipments. Based on very low frequency radio electromagnetic-waves received by the apparatus, there aren't any restrictions presented previously in other groundwater exploration methods such as differences in weather condition, topography and geography. Being portable and applicable in high speed and accuracy made this apparatus advisable and unique. In brief, the following parameters and functions would be determined accurately without any necessary drilled observation wells at approximately two working hours: •Measuring the depth to the free groundwater level from earth surface at any requested point •Locating the best drilling point for shallow and deep wells in lowest groundwater level from the earth surface and highest groundwater reservoirs •Measuring the saturation thickness of groundwater •Specifying the groundwater breakaway of dam foundations •Measuring the contaminated route and salinity changes of groundwater •Separating the fresh and sea water delimitations without any drilled observation wells This method was performed at high level of reliability in more than 500 calibrating sites and also accomplished more than 100 groundwater studies since 2004.



S08.02-P -2

ASSESSMENT OF THE SIMPLIFIED FALLING HEAD TECHNIQUE TO MEASURE THE FIELD SATURATED SOIL HYDRAULIC CONDUCTIVITY

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The Simplified Falling Head (SFH) technique to measure field saturated soil hydraulic conductivity, K_{fs} , has received little testing or comparison with other techniques. Different experiments were carried out to i) determine the effect of ring size on the measured conductivity; ii) compare the SFH and Pressure Infiltrometer (PI) techniques in a clay loam soil; and iii) assess the indirect approach to estimate the α^ parameter used in the SFH methodology. Sampling a relatively large number of sites allowed to detect a statistically significant relationship between the K_{fs} values obtained with rings differing in diameter (0.15 and 0.30 m, respectively). This relationship suggested that a measurement carried out with a small ring contains enough information to make an approximate prediction of the K_{fs} value that would be obtained at the same site with a larger ring. The SFH and PI techniques yielded similar means but substantially different coefficients of variation (much higher for the SFH technique). The two methods should be considered complementary, being usable to determine K_{fs} at the beginning (SFH) and at a later stage (PI) of a ponding infiltration process. Using α^* values directly measured by the tension infiltrometer or indirectly estimated on the basis of a general description of soil characteristics did not modify significantly the K_{fs} predictions obtained with the SFH technique. In conclusion, this investigation gave support to the use of the SFH technique for a rapid and reasonably simple determination of, at least, the order of magnitude of K_{fs} .*



S08.02-P -3

CHANGES IN SOIL WATER INFILTRATION PARAMETERS AFTER FIRE IN SEMI STEPPE RANGELANDS USING MULTI VARIATION ANALYSIS

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Soil water infiltration control processes such as available water plants, leaching, runoff and erosion. Estimating the effect of fire on soil water infiltration is essential for modeling hydrological processes. This study aimed to investigate the impact of fire on soil water infiltration parameters in semi steppe rangelands in Chaharmahal va Bakhtiari province, Iran. For this purpose, several sites with different fire history, 2007, 2008 and 2009, were chosen. Then, soil water infiltration parameters including saturated hydraulic conductivity (K_f), Macroscopic capillary length (a^*) and sorptivity (S), was measured in each site within burned and adjacent control areas with 5 replicates using tension infiltrometer. A principal component analysis (PCA) was performed to investigate the effect of fire on soil water infiltration parameters. The correlatin coefficients between soil water infiltration parameters and the axes for PCA suggest that the first axis is strongly influenced with the K_f ($r = -0.66$). The second axis was negatively correlated with the a^* ($r = -0.75$). The results showed that K_f was significantly lower in burned areas compared to adjacent control areas for all sites with different fire history. The a^* significantly decreased only in burned areas in 2008. Furthermore, in burned areas in 2007, the S was significantly decreased. The results indicate that the decline in basic soil water infiltration is likely caused by creation of two layers of hydrophobicity material and ash, which results in the blockages of macropores at the soil surface. Key words: Fire, Tension infiltrometer, Saturated hydraulic conductivity, Sorptivity, Hydrophobicity.



S08.02-P -4

EFFECT OF SOIL SOLUTION SALINITY ON WATER RETENTION OF SELECTED SUPERABSORBENTS IN THE PROCESS OF WATER DESORPTION.

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Superabsorbents (SAPs) are called loosely cross-linked polymers, insoluble in water, which are characterized by their ability to absorb a large amounts of water. Due to theirs properties they are used in many industries: manufacturing hygiene materials, medicine, agriculture (including cultivation without soil), prevention against the erosion and reclamation of degraded land. The aim of this study was to determine the effect of soil solution salinity on the ability of water desorption by SAPs. For this purpose were made the measurements of soil retention curve for distilled water and the solution obtained from the mollic horizon (0-30 cm) of Phaeozems. The soil used for solution extraction using underpressure 200-500mbar characterized by alkaline (pH 7,9), and salinity 347 mg/dm³. Experiment was performed at 9 superabsorbents. In terms of the chemical composition investigated superabsorbents belong to a group of ionic polymers (cross-linked potassium polyacrylate). Analyzed superabsorbents differ primarily granulation (from coarse to fine papules), and the structure after swelling (from a smooth mass to the structures of different forms and sizes). The experiment was conducted under laboratory conditions. Tests were performed using the Blocks: sand and sandy-kaolinit, and the Richards camera in the pF reference 0-3,7. In the pH range 0-2,85 water retention of superabsorbents considering distilled water is statistically significantly higher than to the soil solution. The difference is no longer statistically significant at the pF 2,85-3,9. Both statements apply to all superabsorbents. Keywords: superabsorbent, desorption, salinity



S08.02-P -5

ELECTRICAL IMPEDANCE SPECTROSCOPY (EIS) METHOD TO DETERMINE WATER CONTENT AND PHYSICAL PROPERTIES IN THE ROCKS

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Nowadays many methods and devices are available for measuring the water content in soils and unconsolidated rocks, while very few are the attempts to create new devices suitable for consolidated rocks. In this study, the Electrical Impedance Spectroscopy (EIS) method has been used to analyze the electrical properties of a consolidated sedimentary rock, known as calcarenite. The electrical impedance in complex form and its changes over time have been measured by means of Z-meter device. Both the resistance and the capacitive reactance have been independently analyzed with the aim to verify the suitability of the device for water content estimation in rocks and to investigate the electrical properties of calcarenite in relation to its structure, porosity and texture. Resistance and capacitive reactance have been investigated within a frequency range from 100Hz to 10000Hz, using KCl water solutions with different concentration characterized by different electrical conductivity (EC) values. The results show a good correlation between the resistance and the water content for different water solutions. The data confirm the independence of resistance on frequency and show a high sensitivity on the EC value of the solution used to saturate the samples. The experimental data are fitted by exponential curves, with the same shape for different EC values. The reactance data are not recorded for the entire range of water content investigated but they are recorded only at certain values of water content which depend not only on applied frequency but also on the EC values of solution used.



S08.02-P -6

EVALUATION OF SOIL PARAMETERS EFFECTS ON THE YIELD CROP UNDER DROUGHT CONDITION

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Drought is an important disaster which its harmful effects may intimidate the environment and the food security directly. Hence, the monitoring of the drought and the assessment of its effects on the crop is very important. Soil is one of the factors that determine the intensity of the drought effects on the plants. This is due to the fact that the drought has different effects on the soils with different characteristics and textures. In this research we have used the AquaCrop model for the assessment of the soil type on the intensity of the drought effects on the plants. The research is conducted in the "Rainfed Agriculture Research Centre" in Sisab which is located in Khorasan Shomali Province in Iran. For this research, we have used the thirty years data (1979-2009) related to the meteorological data, plant data and the soils data that have planted on it. Using this information, we have analyzed the impact of several factors on the yield under drought condition. These factors include the soil texture, the fertility of the soil, existence of mulch on the soil, the number of layers of the soil, the available water capacity, the saturated hydraulic conductivity, the curve number, and the existence of a restrictive soil layer in the soil. The results show AquaCrop model has acceptable performance in comparison with the actual yield.



S08.02-P -7

EXPERIMENTAL STUDY OF SPATIAL VARIABILITY OF STRUCTURAL UNITS IN A SMALL CATCHMENT IN THE NEGEV HIGHLANDS, ISRAEL

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Dryland vegetation is expected to respond sensitively to climate change and the projected variability of rainfall events. Rainfall as a water source is an obvious factor for the water supply of vegetation. However, the interaction of a patchy soil cover on rocky desert slopes is also vital for vegetation in drylands. In this study rock-soil interaction, in particular the relevance of a patchy soil cover for storing plant available water in the northern Negev, Israel, was examined. To determine the amount of rainfall required to fill the available soil pore space sprinkling experiments were conducted. The design of the rainfall-simulator and the selection of the plots aimed specifically at observing infiltration into small soil patches on a micro-scale relevant for the prevalent vegetation cover. The results of the study indicate that the relationship between soil volume and frequency of rainfall events determines the effect of climate change on vegetation cover. The results also illustrate how the qualitative understanding of hillslope eco-hydrology in a rocky desert environment can be expanded by rainfall simulation to assess impact of climate change in a quantitative way.



S08.02-P -8

INFILTRATION RATES AS AFFECTED BY SOIL TEXTURE, PLANT COMMUNITY COMPOSITION AND EARTHWORMS IN A GRASSLAND PLANT DIVERSITY EXPERIMENT

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This study investigates field measurements of infiltration rates in a managed grassland plant diversity experiment. We analyzed the influences of plant community properties, soil texture and earthworms on infiltration rates on a Eutric Fluvisol, covering a gradient in soil characteristics from sandy loam to silty clay. Between June and October 2011 we measured infiltration using a hood infiltrometer on plots with ambient earthworm density and reduced earthworm density (earthworm extraction) and in different plant communities. Significant earthworm effects were only found in plots with finer texture (silt loam, silt clay). In silty soil, earthworm presence increased the infiltration rate significantly (by a factor of 2), but only in spring and independently of plant species richness. Also, the effects weakened with increasing time after earthworm extraction, indicating re-colonization of earthworm reduction subplots. Earthworm effects were weaker in autumn (only a trend was observed). Plant diversity had no effect on infiltration rates. However, presence of certain plant functional groups increasingly influenced infiltration rates during the growing season. In fall, infiltration was significantly higher in plots containing legumes than in plots without, and it was significantly lower in the presence of grasses than in their absence.



S08.02-P -9

INFLUENCE OF BIOLOGICAL SOIL CRUSTS ON SOIL WATER BALANCE COMPONENTS

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The interplant spaces of arid and semiarid ecosystems are very often covered by biological soil crusts (BSCs), which are a community of microorganisms living in the soil surface. BSCs regulate the horizontal and vertical fluxes of water, carbon, and nutrients into and from the soil playing crucial hydrological, geomorphological and ecological roles. We analyse the influence of BSCs on the different components of the water balance in representative semiarid ecosystems of SE Spain. The influence of BSCs on runoff-infiltration and erosion was studied at different spatial scales by rainfall simulations and under natural rainfall, on BSCs in different stages of their development. Results show different responses depending on soil and rainfall properties but, in general, the greater the development of the BSCs, the greater the infiltration rate and the lower the sediment yield. The analysis of the lengths of the runoff flow path on BSCs crusts at hillslope scale show modifications of the hydrological connectivity linked to the crust cover and roughness. Soil moisture monitoring at two depths revealed that soils with better developed BSCs had greater soil moisture than those with less developed ones, under high moisture conditions, but the more developed crusts also lost water faster. The evaporative losses of BSCs measured by microlysimeters revealed small differences in evaporation among crust types caused by differences in the properties of the soil underneath the BSC, rather than by the crust itself. The results of this paper show the important roles of BSCs modulating the water cycle in drylands.



S08.02-P -10

IRRIGATION IMPACTS ON SOIL TRACE ELEMENTS – THE CASE STUDY OF CAIA IRRIGATION PERIMETER, PORTUGAL.

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The growing need for food production improvements will lead, in next years, to an enormous increase of the irrigated area around the world as well as in Portugal. Therefore it is very important to perform additional studies regarding irrigation impact on the soil chemical characteristics. For this purpose a study in Caia Irrigation Area was developed with the objective of quantifying the change in soil trace elements (iron, aluminium, cadmium, chromium, copper, zinc, manganese, plumb, and nickel) content caused by continuous irrigation. To achieve this objective 14280 topsoil samples were collected and referenced geographically (Universal Transverse Mercator (UTM) coordinates), and then, using Geographic Information Systems (GIS), the obtained information layers were superimpose: results (obtained from topsoil samples analysis regarding trace elements content, soil type (Fluvisols, Luvisols, Calcisols, Cambisols, Vertisols and Regosols) and used agricultural system (rain-fed or irrigation). Regarding the irrigated soils, the study area was divided in three classes, according to the irrigation antiquity (< 15 years, between 15 and 25 years and > 25 years). From the obtained results it is possible to conclude that the irrigation does not affect significantly soil's heavy metals content. Nevertheless, the performed statistical analysis highlighted the fact that there is a tendency for iron, aluminium, zinc, manganese and plumb, to initially increase concentration, during the first fifteen years of irrigation, values that tend to decrease after that period along the time soils will continue to be under irrigation.



S08.02-P -11

MERGING MEASUREMENTS OF RECHARGE AND EVAPOTRANSPIRATION IN A SOIL WATER BALANCE MODEL

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Measurements of precipitation (P), recharge (R), storage (S), and evapotranspiration (ET) may not satisfy the water balance (WB) requirement because they may represent different observation scales. The agreement between independent measurements of P, R, S, and ET was investigated with a WB approach. Recharge in an agricultural field was measured directly with four 12.5 m² repacked closed bottom lysimeters placed below the ploughing layer at a depth of 60-210 cm. Lysimeter discharge was measured every 15 minutes with tipping bucket counters. An automated hourly value of S in each lysimeter was measured with nine 100 cm long vertical TDR probes installed from 60 to 160 cm depth. ET was derived from eddy covariance measurements from a flux mast. The mass balance of cumulative P, ET, R, and S for the 2010 growing season did not close well. The reason for the mass balance discrepancy was investigated using a 2D hydrological model. The study clarifies whether the mass balance error can be attributed to uneven irrigation input, non representative ET measurements, or the spatial variability of the flux measurements among lysimeter replicates.



S08.02-P -12

OPTIMISING SOIL DESIGN TO MAXIMISE THE REHABILITATION SUCCESS AT POST-MINING LANDSCAPES

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Ecosystem restoration at semiarid post-mining areas critically depends on the capability of the soil to store and release water. The soil water dynamic is controlled by soil characteristics such as soil texture, thickness, and soil hydrological properties of sequence of horizons, but also affected by plant community processes. Understanding this ecohydrological interplay and the role of physical soil design is crucial for rehabilitating and managing ecosystems in semi-arid areas. However, uncertainties exist in both the predictability of future rainfall events and the mathematical description of plant communities for ecological models. This study investigates how those uncertainties impact decision-making by using an approach for identifying the optimal soil design that maximises the rehabilitation success of native plant communities in Central Queensland, Australia. Simulation results emphasise that the optimal soil design facilitates the robustness of ecosystems in the face of the uncertainties in plant community parameterisation and future rainfall regime. Therefore, soil restoration strategies should carefully reflect on the soil characteristics when rehabilitating water-controlled ecosystems.



S08.02-P -13

**RANDOMISED MOVING PLOTS TO EVALUATE SIMULATED SPATIO-TEMPORAL DYNAMICS
SOIL MOISTURE**

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Models for the simulation of the soil water dynamics almost always need data for a model calibration. However, soil moisture data are usually not available in the time and space resolution desired for a thorough model calibration. We used the measuring concept of “Randomised Moving Plots” (RMP) to observe the spatial and temporal variability of soil moisture in four forested areas. Soil moisture was measured in each of these areas simultaneously at 31 positions over a period of 14 days. Measuring positions were changed randomly every 14 days. From 2008 to 2010, we observed a total of 2356 14day-time series of soil moisture. For each measuring position, various site parameters (e.g. morphology, soils, vegetation) were described. Site parameters which significantly influence the spatial patterns of the soil moisture were included in a regression model which describes the spatial variability of soil moisture. One continuously measuring soil moisture probe in each investigated area was used to relate the spatial variability observed in the 14day-time series to the overall temporal dynamics of soil moisture. With this, we obtained a continuous statistical time-space model of the soil moisture in our investigated areas. Finally, we used this statistical model for the evaluation of a physically based soil water transport model. Although the RMP concept is rather labour-intensive we found it very beneficial for the characterization of both spatial and temporal soil moisture dynamics, which may also serve for developing transfer models for unobserved areas.



S08.02-P -14

SHRINKAGE CAPACITY AS AFFECTED BY SOIL PERTURBATION IN ANDOSOLS AND ANDIC SOILS

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The literature on shrinking-swelling (S-W) capacity of Andosols is contradictory; they are sometimes described as rigid soils while other authors report very large S-W capacity, albeit peculiar. One main reason for these incongruent results appears to be related to the experimental approaches used, especially on the disturbance of the soil samples. Besides, important Andosol components such as allophane, organic matter and halloysite can show different shrinking behaviour. In this work, shrinkage curves of Andosols and andic, halloysitic soils from the Canary Islands were studied in non-disturbed (aggregates) and disturbed (saturated paste) samples. Aggregates showed a large range of structural shrinkage and were relatively insensible to drying, less than 10% volume loss from saturation to 1500 kPa, whereas in andic soils this amount was about 20%. Upon remoulding, the soil shrinking capacity increased significantly, especially in Andosols which showed an initial apparent “normal” shrinkage, followed by a structural shrinking phase. The intersection point between both stages had values greater than 0.8 cm³ g⁻¹. This point has been defined as a shrinkage limit (SL); however, further volume reductions occurred as the soils dried, which is inconsistent with the very definition of SL. After remoulding, the halloysitic, andic soils still showed a structural shrinkage phase, although much less important than in undisturbed samples. These soils presented normal and residual shrinkage phases, the latter in agreement with the soil mineralogy. S-W properties in this type of soils can thus be strongly affected by soil perturbation (cultivation ...), affecting soil porosity distribution and hydrological properties.



S08.02-P -15

SOIL MOISTURE REGIME OF UPLAND SOILS: RELATIONSHIP WITH ZERO TENSION LYSIMETERS

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The soil water regime of soils with contrasting drainage in an upland catchment in the Scottish Cairngorm mountains (450m to >908m altitude) was monitored using Delta-T theta probes for over 6 years as part of a study to assess the impact of N deposition on fragile habitats. The soils ranged from freely drained, weakly podzolised soils through organo-mineral podzols (Histic podzols) to peat soils greater than 1m thick (Histosols). The vegetation was primarily dwarf shrub dominated heathland with some re-colonising Scots pine at lower altitudes. At each site, soil solution leachate was intercepted by eight tensionless tray lysimeters from a surface (organic-rich) and a subsurface soil horizons and collected in sample bottles. The leachate bottles were emptied on a monthly to fortnightly basis and the volume of leachate recorded. Soil moisture and temperature were logged hourly in each of the horizons. Soil cores were taken to determine soil moisture retention characteristics and for horizon specific calibration of the theta probes. We use field and laboratory definitions of field capacity to infer when the soil solution is draining into the lysimeters (when soils are wetter than field capacity). The volume of this downward flux was validated against the volume of soil solution measured in the sample bottles. Uncertainties in the analyses include the significant snow fall (~30%) and freezing conditions experienced, the potential for solutes to bypass the lysimeter trays due to overlying stones or frost heave and establishing 'field capacity'.



S08.02-P -16

SOIL WATER CONTENT DYNAMICS IN THE TOPSOILS UNDER DIFFERENT WAY OF TREATMENT

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Soil moisture plays an important role in plant growth and yield formation. Moreover, it affects the partitioning of net radiation between latent, sensible and soil heat fluxes. Soil water content also controls the partitioning between evaporation and transpiration. Soil moisture is spatially variable due to heterogeneities in vegetation, soil, topography, rainfall distribution etc. Properties of the ground cover and quantity and type of canopy strongly influence the exchanges of energy and moisture between soil surface and the atmosphere. Plants transpire water from soil, intercept it during rainfall and either provide a surface or evaporate water directly to the atmosphere. The land surface plays a key role in convection and precipitation distribution. Land-atmosphere interactions treat cloud formation and rainfall distribution, thereby affecting the regional climate. There is a lack of studies concerning influences of different way of tillage or different plants growing on soil moisture spatial and temporal variability. The studies about soil moisture variability in urbanized soils are also rare. In the mean time 11% of the total land on our planet is used for agriculture and 10% more is used for settlements. The spatial and temporal variability of soil water content was studied in urbanized, agricultural and forest territory soils in Moscow region, Russian Federation. We will present first results and statistical analysis of the research conducted under the LAMP (Laboratory of Agroecological Monitoring and Ecosystem Projecting) project.



S08.02-P -17

SPATIAL AND TEMPORAL VARIABILITY OF SOIL MOISTURE IN AGRICULTURALLY USED TOPSOILS WITH CONSTANT CROP ROTATION AND DIFFERENT TILLAGE INTENSITY IN TWO SOIL MOISTURE NETWORKS OF PAK346

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Soil moisture plays a key role in land-atmosphere interactions and is the component of the land surface models. Soil moisture content is spatially variable due to number of factors such as rainfall variability, vegetation cover heterogeneity, variability in soils and topography, etc. One of the statistical extents of the spatial variability is the relationship between the average soil water content (SWC) and its standard deviation (SD) or its coefficient of variation (CV). A number of scientists studied this approach, however results are contradictive to each other and therefore further exploration is needed. During the field scale experiments it was found that the SD and CV behavior depends on many factors such as differences in hydraulic properties, water status of the topsoils, different soil texture composition and bulk density, different sensor position in the relief and vegetation cover (crops). However there is still lack of knowledge of influencing factors at the regional scale, where the atmospheric forces cannot be count as constant anymore. The present study was made in the frame of the Integrated German Research Foundation Project "Structure and functions of agricultural landscapes under climate change. Processes and projections on a regional scale" (PAK 346). We will present spatial and temporal SWC variability along one year monitoring period (2010-2011). The SD and CV behavior was studied and its relationship with topography and rainfall distribution in the Kraichgau and the Swabian Alb regional wireless soil moisture networks.



S08.02-P -18

SPATIAL VARIABILITY OF DRIED SOIL LAYERS AND RELATED FACTORS AT A REGIONAL SCALE

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The responses of a soil to drought conditions in water-limited systems are seldom known due to the lack of comparative data on soil water content (SWC) in the soil profile. A dried soil layer (DSL) formed in soil profile is a typical indication of soil drought caused by climate change and/or poor land management. We pre-selected 382 sampling sites across the Loess Plateau region, and investigated the spatial variations and controlling factors of DSL thickness (DSL_T) and the DSL depth of formation (DSL_{FD}) using classical statistics, residual maximum likelihood (REML), and geostatistical methods. A total of 17 906 soil samples from generally 5- or 6-m-depths were collected. There was strong spatial variation in DSLs, which had a mean thickness of 160 cm occurring at a mean soil depth of 270 cm. Semivariograms of DSL_T indicated a weak spatial dependence while DSL_{FD} was moderate. REML analysis demonstrated that land use, rainfall, soil type and slope gradient had a significant impact on DSL_T, while only land use, rainfall, and soil type for DSL_{FD}. Further, the impact of land use on DSLs varied among different climatic regions on the Plateau. In arid region, land use had no significant effect on DSLs but there were significant effects in semiarid and semihumid regions. Optimizing land use can mediate DSL formation and development in the semiarid and semihumid regions of the Plateau and in similar regions elsewhere. These results can also be useful to the modeling of the regional water cycle and related eco-hydrological processes.



S08.02-P -19

THE MAP OF NATURAL WATER HOLDING CAPACITY OF EUROPEAN SOILS

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The ability of soil to hold water in its profile belongs to one of the most important soil functions. It is expressed as water holding or water retention capacity and depends strongly on several soil properties, mainly on soil texture, soil type and the soil depth. The water retention in soils together with infiltration rate contribute to the soil resistance to runoff or stagnation of water on the soil surface after heavy rain and subsequently they also contribute to the resistance of the whole environment to flooding effects and thus to flood's prevention and control. An environment where the balance among its individual compartments is missing creates the conditions for the formation of major natural disasters. It is important to know the natural soil water retention capacity as one of the crucial environmental factors influencing the intensity of floods, even if the final result can differ significantly mainly because of human activities. It constitutes an important part of the environmental mosaic showing where the environment can be more vulnerable and more susceptible to floods and where floods can be eliminated to some extent by appropriate management of land use. The map of natural water holding capacity of European soils was created at scale 1:1 M using pedotransfer functions and rules, soil texture and depth. It can contribute to the determination of flood's vulnerable areas in Europe and gives information how much water can be kept in soils as soils are one of the important factors for sustainable water sources.



S08.02-P -20

USING FLUORESCENCE MATRICES TO DETERMINE THE IMPACT OF RISING SOIL TEMPERATURES ON CARBON COMPOSITION IN DRAINAGE WATER INFLUENCING SHALLOW LAKE ECOSYSTEMS.

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In shallow lake ecosystems allochthonous dissolved organic matter (DOM) from groundwater plays a major role in aquatic food webs. Feedbacks on the clear water state in such lakes are under current research in the TERRALAC project in NE Germany. The influx of DOM into a lake might be higher than the aboveground entry of particulate organic carbon (POC), but it could have less importance to the lacustrine food web, because of its higher proportion of refractory organic constituents. Rising soil temperatures and longer dry periods lead to increased degradation of solid soil organic matter (SOM) and thus to a release of DOM. Open questions are, if the temperature induced changes also alter bioavailability and composition of DOM in drainage water. We conducted soil-column experiments at different temperatures and with different irrigation regimes over several month and characterized the leachates by excitation-emission matrix fluorescence spectra. The data indicate a decrease in DOM composition of hydrophobic humic acids as well as in the hydrophilic acid fraction, making DOM in drainage water after a dry period less bioavailable to the aquatic food web. These new results give a first impression on the chemical composition and classification of the DOM entering our lake ecosystems and will give hints on its bioavailability in natural waters with implications on the water quality under changing temperature and rain regimes.



S08.02-P -21

WATER INFILTRATION AND DISCHARGE DURING SNOWMELT PERIODS FOR A SMALL CATCHMENT IN NORWAY

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Climate changes will increase the frequency of extreme precipitation events, floods and snow melt periods. The anticipated climate change effects in cold-climate regions suggest that the potential for an increase in extreme runoff events will exist disproportionately during periods of soil frost and snow cover. Several factors combine during cold periods, including reduced infiltration capacity due to frozen soils and increased water stored on the landscape in the form of snow. Research into appropriate snowpack and snowmelt modeling tools is integral to gaining an understanding of the hydrologic processes which occur within a catchment during cold seasons. Combining this snowmelt modeling with catchment scale infiltration and discharge modeling is done for the 2009, 2010 and 2011 melt period for a small catchment in Norway. For this, the Utah Energy Balance model is used for the snowmelt calculations. The LISEM model is used to calculate catchment discharge. Output of the UEB model is used in the LISEM model for surface discharge estimates and results are compared with measured discharge and infiltration for the melt periods. Good results were found for both timing and magnitude of peak discharge, were infiltration capacity is used for calibration purposes. The coupling of the UEB and LISEM models provides valuable insight into the hydrological processes and responses occurring during winter periods. However, more work is needed to improve our understanding and quantification of soil-water interactions during cold periods, which can cause great deviations from hydrologic processes observed during warmer periods.



S08.03-P - PEDOTRANSFER FUNCTIONS IN SOIL HYDROLOGY: STILL A MYTH, OR A PLEASANT REALITY? APPLICATIONS, VALIDATIONS, AND CASE STUDIES

Friday 06 July 2012 from 17:00 to 18:30. Room Poster Areas

S08.03-P -1

AN APPLICATION OF K-NEAREST CODE AS AN ALTERNATIVE TO CLASS PEDOTRANSFER FUNCTIONS FOR MAPS OF FIELD CAPACITY AND WILTING POINT

Svatopluk Matula, Prague - Czech Republic

S08.03-P -2

CONSISTENT PARAMETER CONSTRAINTS FOR SOIL HYDRAULIC FUNCTIONS

Andre Peters, Berlin - Germany

S08.03-P -3

ESTIMATION OF SATURATED HYDRAULIC CONDUCTIVITY AND INVERSE OF MACROSCOPIC CAPILLARY LENGTH PARAMETER USING PTFS

Ghorbani Dashtaki Shoja, Shahrekord - Iran, Islamic Republic of

S08.03-P -4

ESTIMATION OF SOIL MOISTURE USING RESISTIVITY METHODS

Erika Lueck, Potsdam - Germany

S08.03-P -5

ESTIMATION OF SOIL WATER RETENTION OF A STUDY AREA BASED ON DETAILED CATEGORICAL SOIL MAP INFORMATION

András Makó, Keszthely - Hungary

S08.03-P -6

EVAPORATION METHODS FOR DETERMINING SOIL HYDRAULIC PROPERTIES: A REINVESTIGATION OF LINEARIZATION ERRORS

Sascha C. Iden, Braunschweig - Germany

S08.03-P -7

LINKING PREFERENTIAL SOLUTE TRANSPORT TO SOIL PROPERTIES, SITE FACTORS AND EXPERIMENTAL CONDITION

John Koestel, Uppsala - Sweden



S08.03-P -8

MULTISTEP-OUTFLOW MEASUREMENTS FOR GENERATION AND VALIDATION OF PEDOTRANSFER FUNCTIONS

Heike Puhlmann, Freiburg - Germany

S08.03-P -9

PEDOTRANSFER FUNCTIONS FOR ESTIMATING ATTERBERG LIMITS IN SEMI-ARID AREA

Abbas Ahmadi, Tabriz - Iran, Islamic Republic of

S08.03-P -10

PEDOTRANSFER FUNCTIONS FOR ESTIMATING SOIL HYDRAULIC PROPERTIES. STATUS OF THE RESEARCH CARRIED OUT IN PORTUGAL

Tiago Ramos, Lisbon - Portugal

S08.03-P -11

PEDOTRANSFER FUNCTIONS FOR MACROPORE FLOW IN DUTCH CLAY SOILS

Aaldrik Tiktak, Bilthoven - Netherlands

S08.03-P -12

PREDICTION ACCURACY AND UNCERTAINTY OF PEDOTRANSFER FUNCTIONS AND IMPACT ON SOIL WATER TRANSPORT MODELLING

Heike Puhlmann, Freiburg - Germany

S08.03-P -13

RESEARCH ON THE PHYSICAL PROCESSES INVOLVED IN AIR REGIME IN SOIL

Voicu Petre, Bucharest - Romania

S08.03-P -14

SITE-SPECIFIC OPTIMIZATION OF PEDOTRANSFER FUNCTION RESULTS USING TEXTURAL AND GEOCHEMICAL DATA

Heidi Lissner, Jena - Germany

S08.03-P -15

THE INFLUENCE OF LAND-USE AND SOIL PARENT MATERIAL ON THE ESTIMATION OF SOIL WATER RETENTION

Attila Nemes, College Park - United States



S08.03-P -16

TRANSPOSABILITY AND EVALUATION OF PEDOTRANSFER FUNCTIONS FOR PREDICTING PROPERTIES OF WATER RETENTION ON SOILS OF LOW CHELIFF. ALGERIA.

Sami Touil, Chlef - Algeria

S08.03-P -17

UPDATES AND REVISIONS TO THE HYPRES DATABASE

Allan Lilly, Aberdeen - United Kingdom

S08.03-P -18

UPSCALING SOIL PHYSICAL PROPERTIES FROM SOIL MONITORING DATA

Klaus V.wilpert, Freiburg - Germany

S08.03-P -19

USE OF THE NONPARAMETRIC NEAREST NEIGHBOUR APPROACH TO ESTIMATE SOIL WATER CONTENT OF SOILS IN THE HUMID TROPICS

Botula Manyala Yves-dady , Ghent - Belgium



S08.03-P -1

AN APPLICATION OF K-NEAREST CODE AS AN ALTERNATIVE TO CLASS PEDOTRANSFER FUNCTIONS FOR MAPS OF FIELD CAPACITY AND WILTING POINT

Matula Svatopluk^[1], Mihalikova Marketa^[1], Batkova Kamila^[1], Janku Jaroslava^[2], Kozak Josef^[2], Nemecek Jan^[2], Nemecek Karel^[2]

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The database of soil hydrophysical properties in the Czech Republic HYPRESCZ gathers data needed for derivation of pedotransfer functions (PTF). The information about soil water retention from the database was connected with the Soil Texture Map of the Czech Republic and new maps were created: Map of Field Capacity (FC) and Map of Wilting Point (WP) in topsoil and subsoil layer for the arable land. The number of 1048 suitable database entries was used for mapping data but only a half of them contain information about WP. The number of 488 WPs was necessary to estimate. The code k-Nearest was used as an alternative approach to class PTF. This code employs the k-nearest neighbour (k-NN) method for estimation of FC, WP and standard deviation. The estimation uncertainty was assessed by two approaches: The estimating accuracy (measured and estimated data coming from the same data set) and the estimating reliability (measured and estimated data coming from independent data sets). The estimating reliability of missing WPs was verified once more by the FC independent estimation. The correlation coefficient of accuracy was 0.99 for FC-estimation and 0.98 for WP-estimation. The reliability of estimation was 0.015 cm³ cm⁻³ for FC and 0.018 cm³ cm⁻³ for WP. The k-NN method was compared with commonly used class PTF. The average difference was 0.013 cm³ cm⁻³ in FC-estimation and 0.021 cm³ cm⁻³ in WP-estimation. The results show a good comparability of both methods and the k-NN method allowed to use the maximum of available data.



S08.03-P -2

CONSISTENT PARAMETER CONSTRAINTS FOR SOIL HYDRAULIC FUNCTIONS

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In order to derive pedotransfer functions, parameters of soil hydraulic functions have to be obtained for large sets of retention and conductivity data. These parameters are derived from measurements by means of parameter estimation. Of crucial importance here is the choice of correct constraints in the parameter space. Often, the parameters are mere shape parameters without physical meaning, giving flexibility to the model. A fundamental requirement is that the hydraulic functions are monotonic: the retention function and the conductivity function can only decrease as the capillary suction increases. A stricter physical requirement for the conductivity function is that its decrease with respect to saturation is at least linear. This linear decrease would occur if all pores of a capillary bundle had an equal radius. We derive constraints for the so-called tortuosity parameter of the Mualem conductivity model, which allow highest possible flexibility on one hand and guarantee physical consistency on the other hand. In combination with the retention functions of Brooks & Corey, van Genuchten, or Durner, such a constraint can be expressed as a function of the pore-size distribution parameters. For the Kosugi, Fayer & Simmons, Khlosi or free form retention functions such a constraint should have the fixed value of -1. In the second part, we show that for soils with wide pore size distributions, Fayer & Simmons and Khlosi retention functions can exhibit increasing water contents with increasing suction. We propose a solution for this problem by slightly modifying these models and introducing a correct parameter constraint.



S08.03-P -3

**ESTIMATION OF SATURATED HYDRAULIC CONDUCTIVITY AND INVERSE OF
MACROSCOPIC CAPILLARY LENGTH PARAMETER USING PTFs**

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Khalilmoghaddam Bijhan^[3]

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Saturated hydraulic conductivity (K_f s) and macroscopic capillary length of soil are important soil hydraulic properties that are crucial for water flow and solute transport modeling in soil. On the other hand, measurement of these parameters is tedious, time consuming and expensive. To overcome this problem, indirect methods such as Pedotransfer functions (PTFs) may be used for determining these parameters. The objective of this research was to develop some PTFs for estimating saturated hydraulic conductivity and inverse of macroscopic capillary length parameter (λ^*). Therefore, K_f s and λ^* of 60 points of Azadegan plain in Shahrekord measured using single ring and multiple constant head method. Also, some of the readily available soil data of two first pedogenic layers of the soils were obtained. Then, the desired PTFs was developed using stepwise multiple linear regression. The accuracy and reliability of the derived PTFs were evaluated using root mean square error (RMSE), mean error (ME), relative error (RE) and pearson correlation coefficient (r). The highest correlation coefficients of 0.92 and 0.72 was found between K_f s-bulk density and λ^* -bulk density, respectively. There were no significant correlation between soil particle size distribution and K_f s and λ^* . This can be related to the fact that most of the soil samples were similar in texture and macro pores. The most efficient PTFs in predicting K_f s and λ^* could explain 85 and 66 percent of the variability of these parameters, respectively. All the derived PTFs underestimated the K_f s and λ^* parameters.



S08.03-P -4

ESTIMATION OF SOIL MOISTURE USING RESISTIVITY METHODS

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Water storage capacity and water content are key parameters in hydrological models. The reliability of soil moisture data depends on the method of measurement as well as on the soil homogeneity or heterogeneity of the test site. Traditionally, the data of temporal and spatial variability of soil moisture are often based on sparse point measurements. Whereas Statistics and interpolation techniques are not able to image the existing small-scale variability, Geophysics can provide methods to image the spatial soil heterogeneity and time series can be used to image the temporal dynamics of soil parameters. However, geophysical parameters don't measure the water content directly. Therefore, we want to address our presentation on the relation between a geophysical parameter and the soil water content. Specifically, we focused on the use of electrical resistivity measurements in combination with punctual data of water content (tensiometer, TDR-data and oven-drying method). The correlation between soil moisture and electrical resistivity will be discussed at different scales and for various soil types. Laboratory data show strong (negative) correlation between water content and resistivity. Field data are influenced additionally by soil temperature differences and by soil heterogeneity within the observed soil volume. Conventionally, geoelectrical methods are used at certain points or along transects. The new soil sensor – GEOPHILUS ELECTRICUS - offers a tool for resistivity mapping with rolling electrodes. The recent sensor design and its technical specification allow measuring the electrical parameters at five depth levels up to 1.5 m.



S08.03-P -5

ESTIMATION OF SOIL WATER RETENTION OF A STUDY AREA BASED ON DETAILED CATEGORICAL SOIL MAP INFORMATION

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According to the Hungarian Detailed Soil Hydrophysical Database a group estimation method was developed to predict the soil water retention (SWR) at -0.1, -33, -1500 and -150000 kPa matrix potentials. Ordinal and nominal (categorical) type data, including soil taxonomical information – which are available on soil maps – were used to develop the prediction methods. Pedotransfer rules were worked out by classification tree (CHAID) method. The estimation efficiency of the prediction method was controlled on a test database, and on a dataset of a study area. It can be established that the water retention of soils are sufficiently predictable from the category type data of detailed (1:10 000) soil maps.



S08.03-P -6

EVAPORATION METHODS FOR DETERMINING SOIL HYDRAULIC PROPERTIES: A REINVESTIGATION OF LINEARIZATION ERRORS

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Pedotransfer functions are often derived from or evaluated against data sets collected in large soil hydraulic data bases such as UNSODA or HYPRES. A significant portion of these data stems from evaporation experiments. These experiments are typically evaluated using simplifying assumptions about the nonlinear water flow processes. A common approach to assess the validity of these assumptions and to explore potential linearization errors associated with them is the use of synthetic data. In the past, these synthetic data were generated considering liquid water flow only. In this study, we reinvestigated the accuracy of the evaporation method using a more realistic process description of evaporative drying, including both liquid water flow and isothermal vapour diffusion. In contrast to previous results reported in the literature, our results showed that the simplifying assumptions commonly used to evaluate evaporation experiments may result in strongly biased estimates of the soil hydraulic properties. This linearization error was most pronounced for the unsaturated hydraulic conductivity curve and for coarse textured soils. The bias typically increased progressively during stage-two evaporation, which is characterized by the development of a dry surface layer in which water flow is dominated by diffusion of water vapour, resulting in strongly nonlinear pressure head and water content profiles. As an alternative to the simplified evaluation, we investigated the accuracy and precision of inverse modelling of evaporation experiments for estimating the soil hydraulic functions. The extent to which our results influence the performance and reliability of existing pedotransfer functions remains to be explored.



S08.03-P -7

LINKING PREFERENTIAL SOLUTE TRANSPORT TO SOIL PROPERTIES, SITE FACTORS AND EXPERIMENTAL CONDITION

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In this study we compared soil properties, site factors and experimental conditions to the degree of preferential transport of 793 inert tracer experiments collected from the peer-reviewed literature. We chose the normalized 5%-tracer arrival time as a measure for the strength of preferential transport. We found that the degree of preferential solute transport increases with apparent dispersivity and decreases with travel distance. A similar but weaker relationship was observed between apparent dispersivity, 5%-tracer arrival time, and lateral observation scale, such that the strength of preferential transport increases with lateral observation scale. We also found that the strength of preferential transport increased at larger flow rates and water saturations, which suggests that macropore flow was a more important flow mechanism than heterogeneous flow in the soil matrix. Moreover, we show that preferential solute transport under steady-state flow depends on soil texture in a threshold-like manner: moderate to strong preferential transport was found to occur only for undisturbed soils which contain more than 8% clay. Our results suggest that in developing pedotransfer functions for solute transport properties of soils it is critically important to account for travel distance, lateral observation scale, and water flow rate and saturation. Finally, we grew respective classification trees on the subset of the short and near-saturated soil columns (n=237). Based on a combination of boot-strapping and cross-validation, the classification trees predict the occurrence or absence of preferential transport with an accuracy of approximately 80%.



S08.03-P -8

MULTISTEP-OUTFLOW MEASUREMENTS FOR GENERATION AND VALIDATION OF PEDOTRANSFER FUNCTIONS

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Most pedotransfer functions (PTFs) were developed for agricultural soils. To test the applicability of these PTFs for forest soils, a measuring procedure is presented to estimate both, the water retention and the water conductivity curve. Undisturbed soil samples are taken with 100 cm³ rings in a variety of forest stands in Baden-Württemberg. The rings with the soil cores are placed on porous ceramic plates. Ten samples at the same time are saturated with water and then a hydrostatic pressure of -4 hPa is applied. Subsequently the samples are drained in a multistep-outflow measurement procedure. Depending on soil texture, four different pressure regimes are used up to -500 hPa. During drainage the amount of out flowing water and the pressure head in each sample is logged with high frequency. After the drainage the porosities are measured by pyknometry. In addition the samples are placed in a pressure plate apparatus at -900 hPa to obtain one more supporting point near residual water content. Bulk density texture and organic carbon content are measured and provide the predictor variables for the PTFs. The retention and unsaturated conductivity curves (i.e., the parameters of the MUALEM-VAN GENUCHTEN model) are estimated by an inverse optimization of the multistep-outflow experiments. PTFs were developed based on 1504 soil samples of different forest stands. Our new PTFs have a high predictive accuracy (root mean squared error for retention of 0.045 cm³/cm³ for an independent validation data set). However, their predictions differ significantly from those of PTFs found in the literature.



S08.03-P -9

PEDOTRANSFER FUNCTIONS FOR ESTIMATING ATTERBERG LIMITS IN SEMI-ARID AREA

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Although Atterberg limits can be used to estimate strength and settlement characteristics of the soils and to distinguish between different types of silts and clays too, but measurements of these indices are difficult. This study was conducted to obtain predictive functions to estimation the Atterberg limits from easily and routinely measured soil properties. For this reason 26 soils with contrasting properties from east Azarbaijan. Some soil properties such as soil texture, pH, EC, SAR, OM, CaSO₄ and calcium carbonate equivalent (CCE), CEC were determined using the standard laboratory methods. Liquid limit (LL) and plastic limit (LL) measured by Casagrande and rolling methods, respectively. The relationships between these indices and soil properties were interpreted with correlation and regression analysis. Result showed that LL and PL have a direct and positive relationship with saturated moisture content (SP), CEC, organic matter and clay content, and a negative relationship with very fine sand (VFS) content. The PI values were correlated positively to clay and silt content and negatively to sand and VFS content. Multiple regression models with terms for SP, Silt+VFS and OM content could explain 87% and 70% of the variance in LL and PL respectively. The results also showed that the model with terms for SP and clay content could explain 80% of the variance in PI.



S08.03-P -10

PEDOTRANSFER FUNCTIONS FOR ESTIMATING SOIL HYDRAULIC PROPERTIES. STATUS OF THE RESEARCH CARRIED OUT IN PORTUGAL

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Pedotransfer functions (PTFs) for estimating unsaturated hydraulic properties of Portuguese soils have been developed since 1994. Early PTFs related the parameters of van Genuchten's retention model using 230 retention curves, and the parameters of Gardner's conductivity model using 129 hydraulic conductivity curves, with basic soil properties. More data on unsaturated hydraulic properties has been slowly made available since, with the Portuguese soil hydraulic properties database (PROPSOLO) currently gathering data of 734 retention curves and 300 hydraulic conductivity curves determined in 345 soil profiles distributed across the Portuguese territory (Azores and Madeira islands included). New point and continuous PTFs have been developed to take into account all available information on the hydraulic characteristics of Portuguese soils. Point PTFs were developed to estimate soil water contents at 0.25, 1.0, 3.2, 6.3, 10.0, 33.0, 100.0, 250.0, and 1585.0 KPa from particle size distribution, dry bulk density, and organic carbon content. Continuous PTFs were developed to estimate the van Genuchten-Mualem parameters from particle size distribution, dry bulk density, organic carbon content, and soil water contents at specific pressure heads. PTFs were created considering a hierarchical approach where input data needs increase progressively, and considering more homogeneous soils grouped according to their particle-size distribution, soil stratification and soil type. Recently, a geoestatistical approach has been considered to account for the spatial variability of soil hydraulic properties in PTFs development, and although research is still in its early steps, results show to be promising.



S08.03-P -11

PEDOTRANSFER FUNCTIONS FOR MACROPORE FLOW IN DUTCH CLAY SOILS

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Until recently, the applicability of preferential flow models for large scale assessments was poor because soil information for preferential flow models such as soil structural information was not available at these large scales. In the present study, macropore pedotransfer functions were developed for the spatially distributed pesticide leaching model GeoPEARL. This model is used to simulate the movement of pesticides to surface water in support of the authorisation procedure of pesticides in the Netherlands. The pedotransfer functions relate the geometry of the macropore system to generally available soil data, in particular organic matter content, clay content and the mean lowest depth of the groundwater table as derived from pedological surveys. These pedotransfer functions were constructed using a wide range of Dutch clayey soils. Results indicate a good correlation between these variables and soil structural parameters, which is due to the homogeneous mineralogical composition of Dutch clayey soils. Results of the spatially distributed modeling indicate that due to rapid transport through macropores, the concentration of pesticides in drainage water is generally higher in clayey soils than in light textured soils.



S08.03-P -12

**PREDICTION ACCURACY AND UNCERTAINTY OF PEDOTRANSFER FUNCTIONS AND
IMPACT ON SOIL WATER TRANSPORT MODELLING**

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Pedotransfer functions (PTFs) are commonly used for providing the soil hydraulic parameters needed in soil water transport models. Although they are mostly derived on the basis of laboratory measurements of the PTF predictors (e.g., texture or bulk density), the application of PTFs very often relies on less precise data. In this study we tested how much the PTFs' prediction accuracy decreases and their uncertainty increases when the predictors are derived from different sources (laboratory measurements, soil profile descriptions and small-scale soil maps). We also analysed how these errors propagate into modelled soil water balances. We developed PTFs for the retention and the unsaturated hydraulic conductivity of forest soils in Baden-Württemberg/Germany. We tested the predictive power of the PTF by comparing them with retention/conductivity curves of 516 independent soil samples. The mean prediction error (root mean squared error) increased only slightly from 0.05 cm³/cm³ (calibration and validation data for the PTF development) to 0.06 cm³/cm³ when using soil profile descriptions or soil maps. However, the prediction uncertainties of the profile descriptions were large due to imprecise value ranges for the PTF predictors. Similar trends were observed for the prediction of the unsaturated conductivity. The different PTF predictions were finally used for simulating the soil water regime of a forest soil profile. Modelled characteristics of water availability differed largely between the different versions of the PTFs. Bulk density was found to have the largest impact on prediction accuracy. Prediction uncertainty was mainly due to broad soil texture ranges in the profile description.



S08.03-P -13

RESEARCH ON THE PHYSICAL PROCESSES INVOLVED IN AIR REGIME IN SOIL

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Soil, to serve as a favorable plant growth environment, must possess the ability to store and provide water and needed nutrients and not to contain concentrations of toxic elements that exceed maximum allowable limits. Air content in the soil profile is subject to rapid changes that depend on the total porosity changes and water content. Specific objectives of this project are: 1. Determination and correlation of assessing indicators for air movement through convection for the representative soils. 2. Development pedotransfer functions to assess the air content from the soil and their validation. To achieve the objectives of this project were carried out case studies regarding movement of the air into the soil from convection. Thus, all the data about air from soil have in this paper an important spatial value.



S08.03-P -14

SITE-SPECIFIC OPTIMIZATION OF PEDOTRANSFER FUNCTION RESULTS USING TEXTURAL AND GEOCHEMICAL DATA

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Modeling of unsaturated zone flow and transport is frequently done using van Genuchten-Mualem type of equations. The parameters of these equations (T_r , T_s , n , a , K_s) can be obtained by fitting to an experimentally derived water retention curve (WRC) or by pedotransfer functions (PTFs). To evaluate the applicability of the PTFs at our field site, we compared T_r , T_s , n , and a , which were predicted with the pedotransfer function ROSETTA (Schaap et al., 2001) with the same parameters obtained by directly fitting the WRC with RETC (Van Genuchten et al., 1991). Results revealed a very variable agreement between predicted and fitted functions. To improve the predicted functions we searched for site-specific relationships between the fitted van Genuchten-Mualem parameters T_r , T_s , n , a and textural and geochemical soil properties. Correlations between T_s/n and grain size on the one hand and between a and organic matter/iron oxide content on the other hand were used to correct the ROSETTA estimates. Furthermore, assigning T_r a value of zero for subsoils seemed appropriate for this site. The agreement obtained for the site-specific functions was not much better than for the predictions by ROSETTA due to a systematical shift to larger water contents. However, the shape of the fitted WRC was better captured using site specific information. Thus, the model using site-specific prediction functions will show the same imbibition and drainage behavior as if modeled with a fitted function – only the absolute water content values are shifted to larger values.



S08.03-P -15

THE INFLUENCE OF LAND-USE AND SOIL PARENT MATERIAL ON THE ESTIMATION OF SOIL WATER RETENTION

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The influence of environmental variables on the success of estimating soil hydraulic properties has interested many scientists. However, progress in this direction has often been hampered by lack of a sufficient amount or sufficient quality of the related information. A recent revision of the HYPRES database (a European database of soil hydraulic properties) has allowed us to have access to structured information on environmental variables related to the assembled soil samples, such as land-use and/or parent material and from a wide geographical distribution. Where information was available, we used the k-nearest neighbor non-parametric estimation technique and classification and regression tree methodology to examine what impact the grouping of soils by land-use and by parent material has on estimating soil water retention.



S08.03-P -16

TRANSPOSABILITY AND EVALUATION OF PEDOTRANSFER FUNCTIONS FOR PREDICTING PROPERTIES OF WATER RETENTION ON SOILS OF LOW CHELIFF. ALGERIA.

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Test efficiency of a PTF outside of its development dataset is the better way to assess its robustness. Furthermore, an important question remains about PTF's transposability to others bioclimatic contexts. Models developed and validated in a particular bioclimatic context, were relatively little tested in other contexts. Particularly, no studies have been conducted until now, to evaluate the PTFs for Algerian soils. In this study, most frequently cited PTFs were considered : Saxton et al. (1986), Rawls et al. (1982), Rosetta (Schaap et al. 2002), and Ghorbani Dashtak Homae (2004) Type 1, and Ghorbani Dashtak Homae (2004) type3, Vereecken et al. (1989), Rawls and Brakensiek (1989), Campbell (1974). We used them to evaluate soil water retention at field capacity (FC) and wilting point (WP) as well as the total availability of water (TAW) on a set of 134 samples collected in the low Cheliff Algeria. The Akaike information criterion (AIC) values showed that Rawls et al. (1982, I) and GH-1 (2004) models were the best in estimation of soil water retention at FC (-683,43), TAW (-820,60) and WP (-733,47) respectively. The Results showed that PTF of GH-1 (2004), perform better than others methods (Similar bioclimatic context). The poor performance presented by the PTFs developed on soils from Europe or United States where the organic matter values were much higher than the Algerian soils. However, the transferability of the PTFs formed from data spread from a wider area, produce more accurate predictions than those built from local data (specific bioclimate).



S08.03-P -17

UPDATES AND REVISIONS TO THE HYPRES DATABASE

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The original HYPRES database was developed in the mid 1990's as part of an EU funded Human Capital and Mobility programme. The pedotransfer functions derived from the database [1] are still widely used and the data have been used in a number of studies on hydraulic conductivity [2,3], on estimating plant available water. However, the database itself has remained largely untouched. During a review of the data with regard to extracting related soil profile information from the database [4] a number of issues were raised that prompted the original HYPRES team to consider revising the database. Although few in number, these issues included a reiteration of the primary keys used to link data within the various tables, removal of duplicate data, correction/deletion of unrealistic measurements, a re-evaluation of the relationships between tables and a revision of the documentation to provide details on the changes. In order to make the database more compatible with other European datasets, additional fields to structure information on land use and parent material (where available) were created and populated from textual information already within HYPRES. Georeferences were recalculated to a common projection system where possible. We outline these changes and illustrates some of the recent work on upgrading the existing HYPRES data so that it meets current standards. 1. Wösten, J.H.M. et al. *Geoderma* 90:169-185. 2. Lilly, A. et al. *Soil Science Society America Journal*. 72. 16-24. 3. Han Han et al *Geoderma*. 146, 121-128. 4. Hiederer, R. (2011) *Extending Geographic and Thematic Range of SPADE/M with HYPRES Soil Profile Data*



S08.03-P -18

UPSCALING SOIL PHYSICAL PROPERTIES FROM SOIL MONITORING DATA

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Soil surveys usually focus on soil chemical properties and. Soil physical properties often are treated as descriptive, subsidiary background for soil chemical evaluations without proper analytical value. Many studies in soil science provide qualitative or semi-quantitative assessments of properties like soil texture, bulk density or amount of soil skeleton (>2 mm fraction). In this poster, we describe the process of upscaling soil physical properties based on soil physical measurements and/or soil profile descriptions of forest soil monitoring. In order to enhance the data basis for e.g. process-oriented hydrologic models at landscape level, the use of upscaling techniques based on point-related monitoring data is essential. The statistical methods used in this work include ordinary least square regression (OLS), logistic regression and validation techniques. Since the model performance of the upscaling models depends crucially on the spatial scale where they are related to, the scale problem will be discussed. At the example of the State of Baden-Württemberg (Germany) we achieved to identify upscaling models for soil coarse fraction, fine earth bulk density, percentage of texture classes Sand, Silt and Clay, explaining around 70 % of the parameter variance in the measured data. Making soil physical data from soil survey available for landscape related water budget calculation is one of the aims of this study, but also for all pool calculations reliable soil physical data are essential. Upscaling is a necessary tool when soil information is needed, where no measurement is available, but soil information is needed for practice support.



S08.03-P -19

USE OF THE NONPARAMETRIC NEAREST NEIGHBOUR APPROACH TO ESTIMATE SOIL WATER CONTENT OF SOILS IN THE HUMID TROPICS

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In hydrology, nonparametric approaches are an attractive tool for modelling. One non-parametric method called k-nearest neighbour (k-NN) has been successfully applied by Nemes and coworkers (2006) to predict water content of temperate soils at matric potentials -33 kPa and -1500 kPa using texture, bulk density and organic matter as predictors. Unlike parametric pedotransfer functions (PTFs) which fit equations to data, k-NN predicts the unknown soil property based on pattern-recognition. Nemes and coworkers (2006) recommended studying the ability of the k-NN approach to estimate water content of soils that developed in different climatic and pedological conditions. Therefore, the objectives of this study are (1) to estimate soil water content at 8 different matric potentials based on the k-NN approach, (2) to build a comprehensive dataset of about 1000 soils from the humid tropics and use it as the reference dataset for estimation, (3) to evaluate the ability of the k-NN approach to estimate water content of 70 highly weathered soils from DR Congo based on the tropical soil dataset. The preliminary results revealed that water content at 8 different matric potentials namely 0, -1, -3, -10, -20, -50, -250 and -1500 kPa could be estimated with a root-mean-squared error (RMSE) ranging from 0.03 to 0.07 m³/m³. This error range is similar to RMSEs reported in previous studies for soils of the humid tropics. Therefore, k-NN is a competitive alternative to more classical type PTFs. In the future, more cross-validation studies will be performed on soils with different properties e.g. swelling-shrinking soils.



S08.04-P - DYNAMIC NON-EQUILIBRIUM OF FLOW IN UNSATURATED PORUS MEDIA

Thursday 05 July 2012 from 17:00 to 18:30. Room Poster Areas

S08.04-P -1

AN EXPERIMENTAL SETUP IN AVIGNON (SOUTH OF FRANCE) FOR THE MULTISCALE STUDY OF PREFERENTIAL FLOW IN SOIL AND OF GROUNDWATER RECHARGE PROCESSES

Stephane Ruy, Avignon - France

S08.04-P -2

BROMIDE AND LITHIUM TRANSPORT THROUGH INTACT SOIL COLUMN: INFLUENCE OF FLOW CONDITION AND CROP MANAGEMENT

Golayeh Yousefi, Hamedan - Iran, Islamic Republic of

S08.04-P -3

CHANGES OF PREFERENTIAL FLOW PATHS IN FOREST SOILS UNDER EXTREME METEOROLOGICAL CONDITIONS

Karoly Müller, Bayreuth - Germany

S08.04-P -4

COMPARISON OF OBSERVED AND CALCULATED EXCESS WATER (DRAINAGE DISCHARGE) IN DRAINED SOIL

Ivan Simunic, Zagreb - Croatia

S08.04-P -5

DISCRETE SMALL AND LARGE SCALE MODELS OF UNSATURATED FLOW IN SOILS

Kirill Gerke, Moscow - Russian Federation

S08.04-P -6

DYNAMIC NON-EQUILIBRIUM EFFECTS IN SOIL HYDRAULIC PROPERTIES ESTIMATED WITH TRANSIENT EXPERIMENTS: COMPARISON OF WATER AND ETHANOL EXPERIMENTS

Efstathios Diamantopoulos, Braunschweig - Germany

S08.04-P -7

EFFECT OF BIOFILM ON SOIL HYDRAULIC PROPERTIES: LABORATORY STUDIES USING XANTHAN AS A SURROGATE

Hella Rosenkranz, Braunschweig - Germany



S08.04-P -8

EFFECT OF MINERAL DISSOLUTION/PRECIPITATION ON HYDRAULIC AND TRANSPORT PROPERTIES OF FLOODPLAIN SOILS

Sabine Schaefer, Jena - Germany

S08.04-P -9

HOW DOES COMPACTION INFLUENCE PREFERENTIAL FLOW IN SOIL?

Mona Mossadeghi-Björklund, Uppsala - Sweden

S08.04-P -10

IDENTIFYING THE ROLE OF STONES AND TEXTURAL HETEROGENEITIES ON SOLUTE TRANSPORT SCALE IN SOILS BY SPECTRAL ANALYSIS

Antonio Coppola, Potenza - Italy

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Jean-Charles Michel, Angers - France



S08.04-P -1

AN EXPERIMENTAL SETUP IN AVIGNON (SOUTH OF FRANCE) FOR THE MULTISCALE STUDY OF PREFERENTIAL FLOW IN SOIL AND OF GROUNDWATER RECHARGE PROCESSES

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Preferential flow in soil is of major importance for the dynamic of groundwater recharge, on a quantitative and qualitative point of view. This is particularly the case in Mediterranean regions where this phenomenon is increased due to flood irrigation, high intensity rainfall events and seasonal soil water deficit leading to soil shrinkage and cracking. A large scale experimental setup devoted to a multiscale study of preferential flow in soil and of groundwater recharge processes has been set up in Avignon, South of France in 2002. It is composed of a large scale undisturbed lysimeter associated to a 0.7 ha field. Agricultural practices are the same on both plots. The field plot is equipped with piezometers, groundwater level probes working at a fine time step, water balance sites and porous cups for soil water sampling. The lysimeter is equipped with soil moisture probes and tensiometers, and with an automatic device for measuring drainage flow at the bottom of the lysimeter. Physical and hydrodynamic properties of the field plot and lysimeter have been measured using geophysical devices (electrical tomography and electromagnetic prospection) and the kinematic wave theory for preferential flow. Local hydrodynamic properties of the aquifer are also known. We present some results concerning (i) rainfall simulation on the lysimeter and on the field using chemical tracers and water stable isotopes, (ii) drainage hydrographs obtained at the bottom of the lysimeter under natural rains, (iii) groundwater level variations.



S08.04-P -2

BROMIDE AND LITHIUM TRANSPORT THROUGH INTACT SOIL COLUMN: INFLUENCE OF FLOW CONDITION AND CROP MANAGEMENT

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In this study the role of cropping systems and flow conditions on transport of Bromide (Br-) and Lithium (Li+) through large intact soil column was investigated. Treatments consisted of clay loam and sandy loam soils which had been cropped with either wheat or alfalfa for 4 years. Steady state flow condition was established using tap water prior to performing a pulse of 0.005 M LiBr solution on the surface of soil columns. Leaching was monitored up to four pore volumes for each column. Relative concentration (C/C₀) of Br- and Li+ in drain water was drawn vs. pore volume. Applied crop managements and flux conditions affected the effluent concentration significantly. Breakthrough curves for leached Br- and Li+ in both soil treatments exhibited an early higher concentration indicating the preferential flow effect especially under saturated flow condition, considering that the concentration of Br- was more than of Li+. Both Br- and Li+ concentrations decreased with time and converged at low levels for both soils and crop managements justifying the blockage of macropores on leaching via matrix flow. Both soils under alfalfa showed higher Br- and Li+ concentration levels comparing with wheat crop system. In the soils under alfalfa structural cracks, root channels and wormholes were the cause of higher leached concentration for both tracers comparing with the soil under wheat. In both soils the greater amount of tracers were observed under saturated flow condition as a result of higher water velocity and less contact of tracers with soil particles.



S08.04-P -3

CHANGES OF PREFERENTIAL FLOW PATHS IN FOREST SOILS UNDER EXTREME METEOROLOGICAL CONDITIONS

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Moisture and flow patterns are of utmost importance for matter transport and spatial distribution of nutrients and pollutants in the soil compartment of ecosystems. Soil moisture, soil structure, spatial variation of material functions and upper boundary conditions are key factors of flow path formation. In our research study, we investigate the impact of extreme drought events, the thickness of organic layers and the possible impact of different stone contents on flow patterns and associated soil chemical effects. To simulate these different initial conditions, we assigned forest sites with different stone content and installed special roof constructions for rainfall exclusion. For visualizing preferential flow paths were carried out tracer experiments with Brilliant Blue and potassium iodide. Previous lab examinations showed a significantly higher water repellency with decreasing matric potential, especially in the O- and upper mineral layer. For the examination of possible impacts of organic layer thickness on infiltration patterns, we partly removed the upper 8-12 cm O layer. With the application of spectroscopical methods we want to achieve a considerable improvement of field measurement with respect to time, costs and data quality. Soil spectroscopy is applicable for almost every physical and chemical soil parameter like texture, bulk density, pH, CEC, Corg, contact angle, soil water content, matric potential, brilliant blue concentration, and we could achieve a reasonable calibration ($R^2 > 0,8$) for every parameter. With this method we can carry out a detailed, small scaled and in situ analysis of flow patterns and related influence parameters.



S08.04-P -4

COMPARISON OF OBSERVED AND CALCULATED EXCESS WATER (DRAINAGE DISCHARGE) IN DRAINED SOIL

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S08.04-P -5

DISCRETE SMALL AND LARGE SCALE MODELS OF UNSATURATED FLOW IN SOILS

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This contribution develops a framework for discrete modeling of flow in unsaturated soils using cellular automata approach. First, we consider and discuss some experimental and conventional modeling results which clearly show that Richards equation models do fail to account for preferential flow. One can obtain soil structure information using, for example, X-ray microtomography and then use it for an exact solution for multiphase flow (pore-network, lattice Boltzmann and other numerical, both discrete and continuous, models). However, these solutions can be obtained only for small portions of soils up to approximately tens of cm³. This volumes are clearly too small for hydrological modeling and can not account for larger scale heterogeneities. Based on simple physical assumptions and experimentally obtained data we propose a cellular automata model (kind of inversed diffuse limited aggregation model) which can be used to simulate infiltration staining pattern with accuracy better than Richards equation single-porosity approach or any stochastic model published so far (verified against field observations). At present this model gives only spatial solutions. Finally, an insight in to how account for time solution, soil water repellency, mineral fractions (for example, clay and associated depth of bounded water layer), reactive transport and adsorption (random walk, entrapment constant) and some other factors is provided.



S08.04-P -6

DYNAMIC NON-EQUILIBRIUM EFFECTS IN SOIL HYDRAULIC PROPERTIES ESTIMATED WITH TRANSIENT EXPERIMENTS: COMPARISON OF WATER AND ETHANOL EXPERIMENTS

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Dynamic effects of water flow occurring in simple drainage experiments have received much attention during the last decades. The idea that wettability of the solid surfaces is related to the occurrence of dynamic effects has been recently proposed. A series of primary drainage experiments were carried out in order to investigate the non-equilibrium effects occurring in dynamic experiments. As experimental type the multistep outflow setup was chosen. Experiments were conducted for two different sand materials and for two different liquids (water and ethanol). Ethanol is considered to be a completely wetting liquid, independent of the degree of solid surface wettability. Soil hydraulic properties were obtained by inverse modeling using the cumulative outflow data along with the pressure head data measured inside the soil column in the objective function. The results show that dynamic effects are absent in case of ethanol and therefore, ethanol flow can be adequately described by the Richards equation. However, for the right interpretation of the results the different physicochemical properties of the two liquids must be taken into account.



S08.04-P -7

EFFECT OF BIOFILM ON SOIL HYDRAULIC PROPERTIES: LABORATORY STUDIES USING XANTHAN AS A SURROGATE

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Many soil bacteria produce extracellular polymeric substances (EPS) in which they are embedded while residing in the porous matrix. The EPS is often attached as a biofilm to both the bacteria cell and the soil particles. As a consequence, its influence on water flow through variably saturated porous media often cannot be neglected. While the influence of attached microbial biomass and EPS on saturated water flow has been studied extensively, its investigation for unsaturated flow in soils has found significantly less attention. The objective of this study was the quantification of the effect of biofilms on the unsaturated soil hydraulic properties. We determined the soil water retention and unsaturated hydraulic conductivity functions of biofilm-affected soils by using xanthan as an EPS surrogate. Both multistep outflow and evaporation experiments were conducted on two sandy soils, respectively. The amount of added xanthan was varied in 6 stages from zero to 0.25 %. Additional measurements of soil water retention using the dewpoint method closed the gap from the evaporation method to air-dryness. The experimental data were evaluated by inverse modeling. A mixture model was applied to test its ability to describe the data. The results show that the unsaturated hydraulic conductivity is reduced markedly by added xanthan and the water content increases significantly at all matric potentials with increasing xanthan content. The reduction in conductivity is high enough to fully suppress stage-one evaporation for xanthan-sand mixtures. The water-holding capacity of the xanthan and the alteration of the pore size distribution explain these results.



S08.04-P -8

EFFECT OF MINERAL DISSOLUTION/PRECIPITATION ON HYDRAULIC AND TRANSPORT PROPERTIES OF FLOODPLAIN SOILS

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Biological and physicochemical processes in soils, like root growth, mineral precipitation and dissolution, or colloidal dispersion and flocculation may result in not only temporal changes of the soil structure. Such effects will in turn affect the pore network architecture, the hydraulic and the transport properties. Using soil column experiments, we studied the influence of mineral dissolution and precipitation on the hydraulic conductivity, the water retention characteristic and the apparent dispersivity. Undisturbed soil cores packed with a calcareous floodplain soil from the Danube were flushed with a sodium oxalate solution. The interaction of the released calcium with the oxalate will result in the precipitation of hardly soluble calcium oxalate. Before and after the oxalate treatment we investigated the pore network by computer tomography (CT) (UFZ Halle, Department of Soil Physics) and measure the hydraulic and the transport properties. The CT analysis revealed that the soil samples were rich in micropores; observed macropores are related to old roots. The oxalate treatment leads to a change in the pore structure, which could be detected by the tomographic images. In one instance we were able to detect changed water retention characteristic, in another instance the effects on the transport regime, resulting in an increased dispersivity, could be identified. From these observations we conclude the hydraulic and transport properties and such the functions of soils may even change on short notice due to physicochemical processes. Such effects should be considered in particular at medium to long term studies of flow and transport in natural soils.



S08.04-P -9

HOW DOES COMPACTION INFLUENCE PREFERENTIAL FLOW IN SOIL?

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Background: Soil compaction by vehicular traffic modifies the pore structure and soil hydraulic properties. These changes potentially influence the frequency of preferential flow events in macro pores especially in well-structured clay soils. However, this has been little studied so far. Aim: to study the effect of compaction on saturated hydraulic conductivity and preferential flow. Methods: We conducted a randomized block design trial in two well-structured clay soils mainly different in the level of groundwater. The treatments included two level of compaction referred to as compacted and control. The compacted treatment was created by repeated passes with a 5-ton wheel load. After one year, undisturbed soil columns (20 cm height × 20 cm diameter) from both compacted and control plots at a depth of 30-50 cm were sampled. To study the presence of preferential flow we looked at the shape of bromide breakthrough curves under saturated hydraulic condition. And saturated hydraulic conductivity was calculated from the inflow and outflow measurements during the bromide experiment. Results and conclusion: We observed that saturated hydraulic conductivity was smaller in compacted soil than in control soil. However from the shape of breakthrough curves, bromide arrival in the effluent, relative to the average arrival time, was earlier in compacted soil than in soil from the control plots. So we concluded that although compaction decreased the saturated hydraulic conductivity of the soils, its influence on the pore structure may also have increased the risk of preferential flow events in soil.



S08.04-P -10

IDENTIFYING THE ROLE OF STONES AND TEXTURAL HETEROGENEITIES ON SOLUTE TRANSPORT SCALE IN SOILS BY SPECTRAL ANALYSIS

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Scale-dependence of solute transport parameters in soil is known to be mainly due to the increasing scale of heterogeneities with transport distance and with the lateral extent of the transport field examined. In this work we will analyse the role of textural heterogeneities on the transition from the local scale to the transport scale. The approach is based on the scale dependence of transport moments estimated from solute concentrations distributions measured by time domain reflectometry (TDR) probes at three depths in 37 soil sites 1 m apart along a transect during a steady state transport experiment. Spectral analysis will be used to quantify the relationship between the solid phase heterogeneities (namely, texture and stones) and the scale dependence of the solute transport parameters. Our analysis will show that the organization in hierarchical levels of soil variability may have major effects on the differences between solute transport behaviour at transport scale and transect scale, as the transect scale parameters will include information from different scales of heterogeneities.



S08.04-P -11

**INVESTIGATING FLOW INSTABILITIES CAUSED BY ENTRAPPED AIR: INFILTRATION-
OUTFLOW EXPERIMENT MONITORED BY NEUTRON TOMOGRAPHY**

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Temporal variation of quasi saturated hydraulic conductivity of soil is often ascribed to changing fraction of the entrapped air and it is not considered in standard theory of water flow in porous media. Variation of quasi steady state flow was observed during ponded infiltration experiments on three small undisturbed samples of coarse sandy loam. Two main flow irregularities typical for soil under study were detected for two soil samples during recurrent ponding experiment: (1) Gradual decrease of the quasi-saturated hydraulic conductivity (K_{qs}) soon after outflow appeared and (2) lower K_{qs} during the second infiltration run. The third sample didn't produce similar variability. Series of neutron tomography images of the sample taken during quasi-steady state stage of the first infiltration run showed air trapping in many of large pores and cavities. Furthermore, many of entrapped air bubbles increased in volume during the course of the first infiltration run. Further entrapped air redistribution has been detected during the second run. The fraction of the entrapped air was calculated for series of tomography images taken during the experiment. The increase of entrapped air bubbles volumetric fraction by only 0.005 was accompanied by decrease of quasi-saturated hydraulic conductivity by up to 50% of the initial value. The experimental results support the hypothesis that the effect of the gradual decrease of K_{qs} is caused by entrapped air redistribution and build-up of bubbles in preferential pathways. The trapped air may thus restrict the preferential flow pathways and cause lower infiltration and outflow flux rates.



S08.04-P -12

MAXIMUM EVAPORATION DEPTH ON A COARSE COVER SYSTEMS IN SEMI-ARID AUSTRALIA

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In arid and semi-arid areas, the use of evapotranspiration (ET) covers is widely proposed to minimize water ingress into hazardous waste and hence the potential hazardous effluents from such wastes. The theory of ET cover systems is based on the water balance equation, with plant transpiration and soil evaporation (EV) as the main parameters for water removal from the system. Plant coverage on ET cover systems can be sparse and, as a result, EV forms the main component in the term ET. Therefore, it is important to gain knowledge of maximum EV depth on coarse cover systems. Based on soil suction, evaporation depth was measured on three replicates of two ET cover designs, namely 0.5m compacted material underneath 1.5 m uncompacted material and 2.0 m uncompacted material. Within four months after a period of high rainfall, the maximum drying depth in the treatment with the compacted layer was approximately 1.6 m, just below the top of the compaction zone. However, in the treatment without the compacted layer, maximum drying depth varied between 0.5 m to 1.1 m. The rate of drying at depth varied both within and between the two cover designs. The results indicate that EV can remove water from considerable depths on coarse ET covers. There was evidence that the presence of a compacted layer increased the drying depth, although the degree to which the material dried at depth varied within the same treatment.



S08.04-P -13

MEASUREMENT OF NEAR-WILTING HYSTERESIS USING POLYMER TENSIOMETERS UNDER FIELD CONDITIONS

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Hysteresis in the relation between pressure head and water content is often referred to, sometimes assessed by modeling but hardly ever measured. Measurement of hysteresis requires simultaneous and independent observation of water content and soil water pressure head during drying-wetting cycles. Whereas water content can be measured by several types of sensors, soil water pressure head is measured by tensiometers that establish a hydraulic contact between soil water and some type of pressure sensor. Most of these tensiometers are water-filled, subjecting them to cavitation and limiting measurements to the pressure range between -10 and 0 m. To observe hysteresis under field conditions, we used EchoProbe EC-5 FDR sensors to measure water content and polymer tensiometers (PoTs) manufactured at Wageningen University, Netherlands to measure pressure head. PoTs have a much larger working range than conventional tensiometers, from -160 to 0 m. FDR sensors and tensiometers were installed at three depths in a tropical soil (Kanhapludalf) grown with soy beans. During a long dry period (no rain for more than 50 days, pressure head going down to -150 m in the surface layer), measurements were registered every 30 minutes. Drying due to root water extraction was observed during daytime, while rewetting due to redistribution occurred during the night. Pronounced hysteretic behavior was observed in the range of -10 to -150 m, pressure heads varying in the order of tens of meters at a single water content.



S08.04-P -14

NEW MICROFLOWMETER-TENSION DISC INFILTROMETER: MEASUREMENT AND ANALYSIS OF THE TRANSIENT INFILTRATION RATE.

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This paper presents a new design of tension disc infiltrometer in which the full infiltration rate curve is measured with a microflowmeter plus Mariotte tube system (MF). The cumulative infiltration, $I(t)$ and infiltration rate, $q(t)$, curves recorded with MF were compared with the corresponding curves measured from the water-level drop in the water-reservoir tower (WLD). In a second step, a simple procedure for estimating K_0 and S_0 from the linearization of the transient $q(t)$ curve with respect to the inverse of the square root of time (IRC) was developed. The estimated K_0 and S_0 were subsequently compared to the corresponding values calculated from the linearization of the differential $I(t)$ curve with respect to the square root of time (DCI). The disc infiltrometer was tested in 1D and 3D laboratory soil columns, and in the field in three different soil-structure conditions. Results showed that the MF allowed the most accurate estimates of the $q(t)$ curves. Smoothing data using a simple moving average algorithm improved, in both DCI and IRC techniques, the characterization of the $q(t)$ curves. The IRC method, with more significant linearized models and higher R^2 values, allows more accurate estimation of K_0 and S_0 than the DCI technique. Comparison between the measured and the modelled $I(t)$ curves for the K_0 and S_0 values estimated by the DCI and IRC methods in all laboratory and field measurements shows that the IRC technique allowed better fittings between measured and modelled $I(t)$ curves, which indicates better estimations of K_0 and S_0 .



S08.04-P -15

**SOLUTE MASS TRANSFER EFFECTS IN 2D DUAL-PERMEABILITY MODELING OF
PREFERENTIAL BROMIDE LEACHING WITH DRAIN EFFLUENT**

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The study analyzes effects of local non-equilibrium on field scale preferential flow and transport processes assuming a dual-permeability concept. Bromide leaching was simulated for a tracer experiment on a drained field with glacial till soils. The analysis focused on the diffusive inter-domain solute mass transfer coefficient. A smaller value of this transfer coefficient allowed a better match of the Br^- mass flow observed in the tile drain discharge. The local scale solute transfer between PF and SM domains had a clear impact on Br^- drain effluent at the field scale. The dynamics of advective and diffusive mass transfer components revealed that the diffusive component was controlling preferential solute leaching under these conditions. Improved knowledge on small-scale properties and processes including domain-specific infiltration at the soil surface and mass exchange in the structured soil could contribute to better understanding of larger scale flow and transport processes.



S08.04-P -16

SPATIAL VARIABILITY OF SOIL PHYSICAL PROPERTIES IN A CULTIVATED FIELD

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*Prediction of soil physical properties is important for site specific management practices in precision agricultural systems. Generally, the aim of soil cultivation is to form a homogeneous media to supply optimum growth conditions for seeds and plants. In this study, spatial variability of some soil physical properties in a cultivated field such as; bulk density (BD), penetration resistance (PNT), saturated hydraulic conductivity (Ks), field capacity (FC) and permanent wilting point (PWP), were determined by geostatistical method. While BD values varied between 1.12 and 1.41 g/cm³, PNT resistance in 15 cm soil layer varied between 0.66 and 1.88 MPa. Also, Ks (1.46 to 3.37 mm h⁻¹), FC (30.40 to 39.66%) and PWP (19.22 to 24.42%) values showed variations among the soil samples. In kriging interpolation for the spatial variability of soil physical properties, the biggest r^2 and cross validation r^2 values were determined with spherical model for BD, PNT, Ks, FC values, and exponential model for PWP values. Spatial dependences of the physical properties were found to be strong in the field. The semivariograms for BD, PNT, Ks, FC and PWP showed spatial dependences with the ranges of 12.75, 12.17, 12.82, 10.24 and 112.23 m, respectively. While PNT values significantly increased with increasing BD (0.366**) and decreasing moisture content (-0.408**), Ks values significantly increased with increasing BD (0.340*), and decreasing clay content (-0.905**) and PNT (-0.288*) values in the field.*



S08.04-P -17

TEMPORAL AND SPATIAL VARIABILITY IN NEAR-SURFACE SOIL MOISTURE: A WAVELET ANALYSIS

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How soil moisture responds to atmospheric forcing factors varies in time and space. We propose a characterization of the temporal relationships between soil moisture and precipitation at a very short timescale, i.e. from 1 h to 2 weeks, using a wavelet analysis. The experiment is conducted in a well-drained sandy loam soil planted with potatoes. The analysis is based on seven soil moisture time series from time domain transmission probes positioned along a 90-m transect, and monitored at a 20-min rate in the shallow soil layer (5–25 cm), and on precipitation observed every 15-min. The variance activity depicted by the normalized wavelet spectrum of soil moisture is organized into preferential bands of wavelet scales: 1–48 h, 48 h to 1 week, and 1–2 weeks. For the 1–48 h scale, soil moisture is linked to precipitation occurrence, intensity and duration, while for the 48 h to 1 week scale soil moisture relates to the periodicity of the rainfall events, and for the 1–2 weeks scale to the duration of the dry spells. Additionally, a distance-time (spatial) wavelet analysis is conducted to simultaneously assess spatial and temporal variability for each of the three predefined bands. The spatial analysis showed many similarities between series along the transect that were attributable to soil homogeneity.



S08.04-P -18

**TESTING PERCOLATION THEORY AND SOIL FRACTAL MODEL USING LABORATORY
SAMPLE MEASUREMENTS AND X-RAY MICROTOMOGRAPHY**

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Here we check the applicability of theoretical approach based on percolation theory and different fractal model of soils. To do this different undisturbed soil and other porous samples were collected from different soils types and layers, or other natural porous media. Their permeability, grain-size distribution and WRC characteristics were assessed in laboratory. In addition high resolution scans of soil structure were obtained by means of the X-ray tomography. Based on structure information pore-size distributions were calculated. It seems that fractal models sometimes fail to predict pore-size distributions based on grain size distribution. The main reason for that seems to be high complexity of soil pore structure which is different from nature of fractal models and percolation theory random media. A discussion on possible ways to overcome these problems and account for structured complexity of soil pore structure is given.



S08.04-P -19

UNBIASED SIMULTANEOUS ESTIMATION OF SOIL HYDRAULIC PROPERTIES AND DYNAMIC NONEQUILIBRIUM PARAMETERS FROM TRANSIENT OUTFLOW AND EVAPORATION EXPERIMENTS

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Simulation of variably saturated water flow in soils requires accurate knowledge of soil hydraulic properties. Transient flow experiments like the multistep outflow and evaporation methods are now routinely applied to determine soil hydraulic parameters by inverse modelling. Recent experimental evidence suggests that the water content dynamics during such flow experiments is subject to dynamic non-equilibrium. The extent to which this affects the accuracy of determining the equilibrium soil hydraulic properties is still unknown. Conversely, any bias in the equilibrium soil hydraulic properties caused by an inappropriate parameterization must be expected to lead to biased estimates of the parameters describing the hydraulic non-equilibrium. We coupled the dual non-equilibrium model of Diamantopoulos et al. which combines the Richards equation and the Ross and Smettem approach for non-equilibrium with a free-form inversion algorithm. The free-form method has been shown before to guarantee an unbiased estimation of soil hydraulic properties. The freeform non-equilibrium method was applied to multistep outflow experiments and evaporation experiments with flow interruptions. The results confirm that errors in the parameterization of the soil hydraulic properties cause biased estimates of non-equilibrium parameters which can be eliminated or at least minimized with the free-form approach.



S08.04-P -20

WATER REPELLENCY & CONSEQUENCES ON HYSTERESIS PHENOMENA AND WATER RETENTION: THE CASE OF PEAT GROWING MEDIA USED IN HORTICULTURE

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The knowledge of physical properties over time in horticultural growing media is of vital importance for the effective management of irrigation and fertilization. For this, water retention, shrink/swell properties and water repellency of growing media (more or less decomposed peats) were measured during several drying/wetting cycles with varying intensities (0->-10 kPa, 0->-32 kPa, 0->-50 kPa). Regardless of the intensity of drying, water retention and shrink/swell properties are mainly modified after the first drying process, resulting in degradation of density and water retention (due to a consolidation in the range of potentials varying between 0 and -3 kPa), whereas these properties are not affected by the other cycles, even if hysteresis phenomena are always shown to take place. In parallel, water repellency (estimated by direct contact angles measurements between -10 and -32 kPa) also showed hysteresis phenomena and was also not affected by the number of cycles. Variations in drying intensity reveal a double porosity (inter and inner porosities), with an inflection point observed around -20 kPa (weakly decomposed peat) and -40 kPa (highly decomposed peat). If the 'ink bottle' effect can be considered as the most relevant parameter explaining hysteresis phenomena in the lowest suctions, the use of a bimodal model of van Genuchten taking into account the contact angles showed that water repellency can explain the hysteresis phenomena in the highest suctions.



S09.01-P - SOIL MICROMORPHOLOGY: A JOURNEY FROM SOIL GENESIS TO NEW INTERDISCIPLINARY ADVANCEMENTS

Thursday 05 July 2012 from 17:00 to 18:30. Room Poster Areas

S09.01-P -1

ASSESSMENT OF SOIL STRUCTURE BY MEANS OF X-RAY COMPUTED TOMOGRAPHY IN BIODIVERSITY EXPLORATORIES GRASSLAND SITES

Katrin Kuka, Müncheberg - Germany

S09.01-P -2

CLAY MINERALS IN THE SOILS FORMED FROM GLACIAL TILL AND GLACIOLIMNIC MATERIALS IN NORTH-EASTERN POLAND

Mirosław Orzechowski, Olsztyn - Poland

S09.01-P -3

COMPARISON OF SOIL PORE NETWORK QUANTIFICATION BY X-RAY CT AND THE WATER RETENTION CURVE

Liesbeth Bouckaert, Ghent - Belgium

S09.01-P -4

FORMATION OF RARE MINERALS IN THE SAVANNAH TERRACE LANDSCAPE WITH BRACKISH INFLUENCE IN THE SINE-SALOUM BASIN IN SOUTH SENEGAL

Karl Stahr, Stuttgart - Germany

S09.01-P -5

IMAGE ANALYSIS OF SOIL THIN SECTIONS TO PREDICT THE EVOLUTION OF A CONSTRUCTED TECHNOSOL'S STRUCTURE: QUANTIFICATION OF DESCRIPTORS OF POROSITY AND AGGREGATION

Watteau Françoise, Nancy - France

S09.01-P -6

IMPACT OF RIVER RESTORATION ON TOPSOIL POROSITY IN SWISS FLOODPLAINS

Claire Guenat, Lausanne - Switzerland

S09.01-P -7

LINKING SOIL FORM AND FUNCTION USING 3D X-RAY COMPUTER TOMOGRAPHY

Karin Müller, Hamilton - New Zealand



S09.01-P -8

MICROMORPHOLOGICAL AND MINERALOGICAL PROPERTIES OF CARBONATES IN SOME ARIDISOLS AND INCEPTISOLS

Ahmad Heidari, Karaj - Iran, Islamic Republic of

S09.01-P -9

MICROMORPHOLOGY AS A METHOD OF ASSESSING THE MOUNTAIN SOIL SENSITIVITY IN ORDER TO ELABORATE THE MELIORATIVE TECHNOLOGY FRIENDLY TO ENVIRONMENT AND BIODIVERSITY

Daniela Raducu, Bucharest - Romania

S09.01-P -10

MICROSCOPIC ANALYSES AS A TOOL TO INFER THE GENESIS AND EVOLUTION OF SOILS FORMED FROM SLOPE MATERIALS IN THE CARPATHIAN FOOTHILLS (SOUTHERN POLAND)

Andrzej Kacprzak, Kraków - Poland

S09.01-P -11

NEEDLE FIBER CALCITE INDUCED BY BIOLOGICAL ACTIVITIES AND ORGANIC MATTER IN SEMIARID SOILS OF RASHAKAN REGION, URMIA, IRAN

Shahram Manafi, Urmia - Iran, Islamic Republic of

S09.01-P -12

ORGANO-MINERAL COATINGS GENESIS AND EVOLUTION FROM SOME ROMANIAN PHAEOZEMS

Daniela Raducu, Bucharest - Romania

S09.01-P -13

PEDOGENIC PROCESSES IN DRY LAKE BASINS OF THE SOUTHWESTERN KALAHARI, NAMIBIA

Eric Van Ranst, Ghent - Belgium

S09.01-P -14

POLYGENETIC EVOLUTION AND BIOTURBATION. MICROMORPHOLOGICAL STUDY OF A TERRA ROSSA SOIL IN A TRADITIONAL OLIVE CROP (SARDINIA, ITALY)

Salvatore Madrau, Sassari - Italy



S09.01-P -15

ROCK FRAGMENTS AS FACTOR OF SOIL STRUCTURE FORMATION: AN EXPERIMENTAL STUDY BASED ON SOIL MICROMORPHOLOGY AND IMAGE ANALYSIS.

Laura Gargiulo, Portici NA - Italy

S09.01-P -16

SIMULATIONS OF WATER MOVEMENT IN THE POROUS NETWORK OF DIFFERENTLY FERTILISED SOILS SCANNED WITH X-RAY MICROTOMOGRAPHY

Nicola Dal Ferro, Padova - Italy

S09.01-P -17

USE OF ORGANIC MATTER MIXED WITH CALCIUM CARBONATE PENDANTS IN ORDER TO RECORD CLIMATE CHANGE IN SEMIARID SOILS OF RASHAKAN REGION, URMIA, IRAN

Shahram Manafi, Urmia (Orumiyyeh) - Iran, Islamic Republic of



S09.01-P -1

ASSESSMENT OF SOIL STRUCTURE BY MEANS OF X-RAY COMPUTED TOMOGRAPHY IN BIODIVERSITY EXPLORATORIES GRASSLAND SITES

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Soil structure, the spatial arrangement of pores and solid soil parts, is a key element in grassland ecosystem functioning. It is hypothesized that advanced medical X-ray CT scanning gives valuable insight into the effects of soil type, management and soil biodiversity on soil structure of grassland soils. From 150 grassland sites in the Schorfheide, Schwäbische Alb and Hainich, one to three undisturbed soil cores each (12 cm diameter and height) were taken from the upper 0-12 cm soil depth with an automated sampling device. The cores were scanned with a Toshiba Aquilion X-ray CT scanner at 120 kV and 300 mA (resolution: 0.25 mm). With the three-dimensional data sets, image processing was carried out with OSIRIX and QUANTIM. The analysis of CT data revealed clear effects of parent material, soil type or earthworm activity on the arrangement and quantity of pores and aggregates at the different sites. Management practices, such as hay meadow or grazing, had an additional impact on soil structure. It is to be concluded that advanced medical X-ray CT scanning in combination with novel image processing is a suitable tool to quantify soil structure as affected by land use, soil types and biodiversity. It is hypothesized that this analysis will considerably foster the understanding of the biodiversity-ecosystem function relationship in grassland soils.



S09.01-P -2

CLAY MINERALS IN THE SOILS FORMED FROM GLACIAL TILL AND GLACIOLIMNIC MATERIALS IN NORTH-EASTERN POLAND

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Young glacial areas of northern Europe have diversified relief and are covered with formations of glacial origin. The research was carried out in three catenas in north-eastern Poland located in Sepopol Plain and Masurian Lakeland. The studied region is covered with glacial till deposited during Weichselian glaciation as well as fluvioglacial and glaciolimnic materials formed in the basins of ice-dammed lakes origin during the recession of ice sheet. The aim of the study was to analyse and compare the composition of clay minerals in the soils formed from glacial till and glaciolimnic materials in various sedimentation basins. The composition of clay minerals ($< 2 \mu\text{m}$) varied among the studied soils, within the soil profiles and in a catena sequence. In humus horizons of soils formed from glacial material illite minerals predominated. Mixed-packet minerals of illite/smectite (I/S) type, chlorites and vermiculites were also noted. In deeper horizons of soil profiles the share of smectites was higher. The composition of clay minerals in deluvial deposits corresponded to the composition of clay fraction in eroded material. Deluvial deposits lying deeper in the soil profiles were transformed in changing oxidation-reduction conditions. Clay fraction of soils formed from glaciolimnic materials was less diversified. Illite and mixed-packet minerals of illite/smectite type predominated in these soils.



S09.01-P -3

COMPARISON OF SOIL PORE NETWORK QUANTIFICATION BY X-RAY CT AND THE WATER RETENTION CURVE

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Soil structure and in particular the spatial organization of pores are responsible for regulating soil biochemical processes like soil organic matter dynamics and new techniques to study their interactions should be developed and/or refined. X-ray computed tomography (X-ray CT) is rapidly gaining importance as a technique to obtain three dimensional information about the soil structure in a non-destructive manner. However, a crucial step during image analysis for quantifying a pore size distribution is the separation of the pore space in distinct pores, but no study verified how the available algorithms compare to the classical determination of soil pore size distributions from water retention curves. Therefore, we determined the water retention curve of 8 undisturbed soil cores, where 4 soil cores (\varnothing 5cm, h 5cm) were destroyed to select 4 macro aggregates (\varnothing 2-3mm), 4 submacro aggregates (\varnothing 500 μ m) and 4 micro aggregates (\varnothing 200 μ m) by physical fractionation. These 16 soil samples, 4 undisturbed soil cores and 12 aggregates were scanned by X-ray CT and image analysis was carried out with two different software packages, the UGhent Centre for X-ray CT's program Morpho+ and the commercial software package Avizo Fire 6.2. The pore neck size distribution calculated from image analysis of the CT volumes will be compared with water retention curve data of the same soil cores to verify the separation step of the pore space with algorithms of both software packages.



S09.01-P -4

FORMATION OF RARE MINERALS IN THE SAVANNAH TERRACE LANDSCAPE WITH BRACKISH INFLUENCE IN THE SINE-SALOUM BASIN IN SOUTH SENEGAL

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In the estuary of the Saloum River near Kaolack, there is a terrace landscape formed, consisting of at least four terraces like floodplain lower, middle and higher terrace. The parent material is mainly derived from the Tertiary Continental Terminal sandstone. The soil sequence is built up by Fluvisols, Gleysols, Arenosols and Acrisols. In all soils and terraces, the Continental Terminal derived Quarz and Caolinite are dominant. However there is an influence of illitic Smectitic material through aeolian addition, which becomes increasingly important with the age of the terrace. Furthermore, there is influence of salinity and deposition of brackish clay sediments in the floodplain of the river. By mineralogical and electro microscopic analysis, typical rare minerals could be found, which characterize the soils genetically. This is halite gypsum and pyrite in the young flooded and reduced soils and it is Jarosite and krausite in the acid sulfate soils of the lower terrace (Thionic Gleysols). Also the formation of hematite and ferric properties could be observed. All these young and extreme processes could not change the general mineralogy of the soils. Therefore it is concluded parent material plays an important role in the soil physical and chemical properties, but young dynamics influence soil formation significantly.



S09.01-P -5

**IMAGE ANALYSIS OF SOIL THIN SECTIONS TO PREDICT THE EVOLUTION OF A
CONSTRUCTED TECHNOSOL'S STRUCTURE: QUANTIFICATION OF DESCRIPTORS OF
POROSITY AND AGGREGATION**

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Soil structure, through the architecture of pores and aggregates influences water infiltration and retention. Furthermore, changes in the geometric structure of pores and aggregates are reported to have relation with physical degradation of cultivated soils. In most of cases, these parameters are described qualitatively and synchronically which didn't make it possible to evaluate the evolution of soil structure with accuracy. Many parameters concerning soil structure are determined micro-morphologically or computably aid, some qualitative and others quantitative, but few works are carried out to dictate which are quantitatively better to describe the evolution of soil structure. The aim of this work was to develop a quantitative computer aided method to study the evolution of constructed Technosol's structure. For this achievement, an in situ 1 hectare plot of constructed Technosol was set up in 2007 on the experimental station of the French Scientific Interest Group: http://www.gisfi.fr/index_fr.htm. This station was divided in 24 plots. Undisturbed samples were collected in Kubiena boxes in 2008 and 2010 in each plot for thin sections preparation. Soil structures (pores and aggregates with diameter > 25 μm) were quantified by analyzing thin sections images. Pores and aggregates were classified according to their diameter (four classes: diameter > 2000 μm , 500-2000 μm ; 50-500 μm ; 25-50 μm). Eight descriptors were calculated: number, area, Crofton Perimeter, distance, volume, eccentricity, connectivity and diameter. We will discuss the parameters which better describe the evolution of porosity and aggregation between 2008 and 2010 and the consequences of this evolution on the functioning of this new constructed Technosol.



S09.01-P -6

IMPACT OF RIVER RESTORATION ON TOPSOIL POROSITY IN SWISS FLOODPLAINS

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The number of river restoration projects has strongly increased worldwide since the last decades. Soils are rarely considered in floodplain restoration assessment despite their high information potential. The aim of this study is to better understand the impact of river restoration on the genesis of topsoil structure, in particular on its poroid characteristics. Five sites were taken into account along three Swiss rivers (Rhine, Thur and Emme) with different degree of naturalness. The first one corresponds to a near-natural floodplain along the Rhine River and the others correspond to restored and embanked reaches along both the Thur and Emme Rivers. A selection of representative soils has been done in each site, yielding to nineteen representative topsoils overall. An undisturbed block has been sampled in each topsoil, impregnated with a fluorescent resin and cut in polished sections (16 × 9 × 1 cm thick). Three successive homogeneous sub-sections (4.8x3.5cm) within each section have been selected. These sub-sections were then digitized (resolution of 768x576 pixels) and the images were analysed. Twelve poroid categories have been identified according to their shape (tubular, cracks, packing) and their size (4 classes from <10000µm² to >1000000µm²). A hierarchical classification based on these porosity variables was performed to identify groups. Preliminary results show that these groups correspond to different types of horizon within topsoils characterised by their physico-chemical composition (organic matter content and texture mainly) and degree of evolution (aggregation degree). Further statistical analyses will be performed to better explain the genesis of the topsoil structure.



S09.01-P -7

LINKING SOIL FORM AND FUNCTION USING 3D X-RAY COMPUTER TOMOGRAPHY

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Soils differ in their capacity to filter pathogenic microbes. Adverse consequences can be transmission of zoonotic microbes to aquifers. We hypothesised that filtering is a function of soils' macro-pore (pores > 0.3 mm) structure that can be imaged by 3D X-ray computer tomography (CT). Two soils under permanent pasture were selected that represent different soil structure, and were known to differ in the filtering behaviour for microbes. The soils were an Allophanic (excellent filter) and a Gley Soil (poor filter). Each soil was separated to 1-m depth into structural sub-units (topsoil, Ah; upper subsoil, Bw1 or Bg1; lower subsoil, Bw2 or Bg2) assuming that each sub-unit had a specific macro-pore structure. Infiltration was measured in the field near saturation and the flow-weighted mean (macro-) pore diameter for each structural sub-unit derived. We extracted undisturbed soil cores from the centre of the infiltration areas in order to relate the macro-pore architecture, determined by X-ray CT analysis, to the tension infiltrometry. For the Allophanic Soil, the calculated flux weighted mean macro-pore diameters for all tensions close to saturation were below 0.3 mm. For the Gley Soil, the flux weighted mean macro-pore diameters for all tensions were below 0.3 mm only in the subsoil. In the topsoil, at least at tensions less than -40 mm water, they were significantly greater than 0.3 mm. We scanned the soil cores and established protocols to derive porosity, pore size distribution and connectivity of macro-pores from the 3D X-ray CT data. This analysis is on-going.



S09.01-P -8

MICROMORPHOLOGICAL AND MINERALOGICAL PROPERTIES OF CARBONATES IN SOME ARIDISOLS AND INCEPTISOLS

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Carbonates are among the most common soil constituents in arid and semiarid zones. They show many significant differences in chemical and mineralogical, suite, origin, physical and micro morphological properties and their activities in soil. The differences cause to different properties in calcareous soils. Six profiles of Aridisols and Inceptisols with carbonate accumulations were selected and analyzed according to standard methods. After analyzing the physical and chemical properties thin sections were prepared and analyzed for distinguishing the origin of carbonates using staining with figel and red alizarin red solutions. Powder X ray diffractometry carried out for carbonates detection, while clay mineralogy was done on the oriented pure clay samples. Micromorphology and mineralogy of carbonates (nodules, sparite, micrite, needle-shape calcite and laminar cap) showed that the dominant carbonatic mineral was calcium carbonate. However calcium/magnesium carbonates were also recognized in some cases. The dominant clay minerals were smectites.



S09.01-P -9

MICROMORPHOLOGY AS A METHOD OF ASSESSING THE MOUNTAIN SOIL SENSITIVITY IN ORDER TO ELABORATE THE MELIORATIVE TECHNOLOGY FRIENDLY TO ENVIRONMENT AND BIODIVERSITY

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*In the current context of the global climate changes, in the Carpathians exercises strong pressure on mountain ecosystems due to the massive and uncontrolled deforestation, expansion of the urban areas and land restitution (followed, mostly by land use changing). In these circumstances, the sensitivity of the mountain soils underposed on their existing precarious balance with the environment. The paper emphasized the sensitivity of the mountain soils from a catena, consisting of five soil profiles, located on a slope of the Padurea Craiului Mountains of the Romanian Western Carpathians. The data show a very low pH of the studied soils, ranging from 4.45 to 5.76, as a result the vegetation is acidophilus, dominated by species as *Luzula luzuloides* and *Nardus stricta*. The organic matter content is low in all the studied profiles, as well as the N, P, K values. The soils from the lower part of the slope are strongly affects by stagnogleyization and mobilization of the plasmic material, which generated many types of redoximorphic features and depleted pedofeatures. In order to remove or mitigate the negative effects of the land restrictions and according either to the limiting factors generated by relief and soil conditions, the meliorative works are complexes, while the applied technologies must be friendly with the environment and biodiversity. In conclusion, the melioration will modify the present soil status. Thus, the soil biodiversity, which is currently limited and specialized, being adapted to hard environmental conditions, will be also strongly modify.*



S09.01-P -10

MICROSCOPIC ANALYSES AS A TOOL TO INFER THE GENESIS AND EVOLUTION OF SOILS FORMED FROM SLOPE MATERIALS IN THE CARPATHIAN FOOTHILLS (SOUTHERN POLAND)

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The investigated area is situated in the northern marginal zone of the Carpathian range. The bedrock is mainly composed of sedimentary rocks, called the Carpathian flysch. The flysch formations are interbedded sandstones, mudstones and shales. However, a large part of interfluvial and slopes is covered by silty materials of varied thickness, assumed to be of eolian genesis. The land is used as managed forests and, to a large extent, for agriculture. The research, apart from pure pedological methods, comprised also a macroscopic analysis of rock fragments lithology, supported by microscopic analysis of thin sections in order to increase the possibility of interpretation. The mineral composition of soils, slope sediments and underlying rocks was examined using the XRD method. The obtained results prove a complex genesis of soil substrate due to solifluction and eolian accumulation. Numerous discontinuities were detected within soil parent material. Against this background soil micromorphology was studied to infer the role of varying soil substrates in soil genesis, first of all the formation of illuvial, argic and fragipan horizons. The influence of colluvial processes, induced by human activity, in controlling soil properties is also discussed. The results are presented in relation to the concept of allochthonous model of soil genesis and the model of cover-beds formation in the Central Europe. The study was financially supported by a MNiI grant no. N N305 018037.



S09.01-P -11

NEEDLE FIBER CALCITE INDUCED BY BIOLOGICAL ACTIVITIES AND ORGANIC MATTER IN SEMIARID SOILS OF RASHAKAN REGION, URMIA, IRAN

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Pedogenic forms of calcium carbonate are valuable tools in evaluating soil age, degree of soil evolution, paleoenvironmental conditions and soil classification in arid and semiarid regions. Micromorphologically, in soil environments, there are different forms of pedogenic calcite like, needle fiber calcite(NFC), pendants, coatings and cappings. In this study, needle fiber calcite, from Rashakan region of Urmia-Iran were investigated. Needle-fiber calcite forms infillings and coatings on surfaces of large voids, peds, and coarse fragments. These needles in our soils have 0.5 to 1 μm thick and 5 to 10 μm long and are mainly of MA and MB type of Verrecchia and Verrecchia (1994). These types are found together inside pores with a random fabric. In thin sections, the needle fiber calcite coatings were observed in near surface horizons, which contain more organic matter more than deeper horizons. This, together with the presence of decayed organic residues in voids containing needle fiber calcite, allow us to conclude that they have formed as a result of decomposition of organic matter in voids, where the conditions are given for the maintenance of organic Ca-containing components and also calcified dead roots. Additionally, biologic (or organic) origin of needle fiber calcite was confirmed with SEM studies and X-ray point analyses. SEM studies revealed some rounded structures. The rounded structures suggest a biological origin for needle fiber calcite. X-ray point analyses on one needle confirms that it is calcium carbonate. The needles are most probably of organic origin because they have tubular morphologies, with longitudinal septa.



S09.01-P -12

ORGANO-MINERAL COATINGS GENESIS AND EVOLUTION FROM SOME ROMANIAN PHAEOZEMS

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The paper emphasizes the micromorphological and mineralogical characteristics related to the morphology, genesis and evolution of organo-mineral coatings from some Phaeozems. The studied profiles are located in Bucovina and Transilvania regions from Romania. Mineralogical analysis of clay fraction identified in some of studied profiles illite, smectite and caolinite. The quantitative mineralogical differences in soil profiles are due either to parent material or to some local pedogenetic conditions. The chemical analysis emphasises that the humine represents about 50% (from the organic carbon), while humic acids are higher than 20 - 42%. Fulvic acids are very low (0.23 - 0.25%) in all the studied profiles. Ca-humic acids are prevalent (100% from humic acids). Micromorphological study showed a high variety of clay coatings: from impure clay coatings, very rich in black organic matter ("chroma ? 2 and value ? 3.5"), which sometimes masked the clay (organo-mineral coatings); to pure clay coatings ("argillane"), with rare or no impurities. These coatings varieties represent sequences of their evolution in time (from impure to pure clay coatings), as a result of organic impurities biodegradation by soil microorganisms. The presence of this variety of coating marked the evolution within the soil profiles or along a toposequence (the former impure clay coatings being characteristics for younger soils, while the second type, pure clay coatings, being characteristic for older, more developed soils).



S09.01-P -13

PEDOGENIC PROCESSES IN DRY LAKE BASINS OF THE SOUTHWESTERN KALAHARI, NAMIBIA

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In parts of the Kalahari, the landscape is marked by a high concentration of small closed basins or pans. These dry depressions often contain Quaternary lacustrine deposits, whose thickness and nature varies between basins. The deposits are affected by various types of pedogenic processes, acting along the present basin floor and occasionally associated with palaeosurfaces. The nature of these processes was extensively documented by the study of ~15 pan basins in the Aminuis region of the Southwestern Kalahari in eastern Namibia, concentrating on micromorphological and mineralogical characteristics of the deposits. Pedogenic processes affecting the pan deposits include mechanical processes, causing changes in structure and translocation of soil particles: (i) structure development, (ii) bioturbation, (iii) crust development, and (iv) clay illuviation. All other significant processes are processes of mineral formation and transformation, for specific compounds: (i) calcium carbonate formation and dissolution, (ii) gypsum formation, dissolution and replacement, (iii) halite formation and redistribution, and (iv) formation of highly soluble sulfate salt minerals such as glauberite, eugsterite and kalistrontite. The study of the features recording these processes, including variations within samples, profiles and basins as well as differences between basins, provides information about the factors that control their occurrence. Important factors are recognized to be sediment composition and texture, lithological discontinuities, macroporosity, salinity, groundwater depth, and groundwater flow patterns. The results are applicable to soil environments and to various soil-related lake environments.



S09.01-P -14

POLYGENETIC EVOLUTION AND BIOTURBATION. MICROMORPHOLOGICAL STUDY OF A TERRA ROSSA SOIL IN A TRADITIONAL OLIVE CROP (SARDINIA, ITALY)

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The origin of Mediterranean red soils has been the subject of numerous studies. Complex genetic processes, and massive inputs of allochthonous materials such as wind-blown Saharan dust and volcanic ashes, have been advocated to interpret their genesis. Furthermore, in the Mediterranean Basin Terra Rossa soils have been allocated to traditional permanent crops such as the olive groves, which had a profound influence on the development of the soil features especially in the root-zone. The present study was carried out in a traditional olive grove nearby Sassari (Sardinia, Italy), where the land use remained unchanged for the last 150 years, on Terra Rossa developed on Miocene marine limestone. Chemical, physical and mineralogical analyses were carried out on the bulk samples along with thin section and SEM observations undertaken on the undisturbed aggregates collected from the rhizosphere horizons of the olive tree. The results obtained highlighted the poly-genetic character of soil formation, which included Saharan dust input, together with the effects of vigorous bioturbation and stress phenomena.



S09.01-P -15

ROCK FRAGMENTS AS FACTOR OF SOIL STRUCTURE FORMATION: AN EXPERIMENTAL STUDY BASED ON SOIL MICROMORPHOLOGY AND IMAGE ANALYSIS.

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Available studies that address the controversial role of rock fragments in soil functioning are often oriented to assess effects of their presence in relation to specific applicative problems like soil erosion or influence in agricultural practices. Experimental research is mostly based on water flow monitoring after rainfall simulation using soil boxes with stones added at different concentrations. However mechanisms explaining the measured changes in soil water flow rate can only be speculated without a direct observation of the modification of the pore network. A lab experiment was carried out here on five natural soils selected for their different physical properties aiming at studying the interaction between different soil matrices and rock fragments by soil micromorphology and image analysis. Two concentrations of three different sizes of rock fragments were mixed with the soil material after sieving and put in flowerpots having diameter of 25cm; then such samples have undergone nine wet/dry cycles. At the end the samples were impregnated with fluorescent resin and soil blocks obtained were examined by image analysis. Results showed that rock fragments induced pore formation contiguous to the stones and fractures through the soil matrix. Concentration of the stones has shown to be related to the density of the soil fractures, the size of the fragments to the width while the shape of the stones influenced the orientation of the fractures. Shrinkage range and plasticity were the most important physical properties which explained the different reactivity of the five soil matrices in the soil structure formation process.



S09.01-P -16

SIMULATIONS OF WATER MOVEMENT IN THE POROUS NETWORK OF DIFFERENTLY FERTILISED SOILS SCANNED WITH X-RAY MICROTOMOGRAPHY

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The reliable prediction of water flow through the porous media is of great interest for soil scientists since it allows the estimation of water and contaminants movement in the complex pore . The present paper: a) describes an innovative method to characterise the saturated hydraulic conductivity through the pore network using the images obtained by X-ray microtomography; b) presents a labelling and segmentation method to divide the pore network into smaller connected components c) uses Smooth Particle Hydrodynamics framework to create a computational model of the pores d) compares a flow simulation on the resulting model with laboratory measurements. A total of 12 undisturbed soil cores (3 replicates; 5 cm diameter, 6 cm length), characterised by organic, mineral and no fertilisation, were imaged with the following Computed Tomography operating conditions: 1200 projections with Voltage and Current settings at 100 kV, 300 μ A. Each projection was the mean of 10 and scan time was 7 images s⁻¹. The final pixel resolution was 40 μ m. Reconstructed greyscale images were converted into a binarised stack. The pores were labelled and connected components participating in percolation formed the network model used to simulate saturated hydraulic conductivity (Ks). Fluid flow inside the pore structures was computed using the mesh-free method Smoothed Particle Hydrodynamics (SPH). Successively Ks was calculated on the same soil cores with a laboratory permeameter to compare experimental and modelling results. Laboratory measurements of Ks were in agreement with SPH results and proved the reliability of the method to estimate hydraulic properties.



S09.01-P -17

USE OF ORGANIC MATTER MIXED WITH CALCIUM CARBONATE PENDANTS IN ORDER TO RECORD CLIMATE CHANGE IN SEMIARID SOILS OF RASHAKAN REGION, URMIA, IRAN

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Different forms of calcium carbonate accumulations are present in soils of arid and semi arid regions. Some of most common forms of calcite in micromorphological studies of soils are calcium carbonate pendants, coatings and cappings of calcium carbonate, needle fiber calcite and cytomorphic calcite. Accumulation of secondary calcium carbonates in arid and semiarid regions is a valuable tool in evaluating the degree of soil evolution, soil age, paleoenvironmental reconstruction, soil classification and land use. Especially, laminated pedogenic calcium carbonate pendants can provide some evidence about local environmental and climatic changes. In this study, pedogenic calcium carbonate pendants from Rashakan region of Urmia-Iran were investigated polarizing microscope. Carbonatic pendants occur as mammillary to botryoidally stalactite-like masses (segregation), which grow downwards from the bottom of coarse fragments. Pendants are multilayered and composed of two to five light and dark colored layers indicating the differences in conditions of calcite precipitation. The sequences of light and dark colored laminae in pendants probably can represent climatic changes. We suggest that light colored laminae with relatively pure calcite have been precipitated in dry periods that climatic conditions were not favorable for biological activity. Whereas, the dark colored laminae, composed of calcite and some organic impurities, have been formed in relatively wet periods with better conditions for biological activity. Thus, the sequence of light and dark colored laminae can be used as a tool for paleoclimate and paleoenvironmental research.



S09.02-P - BIOGEOCHEMICAL INTERFACES IN SOIL: ARCHITECTURE, PROPERTIES AND FUNCTIONS

Thursday 05 July 2012 from 17:00 to 18:30. Room Poster Areas

S09.02-P -1

ADVANCED CHARACTERIZATION OF MACROPORE FLOW IN UNDISTURBED SOIL CORES USING TIME RESOLVED THREE-DIMENSIONAL CT IMAGES

Stéphane Sammartino, Avignon - France

S09.02-P -2

EFFECTS OF MODERATE WARMING ON THE STRUCTURE AND RHEOLOGY OF A FLUOROHECTORITE CLAY IN WATER

Elisabeth Lindbo Hansen, Trondheim - Norway

S09.02-P -3

EVALUATION OF SOIL POROSITY UNDER DIFFERENT MANAGEMENT SYSTEMS USING COMPUTED TOMOGRAPHY

José Marcos Garrido Beraldo, Matão - Brazil

S09.02-P -4

EXPLORATION OF INTERFACE AND PORE-SPACE PROPERTIES ON THE CONTINUUM SCALE USING CLOSED-FLOW COLUMN EXPERIMENTS

Thomas Ritschel, Jena - Germany

S09.02-P -5

HOW CAN NMR RELAXOMETRY, MAGNETIC RESONANCE IMAGING, X-RAY CT AND PARTICULATE CONTRAST AGENTS WITH FINELY TUNED INTERFACIAL PROPERTIES, HELP UNDERSTANDING PARTICLE TRANSPORT IN SOIL.

Eric Michel, Avignon - France

S09.02-P -6

HOW TIME-LAPSE X-RAY TOMOGRAPHY CAN HELP UNDERSTANDING COLLOID MOBILIZATION MECHANISMS IN UNDISTURBED SOIL CORES: A CASE STUDY.

Eric Michel, Avignon - France



S09.02-P -7

ORGANIC MATTER COMPOSITION AT FLOW PATH SURFACES IN STRUCTURED SOILS USING DRIFT MAPPING

Horst H. Gerke, Müncheberg - Germany

S09.02-P -8

ORGANIC MATTER DISTRIBUTION IN SOIL FRAGMENTS FROM DIFFERENT CROPPING SYSTEMS: AN APPROACH COMBINING EXPERIMENTAL AND MODELLING TOOLS

Sabrina Juarez, Thiverval Grignon - France

S09.02-P -9

PROPERTIES OF NATURAL SOIL COLLOIDS STUDIED BY AFM AND SEM

Arkadiusz K. Wieczorek, Jena - Germany

S09.02-P -10

SOIL CLAY OIL SUSPENSIONS SUBJECTED TO ELECTRIC FIELDS

Zbigniew Rozynek, Trondheim - Norway

S09.02-P -11

A METHOD FOR COUPLED, QUASI-SIMULTANEOUS MEASUREMENT OF OXYGEN DIFFUSION RATE (ODR) AND REDOX POTENTIAL (EH) IN UNSATURATED AGRICULTURAL SOIL

René Reiser, Zürich - Switzerland

S09.02-P -12

BIO-CLOGGING OF SANDY SOIL USING XANTHAN AND DIFFERENT CROSSLINK

Farzin Kalantary, Tehran - Iran, Islamic Republic of

S09.02-P -13

BIOGEOCHEMICAL INTERFACES IN SOIL: THE DECADAL CHALLENGE TO FUNDAMENTAL SOIL RESEARCH

Kai U. Totsche, Jena - Germany

S09.02-P -14

BIOLOGICAL STABILIZATION OF SANDY SOILS BY THE USE OF INDIGENOUS BACTERIA

Farzin Kalantary, Tehran - Iran, Islamic Republic of



S09.02-P -15

CATION EXCHANGE REACTIONS WITH CU COMPROMISE THE EFFECTIVENESS OF FEEDDHA CHELATES AS SOIL-APPLIED FE FERTILIZER

Walter Schenkeveld, Vienna - Austria

S09.02-P -16

COATING OF MODEL SURFACES WITH ORGANIC FUNCTIONAL GROUPS

Susanne K. Woche, Hannover - Germany

S09.02-P -17

CONTRIBUTION OF DIFFERENT MICROORGANISMS TO CELL WALL ENVELOPE (PATCHY FRAGMENT) FORMATION IN SOIL

Jan Achtenhagen, Leipzig - Germany

S09.02-P -18

CONTRIBUTION OF DISSOLVED ORGANIC MATTER AND ROOT EXUDATION TO THE ANTIOXIDANT CAPACITY OF SOIL SURROUNDING WHEAT ROOTS

André Schlichting, Rostock - Germany

S09.02-P -19

HOW DOES OXIDATIVE DEGRADATION OF ORGANIC MATTER AFFECT SURFACE AREA AND MICROPOROSITY? – A COMPARISON OF THREE COMMON REMOVING AGENTS

Cordula Vogel, Freising-Weihenstephan - Germany

S09.02-P -20

HUMIC SUBSTANCES (HS) MODELS – WATER AND CATIONS INTERACTING WITH HS NANOPORES

Martin Gerzabek, Vienna - Austria

S09.02-P -21

ORGANO-MINERAL ASSOCIATIONS IN AN ANDISOL DEVELOPED FROM VOLCANIC ASHES (PART 2): A SEQUENTIAL DENSITY FRACTIONATION APPROACH

Rota Wagai, Tsukuba, Ibaraki - Japan

S09.02-P -22

RESTRUCTURING OF ORGANIC COATINGS UPON DRYING: CONSEQUENCES FOR THE ACCESSIBILITY OF SORPTION SITES

Jaane Krüger, Berlin - Germany



S09.02-P -23

*THE EFFECT OF DRYING, FREEZING AND AGEING ON THE EXTRACTION OF
NONYLPHENOL AND PHENANTHRENE FROM MONO- AND POLYVALENT CATION
SATURATED SOILS*

Bernd Marschner, Bochum - Germany



S09.02-P -1

ADVANCED CHARACTERIZATION OF MACROPORE FLOW IN UNDISTURBED SOIL CORES USING TIME RESOLVED THREE-DIMENSIONAL CT IMAGES

Sammartino Stéphane^{*[1]}, Capowiez Yvan^[5], Michel Eric^[3], Ruy Stéphane^[1]

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Macropore flow refers to rapid by-pass flow occurring in natural macropores (e.g. earthworm burrows, spaced left by decayed roots, desiccation cracks and inter-aggregates spaces) [1]. During water infiltration, macropore flow may occur, controlled by the balance between vertical and lateral flow rates at macropore surfaces and by the connectivity and geometrical properties of the macroporous network. Although soil macroporosity has been widely characterized, the dynamic of water infiltration in undisturbed macroporous soils is still poorly understood and modeled. Some fundamental questions still remain i) the location of preferential flow paths in the macroporous network and ii) the determination of flow regimes in the active macropores [2]. We propose to characterize macropore flow and preferential flow paths geometry in an undisturbed soil core initially at field capacity using time resolved localization of water infiltration. Our results are based on the 3D images recently obtained thanks to a novel methodological approach developed using the serial images acquired with a multi-slice helical CT during a simulated rainfall. Water flow in macropores will be characterized by 1) the occurrence and detection of "water voxels" in the macroporous network and 2) the localization and water filling of the active macropores as a function of time. Finally, results will be discussed taking into account for the temporal and spatial resolutions (voxel size) of the 3D images [3]. [1] Jarvis, N. J. 2007. *Eur. J. Soil Sci.* 58:523-546. [2] Allaire et al. 2009. *J. Hydrol.* 378:179 – 204. [3] Sammartino et al. 2010 *Proceeding workshop "CESAR"* ISBN 87-91949-59-9.



S09.02-P -2

EFFECTS OF MODERATE WARMING ON THE STRUCTURE AND RHEOLOGY OF A FLUOROHECTORITE CLAY IN WATER

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Dispersions of swelling 2:1 clays in water have the ability to form soft solid phases, a feature that has inspired a number of investigations on the nature of dynamically arrested states in clay systems. In the present study we focus on aqueous dispersions of the synthetic 2:1 clay Na-fluorohectorite, and explore to our knowledge for the first time the prominent role that temperature plays in this system, with regards to particle morphologies and the rheological response to shear. In particular, we find that warming above roughly 40 deg C causes a tenfold increase in the yield stress, and show that this behaviour is caused by the dramatic expansion of the interlayer space of stacked particles, approaching a state of complete particle delamination.



S09.02-P -3

EVALUATION OF SOIL POROSITY UNDER DIFFERENT MANAGEMENT SYSTEMS USING COMPUTED TOMOGRAPHY

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The objective of this work was to evaluate soil porosity under conventional cropping system, no-tillage system and native forest using the computed tomography. Three soil management systems were selected for study: conventional cropping system, no-tillage system and native forest. The soil in the experimental area is Rhodic Eutrudox. Undeformed soil samples were collected in layers of 0.0–0.10 m from an experimental field in Jaboticabal, SP, Brazil. The tomographic images were obtained using a system of X-ray microtomography. After obtaining the images, they were processed and a methodology was evaluated for image conversion to numeric values. The method provided greater accuracy was the method of percentile. The methodology used to analyze the tomographic image possible to quantify the porosity of the soil under different soil management. The soil management changed the porosity of the soil and this difference was more in areas under no-tillage and conventional tillage compared with the area under native forest.



S09.02-P -4

EXPLORATION OF INTERFACE AND PORE-SPACE PROPERTIES ON THE CONTINUUM SCALE USING CLOSED-FLOW COLUMN EXPERIMENTS

Ritschel Thomas*^[1], Totsche Kai Uwe^[1]

^[1]Institute of Geosciences / Friedrich-Schiller-University ~ Hydrogeology ~ Jena ~ Germany

The sorption of dissolved and colloidal substances to immobile sorbents results in the phenomenon of retardation of transport. Besides the interaction at the mineral-water-interface, the sorption rate depends also on the spatial structure of the pore network (size distribution, connectivity, topology). Column experiments allow for the consideration of the structure and thus for a quantification of possible rate limitations. We focus on column experiments run in closed-flow mode. There, a typical oscillation in the breakthrough of solute concentration, which conveys additional information about hydraulic properties (dispersivity, water content, immobile water) as well as the effective interaction kinetics, can be observed. Our objective is to study the interaction between different solutes (conservative tracers, e.g., NaCl or LiBr and reactive tracers, e.g., phenanthrene, difluorbenzene or polygalacturonic acid) and artificial porous media (composed of quartz, illite, goethite and charcoal). The effect of transport on the structure is tracked by X-ray computed tomography measurements of the pore space within the columns. The breakthrough of solutes is measured with non-consuming techniques (fluorescence spectroscopy or electrical conductivity measurements) to ensure chemical equilibrium without affecting the mass balance of the closed system. Interaction parameters obtained from breakthrough data are used to quantify the availability of reactive mineral surfaces or effective rates of physical and chemical non-equilibrium processes. After the column experiments, the effect on the microtopology and mineral surfaces is investigated by atomic force microscopy and scanning electron microscopy. First results allowed for the reconstruction of an adsorption isotherm of oxalate on goethite.



S09.02-P -5

HOW CAN NMR RELAXOMETRY, MAGNETIC RESONANCE IMAGING, X-RAY CT AND PARTICULATE CONTRAST AGENTS WITH FINELY TUNED INTERFACIAL PROPERTIES, HELP UNDERSTANDING PARTICLE TRANSPORT IN SOIL.

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The capability to predict the fate of colloidal particles in soils is of paramount importance for scientists, engineers or policy-makers, as such particles can carry adsorbed pollutant towards the groundwater or be themselves pollutants. Current models often fail to predict actual transport properties, indicating the need for a better understanding of the processes controlling particle attachment, detachment and transport within the soil porosity. Some of these processes can only be studied indirectly (e.g. examining particle breakthrough curves during simulated rainfalls), and soil columns can be considered as “black box” systems. Imaging techniques (X-ray tomography, MRI) have been increasingly used to study water movement in soil cores, but they have seldom been applied to investigate the fate of colloidal particles in the soil. With the aim of comparing their transport properties, both in saturated sand columns and repacked soil cores, we synthesized maghemite nanoparticles and stabilized them by adsorbing either ionic species onto their surface or neutral poly(ethylene-glycol) chains. The ferrimagnetic nanoparticles provided an important contrast for NMR imaging and relaxometry (longitudinal relaxation better than 35 s-1 mM-1). This allowed us to determine the path of the particles in the porous media as well as the locus of their possible retention. As expected, the contrast for X-ray CT was quite low (5 Hounsfield Units per gram of iron) but was nevertheless sufficient to record the dynamics of the particle pulse moving through the cores. We'll discuss how these spatialized informations shed a new light on particle transport processes.



S09.02-P -6

HOW TIME-LAPSE X-RAY TOMOGRAPHY CAN HELP UNDERSTANDING COLLOID MOBILIZATION MECHANISMS IN UNDISTURBED SOIL CORES: A CASE STUDY.

Michel Eric^[1], Porez Aurore^[1], Sammartino Stéphane^[1], Capowiez Yvan^[2]

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Modeling colloidal-sized particle mobilization and transport in soils is a matter of interest to both pedologists (lessivage of clay is thought to be a widespread pedogenesis process) and to those dealing with ground water protection (colloid can act as vectors for sorbing pollutants, transporting them from the surface to the water table). The mechanisms leading to the detachment of these particles are still poorly understood, and as a consequence, the available models are often situation specific and far from being prediction tools. This contribution investigates the effect of rainfall intensity on particle mobilization. This factor has already received some attention but studies published to date showed contrasted results: in some cases mobilization was found to increase with rainfall intensity, while in other it was not affected by intensity changes. We will review shortly the potential reasons of this lack of agreement. We'll then show how (i) a carefully tailored experimental situation involving simulated rainfall events at the columns scale, combined with (ii) a new X-ray tomography technique allowing to visualize water flow in macropores during a simulated rainfall event [1] helped ascertain the effect of rain intensity on particle mobilization. Finally, we will discuss how these results provide a basis to elaborate a mechanistic model of particle mobilization based on the approach by Michel et al. [2] and taking into account the effect of rainfall intensity. [1] Sammartino et al. 2010. Proceedings of the international conference "CESAR", Aarhus University Press, ISBN 87-91949-59-9 [2] Michel et al. 2010. Vadose Zone J. 9:307-16



S09.02-P -7

ORGANIC MATTER COMPOSITION AT FLOW PATH SURFACES IN STRUCTURED SOILS
USING DRIFT MAPPING

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During preferential flow in structured soils, percolating reactive solutes interact predominantly with surfaces of flow paths. These surfaces consist of coatings with an outermost layer that is mostly covered by organic matter (OM). We hypothesize that OM composition of these layers finally controls wettability and sorption properties during preferential movement of solutes. Here, the 2D-spatial distribution of soil OM composition at such intact aggregate and biopore surfaces was studied using Fourier transformed infrared spectroscopy in diffuse reflectance mode (DRIFT). For worm burrows, cracks and root channel, mm-scale maps of OM composition were obtained for samples from different soils. The OM composition is focusing on the CH-/CO- functional group ratios. The results of DRIFT mapping show highly heterogeneous small-scale distributions of OM composition, which indicates yet unknown implications for preferential flow and reactive transport of solutes.



S09.02-P -8

ORGANIC MATTER DISTRIBUTION IN SOIL FRAGMENTS FROM DIFFERENT CROPPING SYSTEMS: AN APPROACH COMBINING EXPERIMENTAL AND MODELLING TOOLS

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Soil respiration is very heterogeneous at scales from the landscape to the aggregate/pore scale, but geostatistical studies suggest that much of the spatial variability is due to processes that occur at microscales. Microbial communities live in the soil pore network and therefore the access they have to organic substrate, oxygen and water is likely to depend on their location within this network as well as on the distribution of organic carbon. Although the relationship between microorganisms and the soil pore network has been studied, to our knowledge, the relationship between pore space architecture and organic matter in has not. This is probably due to the technical difficulties associated with such measurements. The aims of the study therefore, are to identify possible correlations between pore network properties and organic carbon properties at the microscale and to map soil carbon distribution in the pore space topology. This will be achieved by relating pore architecture to organic carbon of soil fragments extracted from soils under different cropping systems (Conventional, Organic and No-tilled), which therefore have different soil structures and organic matter qualities and quantities. The descriptors of pore geometry and connectivity (interconnectedness of the space, distribution of throats diameters, clustering coefficients) will be determined by computer aided X-ray tomography (CAT), and the organic carbon quantity and composition will be measured by elemental analysis, infrared spectroscopy and pyrolysis.



S09.02-P -9

PROPERTIES OF NATURAL SOIL COLLOIDS STUDIED BY AFM AND SEM

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Colloids are involved in a multitude of biogeochemical and physicochemical processes in natural soil systems. They may act as mobile reactive carriers, resulting in either reduced or enhanced solute mobility [1]. Interactions of colloids with themselves and with the immobile solid phase not only affect the hydraulic properties, but severely change geometric, mechanic and physicochemical properties of interfaces. Particularly important are the mineral-organic mixed colloidal phases. They form from complex natural solutions either by the way of sorption or co-precipitation [2][3]. The presence of organic substances during development of colloid may not only affect mineral formation and growth, but also colloid stability by additional steric stabilization forces [4]. Thus, these nanoparticulate mixed phases may be much more stable and mobile than classical mineral, organic, or biotic colloids. In this study, colloids from the effluent from an anoxic floodplain soil (Gleyic Fluvisol) were collected for thorough spectro-microscopic analysis including Scanning Electron Microscopy (SEM), Energy-Dispersive X-ray Spectroscopy (EDX) and Atomic Force Microscopy (AFM). Chemical composition and characterization of the geometric features (size, particle shape, surface area, and roughness) of these particles was possible. Furthermore, the new features of AFM allowed us to obtain nanomechanical properties, including adhesion, elastic modulus, hardness, and energy dissipation of the sample material. [1] Totsche & Kögel-Knabner (2004) *Vadose Zone Journal* 3(2), 352-367. [2] Eusterhues et al. (2008) *Environ. Sci. Technol.* 42, 7891-7897. [3] Eusterhues et al. (2011) *Environ. Sci. Technol.* 45, 527-533. [4] Fritzsche et al. (2011) *Environmental Pollution* 159, 1398-1405



S09.02-P -10

SOIL CLAY OIL SUSPENSIONS SUBJECTED TO ELECTRIC FIELDS

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Electric-field induced structuring from two types of soil clay particles belonging to the kaolin group of minerals, namely kaolinite and halloysite, were studied in relation to the electrorheological response of silicone oil and paraffin dispersions of both clays. Firstly, the structural and morphological properties of both types of clays were probed in detail by means of XRD and FTIR techniques. The second part of this contribution is related to the E-field induced structuring from both types of clay particles, and that was investigated by means of WAXS with a support of SEM, TEM and optical microscopy techniques. Finally, the electrorheological response of the samples was measured. Well-structured kaolinite particle dispersions were found to have an improved response relative to dispersions of the less-structured halloysite particles. Results of electrical current measurements indicated that the improved current response of halloysite vs. kaolinite may arise from involvement of small amount of surface adsorbed water molecules as the applied potentials are far above the water oxidation/reduction electrode over-potentials. The recommended literature to the following main subjects: electric-field induced structuring from clays [1-2], electrorheological properties of clays [3-4]. [1] Fossum J O et al., Europhysics Letters 74 (2006) 438-444. [2] Rozynek Z et al., J. Phys.: Condens. Matter 22 (2010) 324104. [3] Wang B et al, J. Mater. Chem. 19 (2009) 1816. [4] Méheust Y et al, J. Rheol. 55 (2011) 809.



S09.02-P -11

A METHOD FOR COUPLED, QUASI-SIMULTANEOUS MEASUREMENT OF OXYGEN DIFFUSION RATE (ODR) AND REDOX POTENTIAL (EH) IN UNSATURATED AGRICULTURAL SOIL

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Monitoring the temporal course of the redox status of a soil is challenging, since the redox conditions in soil can be extremely heterogeneous. The electrochemical technique reading EH as the voltage between a platinum electrode and a reference electrode seems ideal for continuous and replicate readings. The oxygen diffusion rate (ODR) is frequently used as an indicator for soil aeration and is regarded as a parameter relevant for plant growth. On the other hand, ODR is rarely used as an indicator for changes in soil redox conditions, since it is not obvious which ODR threshold is relevant and stimulates soil microorganisms to turn to anaerobic respiration. A system combining the two electrochemical methods provides additional information and can compensate for some of the losses which are inherent to discrete ODR and EH systems, respectively. For this reason we have established a multiplexer-logger based system for automated quasi-simultaneous recording of ODR/EH-data pairs, each at one and the same platinum electrode. The shortest possible relaxation period after ODR readings allowed a maximum record of three coupled ODR/EH-data pairs per day and reading point in the soil. The ODR/EH-interrelationship was inherently unaffected by soil heterogeneity and thus, the time course of soil redox conditions could be interpreted as a result of oxygen availability and biological activity. Moreover, ODR seemed sensitive under some redox conditions where the EH measurement was insensitive and vice versa. First results from a lysimeter study and from a field trial on controlled traffic farming will be presented.



S09.02-P -12

BIO-CLOGGING OF SANDY SOIL USING XANTHAN AND DIFFERENT CROSSLINK

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Bio-clogging is a method that use for reducing the hydraulic conductivity of soil and porous rocks due to microbial activity or products. A polymer is a large molecule formed by the repeated bonding together of many smaller units (monomers). Bio-polymers are naturally occurring polymer driven from alga, fungus or bacteria sources, and primarily comprise polysaccharides. Xanthan bio-polymer produced by the slime forming bacteria Xanthomonas Campestris is the first microbial polysaccharide of commercial significance. In this study effect of Xanthan in different crosslink and pH on hydraulic conductivity of poorly graded (uniform) medium sand sample were investigated. Improvised falling head test was used to measure hydraulic conductivity. Permeability of the soil after the introduction of Xanthan was reduced by 10^{-3} time. Keywords: Bioclogging, Xanthan, permeability, Falling Head Test, Crosslink.



S09.02-P -13

BIOGEOCHEMICAL INTERFACES IN SOIL: THE DECADEAL CHALLENGE TO FUNDAMENTAL SOIL RESEARCH

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Soil is a dynamic, hierarchically organized, frequently aggregated system of a vast variety of organic and inorganic constituents and diverse communities. The unique spatial architecture of soils defines a large, complex and heterogeneous biogeochemical interface (BGI). The biogeochemical and physicochemical processes are key factors for ecosystem functions. Ultimately, these processes control the fate and transport of contaminants and nutrients and such their biogeochemical cycling. Yet, our general quantitative understanding of the fundamental mechanisms in soils and of soils role for ecosystem services across scales is still in its infancy. In 2007, the German Research Foundation has responded to the growing need for structured and interdisciplinary research on the formation, architecture, maturation and function of BGI in soil by establishing the priority research program SPP 1315 "Biogeochemical Interfaces in Soil" which aims at the structural characterization and functional exploration of BGI. The objective is to unravel und mechanistically understand the interplay and interdependencies of chemical, biological and physical processes on and at BGI that control water and energy flow as well as the fate and cycling of organic chemicals. The program runs now for 4.5-years and a nationwide, inter-disciplinary program with a tight and vivid network structure employing joint experiments and thematic groups across scientific disciplines has now evolved. The presentation will review the major challenges of biogeochemical interface research in soil and present the new avenues strode by the priority program SPP1315 "Biogeochemical Interfaces in Soil" in shaping this emerging and exciting field of fundamental soil research.



S09.02-P -14

BIOLOGICAL STABILIZATION OF SANDY SOILS BY THE USE OF INDIGENOUS BACTERIA

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Abstract: The main objective of this study was to investigate suitable cost-effective microbial process of biological stabilization of sandy soils by the use of indigenous urease active bacteria isolated locally in Iran. Soil samples were collected from Eshtehard mountain region in Alborz province and were experimentally elaborated to isolate and purify different bacteria. Then their urease activity was determined and the superior strain was selected with respect to the capability of producing urease enzyme. A homogenous suspension from this special strain was prepared and its urease activity was evaluated. Columns of sandy soils, collected from the southern shores of Caspian Sea, were then injected with the bacteria and the reacting solution in plastic beakers. A period of 7-10 days were allowed for the process of microbial precipitation and the samples were subsequently subjected to unconfined compressive tests and improvised permeability tests. A subjective evaluation of the clogging effect of enzymatic sedimentation was thus obtained beside the attainment of uni-axial compressive strength which is a measure of biological cementation. **Keywords:** biological stabilization, Indigenous Bacteria, Urease, Permeability, strength, microbial precipitation.



S09.02-P -15

CATION EXCHANGE REACTIONS WITH CU COMPROMISE THE EFFECTIVENESS OF FEEDDHA CHELATES AS SOIL-APPLIED FE FERTILIZER

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FeEDDHA (iron (3+) ethylene diamine N,N'-bis(hydroxyphenyl acetic acid) is a synthetic chelate that is commonly used as iron fertilizer, to mend and prevent iron deficiency in plants grown on alkaline and calcareous soils. FeEDDHA based fertilizers consist of a mixture of analogue FeEDDHA components with different fertilizer properties. Cation displacement reactions in which Fe is displaced from FeEDDHA by another cation can potentially compromise the time span the individual FeEDDHA components remain effective as fertilizer. In the present work the potential of soil-Cu to displace Fe from FeEDDHA components was examined. First the thermodynamic basis for this displacement reaction under soil conditions was explored through multi-surface modeling, combining the NICA-Donnan model (metal binding to natural organic matter), the CD-MUSIC model (metal binding to iron(hydr)oxides) and a model for describing soil solution chemistry. Subsequently, the displacement reaction kinetics were studied in goethite suspensions, also considering the influence of soil properties like available reactive surface area, Cu loading, ionic strength and background electrolyte cation. It was found that all examined FeEDDHA components are susceptible to cation competition from Cu, yet to different degrees. The displacement reaction is surface catalyzed, and the degree to which FeEDDHA components adsorb plays a key role in determining the displacement rate. A displacement rate law equation was derived with which FeEDDHA concentration data from pot trials and incubation studies could well be interpreted.



S09.02-P -16

COATING OF MODEL SURFACES WITH ORGANIC FUNCTIONAL GROUPS

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Biogeochemical interfaces (BGIs) are of particular interest regarding transport and sorption of natural and, especially, hazardous xenobiotic species in soil. Wetting properties (e.g. determined by contact angle, CA), governed by the functional groups exposed, are crucial for sorption processes as well as for the geometry of water films sustaining microbial life. Natural BGIs are characterized by a wide variety of mineralogical and chemical compounds. Their composition is difficult to identify in full even with a detailed analysis. Hence, in order to get a better understanding about BGI processes, an option is the use of defined model surfaces. We exposed smooth glass surfaces to different silanes, resulting in a coating covalently bound to the surface. The wetting properties (CA) and the surface free energy (SFE) are a function of the organic functional group of the respective silane. The resulting surface showed a large variation of CA and SFE with chain length and polarity of the organic functional group. The study of wetting properties was accompanied by AFM analysis for surface roughness, morphology, adhesive force, and hardness and nano-thermal analysis (NTA) for thermal behavior. As the reaction mechanism is known, the surface structure can be modeled based on energetic considerations. Comparison of the principle findings from the model surfaces with natural organic components coating soil particles may further enhance our understanding of the latter, more complex systems.



S09.02-P -17

CONTRIBUTION OF DIFFERENT MICROORGANISMS TO CELL WALL ENVELOPE (PATCHY FRAGMENT) FORMATION IN SOIL

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Soil organic matter (SOM) has a complex chemical structure, which - despite high efforts in the past - is widely unknown. Existing models for SOM genesis consider plant material as the main source. However, recent studies have shown an important impact of microbial residues on SOM formation: chemical analyses show that microbial compounds accumulate during litter degradation, and investigations by means of scanning electron microscopy indicate that cell envelope fragments, are highly abundant in soils. These fragments contribute to a large extent to SOM formation and seem to be important biogeochemical interfaces. Here, we will present the results of a six-month incubation experiment, where we elucidate the contribution of different types of organisms to patchy fragment formation. We hypothesize, that the cell walls of organisms contribute, due to their particular chemical composition and spatial arrangement, disproportionately more than other organic compounds to SOM formation. To study the relative contribution of different types of microorganisms, we incubate intact and ultrasonically disrupted cells of Gram-positive bacteria, Gram-negative bacteria, actinomycetes and fungi in artificial soil systems. During incubation, the changes in amount and the composition of the total fatty acids and phospholipid fatty are monitored to investigate the transfer of living biomass into nonliving biomass. Furthermore, the DNA content and the iron species are monitored. The spatial arrangement and the fragments are characterized by scanning electron microscopy after density fractionation and immunogold labelling. The results will help understanding, how small-scale processes influence macroscopically visible processes in soils.



S09.02-P -18

CONTRIBUTION OF DISSOLVED ORGANIC MATTER AND ROOT EXUDATION TO THE ANTIOXIDANT CAPACITY OF SOIL SURROUNDING WHEAT ROOTS

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Plants contribute to the antioxidant capacity (AOC) of soils, but it is unknown whether the above- or below-ground biomass affects this property more. It has already been shown that antioxidant compounds in soils can be directly attributed to above-ground biomass, but only to a limited extent. In consequence there is actually no direct measure for the contribution of this pool. Furthermore it is most likely that the contribution of plants to the pool of antioxidants in the soil will be determined by root exudation and the interaction of plants with microorganisms. The aim of this study was to measure the AOC of rhizosphere soil and dissolved organic matter (DOM) in the vicinity of wheat roots for its AOC and to relate it to their molecular-chemical composition, characterised by pyrolysis field ionisation mass spectrometry (Py-FIMS). Soil and leachate samples were obtained from greenhouse pot experiments with seven wheat varieties and unplanted soil. The AOC values of the leachates were independent of the variety, but affected by the growth stage. Relative to the unplanted control, the contribution of DOM to the AOC increased during plant development, whereas the absolute amount decreased. The Py-FIMS analysis revealed complementary results, since the plant growth stage affected the molecular-chemical composition most. It showed that lipids and free fatty acids, representing markers of root exudation and microorganisms, were important in explaining the differences in the mass spectrometric pattern of soil leachates (rhizodeposition) at different growth stages. We suggest a number of hypotheses to explain these results.



S09.02-P -19

HOW DOES OXIDATIVE DEGRADATION OF ORGANIC MATTER AFFECT SURFACE AREA AND MICROPOROSITY? – A COMPARISON OF THREE COMMON REMOVING AGENTS

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Removal of organic matter (OM) by chemical reagents is a common treatment in soil analyses. Usually, chemical destruction is used with the assumption that minerals are unaffected by this oxidation. Our study aims to get insight into the contribution of organo-mineral associations to the formation of microporous interfaces by selective removal of OM and Fe-oxides from soils by different oxidation methods, assuming that different reagents have various effects on the structure of organo-mineral interfaces. We used bulk soils of four A-horizons and two B-horizons. After chemical destruction of OM by H₂O₂, NaOCl or Na₂S₂O₈, samples were analyzed for Fe-oxides by dithionite and oxalate extraction. Specific surface area (SSA) was measured by N₂-physisorption (BET). Micropore surface area and volume were calculated by the t-plot-method. The remaining OM was characterized by solid-state ¹³C NMR spectroscopy. Na₂S₂O₈ and H₂O₂ lead to the highest extent of organic C removal. The remaining OM is dominated by aromatic C moieties. The highest SSAs and micropore surface areas were found after Na₂S₂O₈ treatment. Subsequent removal of Fe-oxides resulted in a significant reduction in SSA and micropore surface area, indicating that Fe-oxides are the main contributors to SSA and microporosity. This implies that Na₂S₂O₈ is the most effective reagent for removing OM from mineral surfaces and unmasking micropores. Additionally, possible changes in the surface structure of the minerals during chemical oxidation will be discussed.



S09.02-P -20

HUMIC SUBSTANCES (HS) MODELS – WATER AND CATIONS INTERACTING WITH HS NANOPORES

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Molecular modelling offers the opportunity to research basic molecular features of humic substances. Recently we investigated the wetting process of model nanopore segments (oligo acrylic trimers) in humic substances. At shorter distances between the two oligomer chains an outer solvation was most stable. However, with increasing distance of the two oligoacrylic trimers the water molecules penetrated into the created free space, connecting the two chains by means of a hydrogen-bonded network. Significant stabilization effects of 10-20 kcal/mol were observed. The model strongly supports the hypothesized bridging function of water molecules in humic substances. The stabilizing effect of water molecule bridges (WAMB) on polar regions in humic substances was investigated. Four undecanoid fatty acids served as models for spatially fixed aliphatic chains in HSs terminated by a polar (carboxyl) group. The rigidity of the oligomer chains is significantly enhanced as soon as the water cluster is large enough to comprise all four carboxyl groups. Increasing the temperature leads to evaporation and destabilization. Embedding it into the nonpolar environment introduces a pronounced cage effect which significantly impedes removal of water molecules from the cluster region. Structural and energetic properties of cation bridges in soil supramolecular aggregates were studied by means of a model system in which two carboxylate groups connected to aliphatic oligomer chains were bound by Al^{3+} , Ca^{2+} and Na^{+} , respectively. Characteristic difference on drying (stepwise reduction of water molecules) between Al^{3+} , Ca^{2+} and Na^{+} complexes were observed affecting the predicted mobility of monovalent and divalent cations in soils.



S09.02-P -21

**ORGANO-MINERAL ASSOCIATIONS IN AN ANDISOL DEVELOPED FROM VOLCANIC ASHES
(PART 2): A SEQUENTIAL DENSITY FRACTIONATION APPROACH**

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Volcanic soils hold significantly greater amounts of organic matter (OM) than non-volcanic soils due presumably to the strong interaction of OM with short-range-order minerals and dissolved metals. Carbon (C) in Japanese Andisols can be quite old (>1000 yr) even at surface horizons. Yet little is known about how the old C is stabilized in soil matrix. One hypothesis is that old C age is controlled by recalcitrant OM such as char. An alternative hypothesis is the mineral protection of OM via sorptive or aggregation-type interactions. The former type of old C can be isolated as low-density fraction whereas the latter type should be found in higher density fractions. To test these ideas, we used a surface (Ap) horizon of an allophanic Andisol in central Japan and separated into six density fractions (from <1.6 to >2.5 g/cm³) by shaking without sonication. We found two old C pools (1200-1400 yrs old) of contrasting chemistry. The 1.6-1.8 g/cm³ fraction had high C:N, high aromaticity, and low extractable metals, indicating the presence of old char. The 2.0-2.5 g/cm³ fraction (accounting for 60% of total C) was characterized by clearly lower C:N, higher delta N-15, higher oxalate-extractable metal concentrations and specific surface area, which implies intimate association of microbially-processed OM with short-range-order minerals. The density fractionation approach was effective to distinguish the OM pools of contrasting ages and forms, which may help to calibrate SOM models or to develop a more mechanistic model.



S09.02-P -22

RESTRUCTURING OF ORGANIC COATINGS UPON DRYING: CONSEQUENCES FOR THE ACCESSIBILITY OF SORPTION SITES

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Organo-mineral associations are prevalent in soils. The structure of the organic molecules, which are attached to the mineral surface, largely affects the physicochemical reactivity of these associations. There is experimental evidence, that drying and rewetting of soils causes restructuring of the organic macromolecules associated with mineral phases and hence alters the physicochemical properties of these mineral-organic associations (e.g. surface charge). We hypothesize that restructuring upon drying results in decreased accessibility of negatively charged functional groups of organic molecules. Polyvalent cations may stabilize the structure of organic coatings by cross-linking. These processes may explain the effect of drying on sorption of organic pollutants in soils. To test the hypothesis we prepared various polygalacturonate (PGA) coated mineral colloids and conducted sorption experiments with MCPA and phenanthrene. The sorption experiments were conducted using (1) freshly prepared PGA-minerals and (2) PGA-minerals which have been air-dried and rewetted in the presence of both K^+ and Al^{3+} . Our results suggest that structural changes upon drying are crucial for the assessment of sorptive interactions of organic pollutants at organo-mineral interfaces not only by decreasing accessibility of sorption sites but also by changing the predominant sorption mechanism or the degree of hydrophobic interactions. Nano-calorimetry experiments are recently conducted to further test this assumption.



S09.02-P -23

THE EFFECT OF DRYING, FREEZING AND AGEING ON THE EXTRACTION OF
NONYLPHENOL AND PHENANTHRENE FROM MONO- AND POLYVALENT CATION
SATURATED SOILS

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Organic chemicals that are introduced into soils by human activities may persist, be translocated or are subject to complete mineralization or partial degradation. For many chemicals, the parent compounds or their metabolites form non-extractable residues, mainly through interactions with the native soil organic matter (SOM). To date, there is only limited knowledge about the formation and binding mechanisms of these residues which in turn complicates their risk assessment. The objective of this study was to determine the effects of SOM structural conformation on the bioaccessibility and biodegradation of the two model compounds nonylphenol and phenanthrene. The structural conformation of organic matter in a sandy soil was altered by saturating the exchange sites with different cations (Na^+ , Ca^{2+} , Al^{3+}). The sterilized samples were contaminated with ^{14}C -labelled nonylphenol or phenanthrene in amounts of $10 \mu\text{g g}^{-1}$. Samples were then used in four parallel experimental setups: (i) nine months ageing under sterile conditions, (ii) inoculation by native original soil with further five months incubation, (iii) drying and wetting or (iv) freezing and thawing of soils. Water, cyclodextrin and ethanol extractability of xenobiotics was investigated in aged, incubated and temperature treated soils. The results show that drying and freezing decreased the compounds extractability. Mineralization of pollutants was governed by cation-treatment of soil, whereas formation of bound residues in degraded soils was independent of salt amendments or rates of mineralization. During the long-term ageing under sterile conditions a permanent decrease of extractability and formation of bound residues were observed.



S10.01-P - PLANT SOIL INTERACTIONS FROM THE RHIZOSPHERE TO THE FIELD SCALE

Monday 02 July 2012 from 17:00 to 18:30. Room Poster Areas

S10.01-P -1

ACTIVITY OF SOIL MICROORGANISMS INFLUENCED BY TWO-YEAR CROP ROTATION

Inga Jansone, Dizstende, Talsu District - Latvia

S10.01-P -2

AGE OF FINE ROOT CARBON IN BOREAL CONIFER FORESTS DETERMINED BY RADIOCARBON METHOD

Shambhu Prasad Sah, Helsinki - Finland

S10.01-P -3

AMELIORATIVE EFFECT OF SILICON, CHICKEN MANURE ON YIELD AND AVAILABILITY OF NUTRIENTS UPTAKE BY BARLEY PLANTS, GROWN IN NEWLY RECLAIMED SOILS

Hanan Siam, Cairo - Egypt

S10.01-P -4

ARTIFICIAL VISION SYSTEM FOR THE IDENTIFICATION OF SULFUR NUTRITION OF CORN PLANTS

Pedro Henrique De Cerqueira Luz, Pirassununga - Brazil

S10.01-P -5

BARRIER FUNCTIONS PLANTS IN THE CONDITION OF SOIL CONTAMINATION BY HEAVY METALS

Saglara Mandzhieva, Rostov-on-Don - Russian Federation

S10.01-P -6

BELOWGROUND BIOMASS AND ROOT DISTRIBUTION OF TWO PERENNIAL BIOMASS CROPS IN A DEEP LOAMY SOIL

Fabien Ferchaud, Laon - France

S10.01-P -7

BIODIVERSITY AND THROUGHFALL KINETIC ENERGY IN FOREST ECOSYSTEMS IN THE HUMID SUBTROPICS OF SE CHINA – EFFECTS OF TREE CANOPY STRUCTURE, TRAITS, AND DIVERSITY

Christian Geißler, Tübingen - Germany



S10.01-P -8

BIOGENIC TRANSFORMATION OF CLAY MINERALS IN FOREST-STEPPE SOILS

Alexander Shinkarev, Kazan - Russian Federation

S10.01-P -9

BIOTRANSFORMATION OF SE BY SE-TOLERANCE RHIZOBACTERIA ISOLATED FROM RHIZOSPHERE OF CEREALS GROWN IN ANDISOL.

Jacqueline Acuna, Temuco - Chile

S10.01-P -10

CALCIUM DEFICIENCY IN CORN PLANTS IDENTIFIED BY ARTIFICIAL VISION SYSTEM

Pedro Henrique De Cerqueira Luz, USP - Pirassununga ~ Brazil

S10.01-P -11

CALIBRATION OF TRANSPIRATION REDUCTION FUNCTION PARAMETERS USING SWAP AND PEST

Quirijn De Jong Van Lier, Piracicaba - Brazil

S10.01-P -12

CHANGES IN BIOPORE ARCHITECTURE AFTER RECOLONIZATION OF SOIL MICROCOSMS WITH ANECIC EARTHWORM SPECIES INVESTIGATED BY X-RAY MICROTOMOGRAPHY

Sebastian K. Pagenkemper, Kiel - Germany

S10.01-P -13

COMBINING PHYTOMINING AND HYDROMETALLURGY FOR NICKEL PRODUCTION

Marie-Odile Simonnot, Nancy - France

S10.01-P -14

COMPARATIVE STUDIES OF RELATION BETWEEN SOIL TEXTURE AND SCOTS PINE (PINUS SYLVESTRIS L.) GROWTH IN POLAND AND FINLAND

Piotr Sewerniak, Torun - Poland

S10.01-P -15

CORRELATIONS OF METALS CONCENTRATIONS IN MINING-AFFECTED SOILS AND THEIR ACCUMULATIONS IN EDIBLE PLANTS USING MULTIVARIATE ANALYSIS

Marin Senila, Cluj-Napoca - Romania



S10.01-P -16

COUPLING THE LAND SURFACE MODEL NOAH WITH THE GENERIC CROP GROWTH MODEL GECROS

Joachim Ingwersen, Hohenheim - Germany

S10.01-P -17

DENSITY OF PLANTATION, SOIL HUMIDITY AND SOIL DEPTH INFLUENCE CATABOLIC STRUCTURE OF MICROBIAL COMMUNITIES IN MAIZE CROP SYSTEM

Berard Annette, Avignon - France

S10.01-P -18

DIURNAL VARIATION IN PHOTOSYNTHESIS AFFECTS ROOT RESPIRATION RATE IN BLOOD LEAVED JAPANESE TREES

Naoki Makita, Kyoto - Japan

S10.01-P -19

DIVERSITY OF ARBUSCULAR MYCORRHIZAL FUNGI IN DISTINCT MANAGEMENT SYSTEMS OF PEANUT

Milene Moreira, Piracicaba - Brazil

S10.01-P -20

DIVERSITY OF SOILS AND VEGETATION ON INLAND DUNES IN THE MILITARY AREA NEAR TORUN (NORTHERN POLAND)

Piotr Sewerniak, Torun - Poland

S10.01-P -21

DO PLANT SPECIES INDUCE DIVERGENCE IN SOIL MICROBIAL DIVERSITIES? A CASE STUDY FROM THE NEGEV DESERT.

Adrian Unc, Las Cruces, New Mexico - United States

S10.01-P -22

EFFECT OF APPLICATION LIME AND GYPSUM BY-PRODUCTS TO A DEGRADED MEDITERRANEAN ULTISOL ON THE DEVELOPMENT OF QUERCUS SUBER AND QUERCUS FAGINEA IN THE "DEHESA" AGROSYSTEM

Ignacio Mariscal-Sancho, Madrid - Spain



S10.01-P -23

EFFECT OF BORON AND LIMING ON THE DEVELOPMENT FOREST SPECIES PLANT OF THE ATLANTIC FOREST

José Carlos Casagrande, Araras - Brazil

S10.01-P -24

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Mariane De Souza Oliveira, Araras - Brazil

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Andreas Hammelehle, Zürich - Switzerland

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Ute Katharina Perkons, Bonn - Germany

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Lelde Grantina, Riga - Latvia

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M^a Concepción Benítez, Córdoba - Spain

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Ivana Spasojevic, Belgrade - Serbia

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Holger Fischer, Stuttgart - Germany

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TRANSFER OF URANIUM ISOTOPES, THORIUM AND THEIR DECAY PRODUCTS FROM SOIL TO LETTUCE AND WHEAT IN FIVE DIFFERENT REGIONS OF THE FRENCH TERRITORY.

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VARIABILITY OF SOIL PROPERTIES AND PRODUCTIVITY OF FORESTS PLANTED ON AGRICULTURAL LAND

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WATER DEPLETION IN INTERCROPPING SYSTEMS: A CASE-STUDY IN WESTERN THAILAND

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WILD PLANTS, PLASTICITY OF MINERAL NUTRITION AND MYCORRHIZA IN HETEROGENEOUS SOIL CONDITIONS OF COASTAL HABITATS

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WINTER COVER CROPS AND TIME OF PLANTING ON OVAL-LEAF FALSE BUTTONEWEED (SPERMACOCE LATIFOLIA AUBL.) POPULATION

José Alfredo Baptista Dos Santos, Ponta Grossa - Brazil

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YIELD-TRANSPIRATION RELATIONS OF SAKHALIN KNOTWEED (FALLOPIA SACHALINENSIS) IN A LYSIMETER EXPERIMENT

Dario Mantovani, Cottbus - Germany



S10.01-P -1

ACTIVITY OF SOIL MICROORGANISMS INFLUENCED BY TWO-YEAR CROP ROTATION

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Appropriate soil and crop management practices can notably enhance the growth and activities of beneficial soil microorganisms that, in turn, can improve the growth, yield, and quality of crops. The use of green manure in sequence with cereals and other crops is known as a traditional element of crop rotation. In our pilot scale experiment on organic farming, the effect of crop rotation to soil microbial activity was compared using nine different "second-year" plants (barley, wheat, oat, buckwheat, white mustard, alfalfa, fenugreek, blue fenugreek, red clover). As the first-year crop, buckwheat was used for all experimental sets. After 30 days' vegetation experiment, soil microbial activity was tested. The most probable number (MPN) of heterotrophic microorganisms in bulk soil varied in the range of $6.54 \times 10^6 \div 2.92 \times 10^7$ cfu/gdw in all tested sets. The highest microbial amount in rhizosphere was found in the variant with fenugreek, i.e., 1.09×10^{10} cfu/gdw. Substrate-induced respiration of soil microorganisms was more active in soil with barley and white mustard. Soil microbial diversity was evaluated by EcoPlates[®]. After 20h cultivation, the highest diversity index was shown for the soil with buckwheat and alfalfa. These results are in a good agreement with the previous study of the authors: cultivation of buckwheat used as the both, first- and second-year crop, - resulted in an increase of the diversity index of soil microbial community. Further study will be focused on the relationship among crop rotation, microbial activity, yield and quality of crops in the context of Latvia climatic and geographical conditions.



S10.01-P -2

AGE OF FINE ROOT CARBON IN BOREAL CONIFER FORESTS DETERMINED BY RADIOCARBON METHOD

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We used natural abundance of ^{14}C to estimate root carbon age in four boreal Norway spruce and Scots pine stands in Finland and Estonia. This study is a continuation of our previous study, in which we tested the feasibility of using radiocarbon to determine root age by comparing the ^{14}C age of ingrowth core fine roots with their known maximum age. In this study, we expanded our research to archive soil core roots sampled at the same time as the ingrowth core roots. The main objectives of this study were to determine how the fine root cellulose C age varies between tree species & stands, root diameter and soil depths, and to compare the C age of fine roots from soil cores and ingrowth cores. Our results showed older fine root C in the more northern sites (11-12 years) in comparison to the southern and more fertile site (3 and 8 years), implying that roots may live longer in more northern conditions and less fertile soil. We further observed that the soil core fine roots showed similar C age (7-12 years) as in the less than 2 years old live fine roots of ingrowth cores of one of our study sites (Punkaharju, pine stand). Such observations lead us to conclude that this is only possible if these new live roots used at least partly old carbon reserves for their cellulose formation. KEY-WORDS: Ingrowth core, soil core, carbon, root age, ^{14}C , boreal forest



S10.01-P -3

AMELIORATIVE EFFECT OF SILICON, CHICKEN MANURE ON YIELD AND AVAILABILITY OF NUTRIENTS UPTAKE BY BARLEY PLANS, GROWN IN NEWLY RECLAIMED SOILS

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A greenhouse experiment was conducted at the National Research Centre, Cairo, Egypt. The experiment was designed to study the response of barley plants to sodium metasilicate at 500 ppm SiO₂ level, chicken manure as organic fertilizer and addition rate of P (0, 30 and 60 kg P₂O₅ /fed). On productivity and quality of barley plants. The response was depending on the application of silicate, organic fertilizer and rate of phosphorus in sandy soil. Results show that silicate application in combination with chicken manure compost to the soil improved the yield, availability of macro and micronutrients. The highest values of yield, content of P, Si and Fe, Mn, Zn as micronutrients and their uptake by plants grown in newly reclaimed soil were found by using silicate, chicken manure with phosphorous addition, while the lowest values were found with P alone. Also data revealed that, yield, P, Si and micronutrients uptake by grain was increased due to the application of chicken manure compost with P when compared with the addition P alone. Also application of stiticate and chicken manure had an effective and significant and role in increasing quality parameters. Generally results show that the highest P and Si values were found in grains followed shoots and roots in decreasing order, while the highest Fe, Mn and Zn values found in roots followed shoots and grains in decreasing order. Keywords : Silicate, chicken manure, phosphorous, barley, yield, organic, micronutrients.



S10.01-P -4

ARTIFICIAL VISION SYSTEM FOR THE IDENTIFICATION OF SULFUR NUTRITION OF CORN PLANTS

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The artificial vision system (AVS) is a technology that allows identifying nutritional deficiencies in plants. This permits the correction through the diagnosis in the beginning of the corn development, independently of the human evaluation. This study evaluated the AVS method to identify deficiencies of sulfur (S) in corn (Zea mays L.). The experiment was carried out in hydroponic condition with nutrient solution of Hoagland and Arnon (1950) in a greenhouse in USP/Pirassununga/Brazil. The treatments were 0, 33, 66 and 100% of S in solution, 4 replicates. The 9600 DPI scanner was used to scanning images of new leaf (NL) in plant stages V4 and V6, leaf 4 (F4) in V4, and leaf 6 (F6) in V6. The images were processed by AVS and the leaves were analyzed chemically. The AVS techniques evaluated were: Fractal Dimension Volumetric (FDV), Gabor Wavelet (GW) and Fractal Dimension Volumetric using canonical analysis (FDVCA). The base, middle and tip of the leaves were analyzed for each technique using gray and color images. The S concentration in leaves increased with the increase of S in the nutrient solution, Although the visual symptoms were not evident, the AVS was able to identify the deficiency of S showing 78% of accuracy with the technique GW color images for the NL base in V4 and 57.5% with the technique GW grayscale to the NF middle third in V6. The AVS was efficient in processing digital images and it identified the isolated S deficiency in corn leaves.



S10.01-P -5

BARRIER FUNCTIONS PLANTS IN THE CONDITION OF SOIL CONTAMINATION BY HEAVY METALS

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In field experience, zinc (96 mg/kg) and lead (300 mg/kg) were applied separately in the form of acetate salts into the plow horizon on chernozem (pH 7.5). Contamination with Zn and Pb increased the total contents of these metals in the chernozem by a factor of 5. The contents of weakly bound metal compounds increased by a factor of 11–14. In the Pb-polluted soils, the content of complex Pb forms increased to the maximum extent; in the Zn-contaminated soils, the content of exchangeable forms of Zn increased most significantly. The soil contamination led to the accumulation of Zn and Pb in barley grain in concentrations exceeded the corresponding MPC values (50.0 mg/kg for Zn and 0.5 mg/kg for Pb) . The contents of Zn in grain, stalks and roots of barley grown on the unpolluted soil were in the ratios of 1 : 1 : 1; in the polluted soil, 1 : 1 : 3. As for Pb, these ratios were 1 : 5 : 15 and 1 : 4 : 8, respectively. Thus, upon the application of Zn, the barrier became higher at the root–stalk and stalk–grain interfaces by factors of 2.8 and 1.1, respectively; upon Pb application, it was lowered by factors of 2.2 and 3.5, respectively. Therefore, the main barrier function for reducing Zn uptake by plants is performed by their roots.



S10.01-P -6

BELOWGROUND BIOMASS AND ROOT DISTRIBUTION OF TWO PERENNIAL BIOMASS CROPS IN A DEEP LOAMY SOIL

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The development of biomass crops for energy production is expected to provide significant fossil energy substitution and greenhouse gas mitigation. The two perennial C4 rhizomatous grasses, miscanthus and switchgrass, have potential to be serious candidates as biomass crops. However, their water requirements and environmental impacts are still poorly known. Studying belowground biomass and distribution in soil can provide insight of the ability of these crops to recover soil water and nutrients and increase soil carbon storage. We have investigated the belowground biomass, C and N contents and the vertical root distribution of these two perennial crops. The crops were established in spring 2006 in a deep loamy soil in Picardie region in Northern France. In spring 2010, 4 pits were dug for each crop down to 3 meters depth. The vertical root distribution was determined using the trench profile method. Soil monoliths were cut off from the profile plane in order to quantify root biomass in the 60-210 cm layer. In spring 2011, root and rhizome biomass in the 0-60 cm layer were quantified by collecting soil cores for both species and entire rhizomes of miscanthus. The results showed high belowground biomass and deep rooting for both species. Miscanthus had higher belowground biomass than switchgrass due to its large rhizome and deeper root extension. Root density of miscanthus decreased faster with depth than switchgrass in the first 150 cm but the opposite occurred below 150 cm. The significance of these results in relation to water and nitrate uptake will be discussed.



S10.01-P -7

BIODIVERSITY AND THROUGHFALL KINETIC ENERGY IN FOREST ECOSYSTEMS IN THE HUMID SUBTROPICS OF SE CHINA – EFFECTS OF TREE CANOPY STRUCTURE, TRAITS, AND DIVERSITY

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Throughfall kinetic energy (KE) and its variability in relation to biodiversity and other forest stand variables (canopy structure, canopy functional trait identity and canopy diversity) were studied in a secondary subtropical broad-leaved forest ecosystem. The overall aim was to contribute to the understanding of the mechanisms of the ecosystem service of soil erosion prevention in forests. Measurements were performed in the Gutianshan National Nature Reserve, a biodiversity hotspot in the northern hemisphere with more than 60 woody species per km². Using a mixed model approach we could identify effects of tree canopy structure, diversity and functional trait identity. Throughfall KE increases with canopy height, biodiversity and an interaction between canopy height and rainfall amount where both factors reinforce each other. It decreases with increasing proportion of needle leafed species within a plot and an increasing LAI. In subtropical broad-leaved forests throughfall KE is largely controlled by forest structure, traits and the number of the species present in the canopy. High coverage and a low total height keeps throughfall KE low in younger plots whereas canopy gaps and a higher total height enlarge the values of throughfall KE in older plots. The variability of throughfall KE is controlled by rainfall intensity and biodiversity which counteract against each other. The variability of throughfall KE is highest in highly diverse plots when the intensity of a given rainfall event is low. This study is the first to contribute to the understanding of the ecosystem service of soil erosion prevention in diverse subtropical forests.



S10.01-P -8

BIOGENIC TRANSFORMATION OF CLAY MINERALS IN FOREST-STEPPE SOILS

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We studied virgin forest-steppe soils derived from a uniform parent material. By complex of modern methods it is shown, that fixation of organic substance in forms resistant to H₂O₂ treatment is related to change of actual structure of clay aggregates. At interaction of clay minerals with the products of transformation of plant residues in A horizon of forest-steppe soils such organic-mineral complexes as composites are formed. Penetrating into slits between thin particles of layer silicates and between smectite layers, organic molecules output from X-ray-diffraction a considerable part of crystalline substance, breaking a constancy and (or) plane-parallel arrangement of its interlayer distances. Remaining principally crystal phases, these original organic-silicate compositions can not bring the contribution to X-ray-diffraction of the oriented preparations. Formation organic-smectite complexes with hybrid structure, disorder on c axis, is the usual and universal mechanism of clay transformation at soil formation in forest-steppe conditions. It limits possibilities of X-ray-diffraction for smectite quantification in natural organo-clays. Therefore, the labile interlayer spaces should be studied using the independent methods. Smectite quantification by an adsorptive-luminescent method (Eirish et al. 1975) and by thermogravimetric analyses (Nieto et al., 2008) can be the useful tool as a complement to X-ray-diffraction determinations of expandable clay content in soils. The first method is based on ability of smectites to adsorb rhodamine after dispersion and peptization of clay particles by sodium pyrophosphate, the second – on measuring the weight loss between 100 and 450 °C of samples solvated with ethylene glycol and previously saturated in Mg.*



S10.01-P -9

BIOTRANSFORMATION OF SE BY SE-TOLERANCE RHIZOBACTERIA ISOLATED FROM RHIZOSPHERE OF CEREALS GROWN IN ANDISOL.

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Selenium (Se) is an essential micronutrient although for higher animals that is commonly deficient in cereal grains grown in Chilean Andisols. Bacteria play an important role in the Se cycling in soils, there are no studies on the potential application of bacteria to increase the availability of Se in the rhizosphere. In this research, our goals were to (i) investigate the Se transformations by rhizobacteria associated with cereals crops, and (ii) to evaluate the potential of Se-tolerant rhizobacteria (SeTR) to increase the Se-content in wheat grown in Chilean Andisols. We isolated culturable strains from cereal rhizospheres that were screened for their ability to growth and biotransform Se in media supplemented with 2-10 mM Na-selenite. This included culturable SeTR, belonging to genus *Pseudomonas*, *Bacillus*, *Enterobacter* and *Stenotrophomonas*, with combinations of traits that are commonly associated with plant growth promotion (ACC deaminase, IAA production, P mineralization and siderophore production). In further studies, inoculation with SeTR (grown in the presence of Se) enhanced the total Se content in leafs of wheat without affecting the plant growth. Our study revealed the occurrence of native SeTR in cereal crops grown in Chilean Andisols and suggests the potential use of these strains to increase the Se content in cereal grains for animal and human nutrition. Acknowledgements: This study is supported by CONICYT Scholarship and FONDECYT no.1106625.



S10.01-P -10

CALCIUM DEFICIENCY IN CORN PLANTS IDENTIFIED BY ARTIFICIAL VISION SYSTEM

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The nutrients determination through chemical analysis of leaf tissue involves sampling in advanced stage or visual diagnosis that is dependent of the evaluator. The artificial vision system (AVS) is a set of methods to interpreting images that allows the correction of the nutrient deficiency at the beginning of the crop cycle. This study evaluated the AVS method to identify deficiencies of calcium (Ca) in corn (Zea mays L.). The experiment was carried out in hydroponic condition with nutrient solution of in a greenhouse in USP/Pirassununga/Brazil. The treatments were 0, 33, 66 and 100% of Ca, 4 replicates. Using 9600 DPI scanner was used to scanning images of new leaf (NL) in plant stages V4 and V6, leaf 4 (F4) in V4, and 6 (F6) in V6. The images were processed by AVS and the leaves were analyzed chemically. The AVS techniques evaluated were: Fractal Dimension Volumetric, Gabor Wavelet (GW) and Fractal Dimension Volumetric using canonical analysis. The base, middle and tip of the leaves were analyzed for each technique using gray and color images. The increased of Ca concentration in the solution increased its concentration in leaves, was observed visual symptoms characteristic of situations with absent or in low concentrations of Ca. The best technique for this identification of Ca deficiency was the GW with color images in the middle third of new leaves in both stages, it showed 80% accuracy in V4 and 69.5% in V6. The AVS was effective to diagnosing the levels of Ca in corn leaves.



S10.01-P -11

CALIBRATION OF TRANSPIRATION REDUCTION FUNCTION PARAMETERS USING SWAP AND PEST

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Transpiration reduction functions are used to estimate actual transpiration as a function of system boundary conditions. At present, two reduction functions are built-in in the ecohydrological model SWAP: a well-known pressure head based function proposed by Feddes (1978) and a less explored matric flux potential based function proposed by De Jong Van Lier (2008). Both functions include one or more empirical parameters. We investigated the value of these parameters and the sensitivity of their determination from field experiments with Common Bean and Soy Bean in Brazil. Field experimental results were compared to simulations with SWAP. The optimization program PEST was used to calibrate root length densities as well as limiting values from both models (h_3 and h_4 for the Feddes model, h -wilting and root efficiency factor f for the De Jong van Lier model). Good fits were obtained and estimated parameter values were within expected ranges. Model sensitivity was high, especially for root length density in the De Jong van Lier model. Internal root resistance should be included in this model to avoid unrealistic simulation results, especially in low root density layers. We concluded that the high sensitivity of reduction functions to some of the involved empirical parameters and the lack of experimental results available makes the use of reduction functions with generic values for empirical values cumbersome. Especially for the more physically based De Jong van Lier reduction function, good information on root length density is imperative.



S10.01-P -12

CHANGES IN BIOPORE ARCHITECTURE AFTER RECOLONIZATION OF SOIL MICROCOSMS WITH ANECIC EARTHWORM SPECIES INVESTIGATED BY X-RAY MICROTOMOGRAPHY

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We used X-ray micro-tomography (XMCT) to visualize and quantify the changes in pore architecture after controlled recolonization of soil microcosms with an anecic earthworm species (*Lumbricus terrestris*). Large soil monoliths (20-cm diameter, 70-cm height) were collected from a Haplic Luvisol (loamy-silt) from loess of an experimental field trial (Chicory treatment) and scanned before and after recolonization. Additionally smaller soil cores (5.5-cm diameter, 4-cm height) in particular containing biopore channels, were extracted from the soil monoliths and also scanned to analyze pore architectures from the pedon (soil monoliths) to rhizosphere scale (soil cores). While activities of earthworms and plant roots in subsoil can positively contribute to processes like aeration and infiltration, these biopores can also be seen as an easily accessible and highly reactive interface leading into the soil matrix. Therefore, biopores can contribute to transportation processes at different scales, such as rapid transfer through the biopore channels and lateral diffusion in pore-soil matrix passages. The evolution of root and earthworm induced biopore networks affect root-soil interactions such as local water and nutrient uptake and increased oxygen diffusion. Also biopores created by plant roots may influence earthworms reusing these channels. We found that after 28 days of incubation partly new burrows were made as well as recent biopores were reused by earthworms. Physical properties like porosity and reactive surfaces were changed with respect to the original state. The derived morphological and topological characteristics of the biopore architectures will be useful parameters for modeling approaches regarding transport processes at multiple scales.



S10.01-P -13

COMBINING PHYTOMINING AND HYDROMETALLURGY FOR NICKEL PRODUCTION

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Phytomining is the harvesting of hyperaccumulating plants followed by metal recovery. Its economic interest clearly appeared when metal prices sharply rose in 2007. In different regions of the world, soils formed on serpentine rocks exhibit a high concentration in nickel, but this resource is too dispersed to be recovered by smelting. Some hyperaccumulating plants, e.g. Alyssum murale naturally grow on such soils and accumulate up to 3% of nickel. Research on agronomical options in ultramafic areas has proved that Ni yield could reach up to 100 kg ha⁻¹. Two methods based on hydrometallurgy were developed at the bench scale to obtain valuable nickel products. They included (1) acid leaching of nickel from the dry biomass or from ashes after incineration and (2) leachate treatment. Direct selective precipitation was not possible since nickel was bound to organic complexing agents. The first method consisted of extracting nickel from the leachate by solvent extraction (Cyanex 272) and to recover nickel by electroplating. This process led to pure nickel metal with a global yield of 72%. However, it was not economically feasible mainly because of the solvents cost. The second method aimed at obtaining a double salt of nickel of high purity. Acid leaching of ashes was followed by neutralization and evaporation. The cold crystallization at 2°C of this solution by addition of ammonium sulphate enabled us to obtain a Ni ammonium disulphate salt, Ni(NH₄)₂(SO₄)₂·6H₂O, potentially valuable for industry. Our perspectives are to upscale this process and show its feasibility in the aim of transfer



S10.01-P -14

COMPARATIVE STUDIES OF RELATION BETWEEN SOIL TEXTURE AND SCOTS PINE (PINUS SYLVESTRIS L.) GROWTH IN POLAND AND FINLAND

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The research was conducted in 3 regions located in different part of the European pine limit (Wroclaw in Poland, Kolari and Kevo in northern Finland). In the Wroclaw region the soil texture impact on pine growth was analysed in two humidity soil groups (non-gleyic and gleyic soils). In Poland, site index of pine was positively correlated to the $\phi < 0.02$ mm soil fraction content in sandy soils that was particular distinct for non-gleyic soils. It was mainly caused by improving humidity conditions in such soils as a result of water sorption by the fraction. The correlation between content of the $\phi > 2$ mm fraction and pine site index was opposite for two analysed soil groups in Poland (negative for non-gleyic and positive for gleyic, $p < 0.05$). In the Wroclaw region even very minor diversification of soil texture implied differences in pine growth. The results showed that in Poland Scots pine do not fully utilize the potential trophy of fine-textured soils, thus pine stands that grow on such soils should be converted into broadleaved forests. All the examined relations between soil texture properties and pine growth were insignificant for both analysed regions in Finland. The results showed that near the north pine limit even relatively minor climate difference can significantly form site index of Scots pine. The climate there is much more important factor for pine growth than soil texture. The author acknowledge the support of the European Community - Research Infrastructure Action under the FP6 "Structuring the European Research Area" Programme, LAPBIAT (RITA-CT-2006-025969).



S10.01-P -15

CORRELATIONS OF METALS CONCENTRATIONS IN MINING-AFFECTED SOILS AND THEIR ACCUMULATIONS IN EDIBLE PLANTS USING MULTIVARIATE ANALYSIS

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The metals concentrations were evaluated in soils and edible plants cultivated on this soils in rural areas from a historical mining and ore processing center from NW Romania, Baia Mare. The results showed that the levels of heavy metals concentrations from soil generally exceeded the maximum admitted levels for soils, established by the Romanian and International Legislation, with influence on metals accumulation in edible plants cultivated by locals in their gardens, representing a potential risk for public health. To study the relationships between the metals accumulations in plants, metals in soil and the physicochemical properties of soils (pH, Total Organic Carbon (TOC)) multivariate statistical techniques were used.



S10.01-P -16

COUPLING THE LAND SURFACE MODEL NOAH WITH THE GENERIC CROP GROWTH MODEL GECROS

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Weather- and climate simulations depend heavily on an accurate description of the exchange of water and energy between land surface and atmosphere. The aim of the present study was to couple the NOAH land surface model (LSM) with the generic crop growth model GECROS. We tested two different coupling approaches: a simple “Data hand-over” and a more sophisticated “Cut & Merge” approach. In the latter, not simply data but routines are exchanged between both models. In the “Cut & merge” coupling, among others, the empirical Jarvis scheme of the NOAH LSM was replaced by the Penman-Monteith equation implemented in GECROS, in which the canopy resistance is a function of the actual photosynthesis rate. NOAH-GECROS was calibrated against a 3-year (2009-2011) plant data set from two winter wheat stands in southwest Germany. The simulations of the energy- and water fluxes were evaluated against eddy covariance flux measurements, which were performed during the same period of time. The coupled models produced significantly better simulations of latent and sensible heat fluxes at the land surface. The „Cut & Merge“ coupling was superior to the simple „Data hand-over“ approach. The latent heat fluxes of the photosynthesis-based approach implemented in GECROS were about 30% lower than those calculated with the empirical Jarvis scheme of the NOAH land surface model. Finally, we will discuss consequences of our findings for regional climate simulations.



S10.01-P -17

DENSITY OF PLANTATION, SOIL HUMIDITY AND SOIL DEPTH INFLUENCE CATABOLIC STRUCTURE OF MICROBIAL COMMUNITIES IN MAIZE CROP SYSTEM

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Microbial activity in soils plays a critical role in decomposition of organic matter and in immobilization and mineralization of nutrients, which are important processes for plants in agricultural systems. Inversely, plant community structure and density can drive edaphic microbial communities. Mediterranean-type ecosystems surface soils undergo prolonged periods of drying interspersed with rapid rewetting events. These events can affect directly and indirectly plant production and microbe activities. We tested the hypothesis that in context of drought stress, different geometry and density of plantation may influence catabolic structure of microbial communities in maize crop system. A field experiment was conducted to examine microbial catabolic structure in two soil depths under three different conditions of drought stressed maize plantation. Measurements of substrate-induced respiration were realized before and after the autumn rain events. Water soil content was measured in situ with Electrical Resistivity Tomography and maize biomass was measured at the end of crop. The microbial biomass and catabolic structure distinctly changed with depth, probably related to the soil moisture dynamic conditions and to the quantity and quality of total organic carbon. At 20cm depth, plantation density seems to influence catabolic structure. Catabolism structure changes before and after the rain for the higher density plantations but not for the lower one. Finally the repartition between vegetative and reproductive maize biomass was different between the two densities of plantation. These results suggest that interactions between microbes and plants via microbial carbon degradation and root exudates are dependent upon environmental conditions like water availability.



S10.01-P -18

DIURNAL VARIATION IN PHOTOSYNTHESIS AFFECTS ROOT RESPIRATION RATE IN BLOOD LEAVED JAPANESE TREES

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Root respiration is a major source of soil CO₂ efflux in forest ecosystem. Although root respiration rate generally increases exponentially with soil temperature, a growing body of evidence suggests that the controls of root respiration rates are more complex and regulated with photosynthetic activity supplying carbohydrates from leaves to roots via the phloem. To evaluate the effect of diurnal photosynthesis patterns on root respiration, we simultaneously and continuously measured soil respiration and leaf photosynthesis in three-year-old seedlings of Quercus crispula and Fagus crenata during the period of peak biomass on clear days. In our result, leaf photosynthesis of both species increased gradually with increasing photosynthetically active radiation, but the photosynthesis decreased from around 9:00 due to photo-inhibition and stomatal closure of leaves. The root respiration rates of both species were low in early morning, and increased gradually as soil temperature increased in the morning. Then the respiration dramatically decreases at around 11:00–12:00, whereas the root temperature remained constant or even increased. Our results showed that the pattern of root respiration was strongly correlated with the photosynthesis, but with a time lag of 2-3 h. In addition, we observed the depression in root respiration rate. This result indicated that midday depression of photosynthetic activity affects diurnal pattern of root respiration rate. We found that the diurnal pattern of root respiration rate was driven by not only soil temperature but also photosynthetic activity.



S10.01-P -19

DIVERSITY OF ARBUSCULAR MYCORRHIZAL FUNGI IN DISTINCT MANAGEMENT SYSTEMS OF PEANUT

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São Paulo state is the greatest peanut producer in Brazil and this culture is established in areas previously occupied by degraded pastures and sugarcane crops, being cultivated with distinct management systems. The aim of this work was to study the effect of these management systems on diversity of arbuscular mycorrhizal fungi (AMF). Rhizosphere soil of peanut cultivar RUNNER IAC 886 was sampled at 0-20 cm depth during the flowering period. Ten plants were sampled in two localities under distinct management system: Mirassol (20° 49'S 49° 31'W) soil classified as Red Yellow Podzolic (Kandudalf), fine and sandy texture and Ribeirão Preto (21° 11'S 47° 93'W) classified as Eutroferric Red Latosol, clayey soil, both localities with conventional tillage, non tillage and minimum cultivation. Soil samples were submitted to chemical analyses. AMF spores were counted and identified by morphology to determine AMF species richness. Species richness was 14 in Mirassol with non-tillage followed by Mirassol with conventional tillage (13 species) and minimum cultivation (10 species) while only 6 species were identified in Ribeirão Preto in both management systems. Dominant species were *Glomus etunicatum* and *G. macrocarpum* in the both areas. In Ribeirão Preto, organic matter, phosphorus, K, Ca and Mg contents were higher compared to Mirassol. Composition of AMF community associated with peanuts was distinct among localities due probably the most fertile soil in Ribeirão Preto that can be contributed to the low diversity of AMF species detected in different management systems compared with the area of Mirassol.



S10.01-P -20

DIVERSITY OF SOILS AND VEGETATION ON INLAND DUNES IN THE MILITARY AREA NEAR TORUN (NORTHERN POLAND)

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The research was conducted in the artillery range located south of Torun (52°55'N, 18°36'E). The area represents landscape of inland dunes, overgrown by pine forest with podzolization as the dominant soil-forming process. The central part of the area is covered with vegetation of natural, secondary succession, due to formerly deforestation caused by military activity. The research was conducted in two study plots: 1. located in a timber, pine forest, 2. located in a mosaic of heathlands and grasslands. Both sites showed spatially ordered variability of soil properties and vegetation, according to dune slope exposure. In spite of the same parent material (quartz, loose sand) soils of north slopes in comparison to south exposure were characterized by higher organic matter and nutrients (N, Mg, K, Ca) stocks, and higher humidity. The differences in soil properties and plants distribution following from slope exposure were clearly less distinct in the pine forest than in the deforested area. In the forest, northern and southern slopes were covered by the same plant community (Peucedano-Pinetum), however, distinct differences in ground vegetation species composition and stage of podzolization were found. In the area of natural succession the relief implied plant communities and soil type diversification. Northern slopes were characterized by heathlands (Calluna vulgaris) covering podzols. Southern slopes, as drier, were found to be more susceptible to deflation. Actually they are occupied by grasslands (Festuca sp. and Calamagrostis epigejos) overgrowing Arenosols. The research was financed by the Polish Ministry of Science and Higher Education (project N N305 304840).



S10.01-P -21

DO PLANT SPECIES INDUCE DIVERGENCE IN SOIL MICROBIAL DIVERSITIES? A CASE STUDY FROM THE NEGEV DESERT.

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Water and nutrient availability are the major limiting factors of biological activity in arid and semi-arid ecosystems. Perennial plants have developed different ecophysiological adaptations to cope with the severe, harsh conditions. Artemisia sieberi is known to excrete allelopathic compounds in the under-canopy, rhizosphere soil; Noaea mucronata has no known allelopathic effects on its surroundings. We examined the influence of these two different shrubs on soil microbial diversity. Soil samples were collected monthly, from December 2006 to November 2007, near canopies of both shrubs (0-10 cm depth). Samples were used for abiotic tests. Determination of soil bacterial diversity was carried out by employing a range of standard microbiological and novel taxonomic procedures. Both DGGE diversities, and taxonomic diversity analyses based on cloned and sequenced 16S rDNA amplicons, were obtained. This also allowed a direct comparison of the results obtained with the various methods. No significant differences were found in the abiotic variables (soil moisture, total organic matter, and total soluble nitrogen) between soil samples collected under A. sieberi and N. mucronata during the study period. No obvious differences in the Shannon-Weaver index, evenness values or total phylogenetic distances were found for the soil microbial communities. However, detailed DGGE clustering and taxonomic diversity analyses indicated clear shifts in the soil microbial community composition, shifts governed by seasonal variability in water availability and critically by the type of plant species. These results support the assumption that plant allelopathic compounds, as produced by A. sieberi, affect soil microbial community.



S10.01-P -22

EFFECT OF APPLICATION LIME AND GYPSUM BY-PRODUCTS TO A DEGRADED MEDITERRANEAN ULTISOL ON THE DEVELOPMENT OF QUERCUS SUBER AND QUERCUS FAGINEA IN THE "DEHESA" AGROSYSTEM

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We established an experimental field in Cañamero's raña (SW Spain) for the study of the recovery of degraded Mediterranean Ultisols due to inappropriate agricultural use. The experiment involved the application of liming materials, based on "sugar foam" alone or with "phosphogypsum" and the implementation of a dehesa, through the reforestation with Quercus suber L. or Quercus faginea Lam. with or without a leguminous shrub of Adenocarpus telonensis (Loisel) D.C. This Mediterranean ecosystem allows the coexistent of a sustainable agroforestry crop, common in the study area, with a high range of biodiversity. After 3 years of the establishment of the experiment, the mixture with "sugar foam" and "phosphogypsum" was effective in reducing the exchange Al and increase the exchange Ca to a depth of 50 cm, while the "sugar foam" affected the 35 cm depth of the soil, where the argillic horizon (with low permeability) begins. However, the amendments had a weak influence on the development of the trees, and this result contrasted with the positive effect exerted both amendments on the biomass production of pasture and forage crops in a field experiment attached to this since the first year of its application. Adenocarpus scrub grew rapidly in all cases, especially in amended plots, and had a negative impact on the development of the trees due to water competition in the dry season (June to October).



S10.01-P -23

EFFECT OF BORON AND LIMING ON THE DEVELOPMENT FOREST SPECIES PLANT OF THE ATLANTIC FOREST

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The Atlantic forest (rain forest) biome was one the first to be devastated, in a slow process of substitution by logging and farming along the Brazilian coast and covering less than 8% of the original area. The goals of this work were: (i) verify the influence of four levels of boron (B) and three levels of saturation of bases (V%) on the plant development of six forest species native of the Atlantic forest biome; (ii) evaluate symptoms of deficiency of B in these species. The liming was made to achieve saturation of bases (V% natural = without liming, V% = 50 and V% = 70). The species tested were: *Croton floribundus*, *Croton urucurana*, *Peltophorum dubium*, *Gallesia gorazema* (*Patagonula americana*), and *Hymenaea courbaril*. The four levels of B were: 0, 0.5, 1.0 and 2.0 kg-1 B ha. Regardless of the ecological group of the forest species studied, were not observed answers regarding biometric parameters (growth in height and total, aerial and root system dry matter) concerning to saturation of bases (V%) and soil fertilization with B, demonstrating high adaptation to conditions of low fertility and efficient physiology for absorption of B; the omission of B resulted in visual symptoms of nutritional deficiency only for the species *Croton floribundus* and *Gallesia gorazema*.



S10.01-P -24

EFFECT OF BORON AND LIMING ON THE INITIAL DEVELOPMENT OF EUGENIA DYSENTERICA DC., A NATIVE VEGETAL SPECIE OF BRAZILIAN CERRADO

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The Brazilian Cerrado (savanna) is among the main priority areas for global biodiversity conservation. Due to a high degree of weathering, soils of Cerrado are characterized by low-activity clays, low nutrient content (including micronutrients), high toxic aluminum concentration, and high acidity. Thus, the native plant species of Cerrado have very specific ecophysiological, nutritional, and environmental requirements. The objective of this study was to evaluate the influence of B supply (0, 0.5, 10 and 2.0 kg ha⁻¹) and liming on the initial growth of cagaita (Eugenia dysenterica DC.). Samples of a Typic Quartzipsament were incubated to reach three levels of base saturation (natural, 50% and 70%). Four months after transplanting, plant development was assessed by growth rate (H), root dry mass (RDM), shoot dry mass (SDM) and B concentration in the shoot ([B]), which showed the following variations, respectively: 0.32-14.5 cm, 1.15-2.13 g, 0.72-1.74 g, and 50.0- 121.5 mg kg⁻¹. No significant difference was observed on the initial plant development with increase in B supply and soil liming. The natural chemical conditions of the soil, i.e., 0.15 mg dm⁻³ of B and low base saturation (36%), was sufficient to ensure the full initial development of E. dysenterica, wich was highly adapted to the restrictive conditions of the Cerrado soil. Additional studies must also focus on the specialized physiology of these plants to absorb nutrients under restrictive conditions.



S10.01-P -25

EFFECT OF CONVENTIONAL AND ORGANIC CROPPING SYSTEMS ON BELOW GROUND C AND N INPUTS FROM SOYBEAN AND ITS FATE INTO FUNCTIONAL POOLS

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Investigations were carried out in the DOK trial (Basle, Switzerland) comparing two organic, two conventional cropping systems on two fertilization levels (1=50%; 2=100% standard fertilization) since 1978: bio-organic (ORG1, ORG2), conventional with manure (CON2), conventional without manure (MIN2), control (NON). Soybeans were pulse labelled with ^{15}N urea and ^{13}C glucose using a wick technique. C and N rhizodeposition (CdfR, NdfR) and its fate in functional soil pools were determined by a isotope mass balance approach. Plant total C (Ct) and N (Nt) uptake constituted 525 – 856 g C m⁻² and 32 - 49 g N m⁻², respectively. Surprisingly Ct was decreasing in the order: NON a=MIN2=ORG1=ORG2=CON2 b and Nt in the order: MIN2a=NON=ORG1=ORG2=CON2b. Differences between treatments were mainly determined by the extend of rhizodeposition. It accounts in average 29% of both Ct and Nt. The highest inputs were observed in NON with 53 % and 46% of Ct and Nt respectively. Rhizodeposition was quickly incorporated in "stable" soil organic matter fractions (SOM). 77 % of CdfR was stabilized in SOM, 22% as microbial C but < 1% found as dissolved organic C and 78% of NdfR was stabilized in SOM, only 11% found as microbial N but 10% as mineral N. Differences between treatments were small. High below ground C and N inputs in low input systems could compensate the lower above ground C and N uptake compared to high input systems.



S10.01-P -26

EFFECT OF DIFFERENT N MANAGEMENT ON IMPROVING N EFFICIENCY IN RICE- TAROM VARIETY

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*Inappropriate N management has the determinal-major effects on crop yield and environment and -agrees disease and pest incidence and it leads to further lowering of N fertilizer recovery efficiency (RE), which is already not more than 50 %. The chlorophyll meter (SPAD) and leaf colour chart (LCC) are simple, portable diagnostic tools that can measure the crop N status in situ in rice fields to determine the timing of N top dressing. An experiment was carried out in Rice Research Institute in mazandaran, in 2009. A test material has been evaluated in a Randomized Complete Block Design with three replications. Tarom variety were grown under eight treatments at plant density of 25*25. Eight treatments included a zero-N control, two splits, chlorophyll meter 35, 37,40, LCC 4 and 5. Result showed that Both LCC and SPAD can be used to improve N management for rice. The optimal SPAD threshold for determining the timing of N-application was 35. LCC treatments indicated that N-management based on LCC shade 4 helped avoid over application of N. Critical value of LCC 4 was more beneficial in enhancing the growth and agronomic, physiologic and internal efficiency. It is suggested that when N-management technology such as real time N-management (SPAD and LCC) were used, would avoid to over application of N fertilizer by rice farmers. Key wordes: N management-Efficiency – LCC –SPAD -Rice*



S10.01-P -27

EFFECT OF DIFFERENT SOIL AMENDMENTS AND ORGANIC FERTILIZERS ON THE BIOLOGICAL SOIL QUALITY AND MYCORRHIZATION OF STRAWBERRY CROPS.

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The use of organic fertilizers and soil amendments containing beneficial microorganisms (PGPR and AMF) and bio-products of natural origin may affect the relationships between plants and soil microorganisms, including nematodes. A field trial was carried out on strawberries cv. Elsanta. The structure of nematode and rhizosphere microorganisms populations after addition of 5 different organic fertilizers and amendments was monitored. The products used were: dried manure, an extract from vermicompost (Humus UP), a seaweed extract (BF Quality), a by-product obtained in the production of yeast (Vinassa) and a microbial consortium (Micosat) composed of mycorrhizal fungi, PGPR and Trichoderma. Control plants were not treated or were fertilized with standard NPK chemical fertilizers. Soil samples were gathered before application of the products in spring time and again in autumn for three years. The different organic products generally increased the total population of nematodes, but their effect on the trophic groups varied. Similarly, the populations of soil bacteria and fungi were affected differently by the products, even if they were applied as foliar. Changes in root mycorrhization rates were also recorded. All these results are suggesting a possible indirect influence of the products through root exudates.



S10.01-P -28

EFFECT OF GYPSUM ADDITION ON MINERAL CONTENT IN Highbush BLUEBERRY GROWING IN AN ANDISOL WITH HIGH ALUMINUM SATURATION

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*In Chile, highbush blueberry (*Vaccinium corymbosum* L.) is an important fruit crop that is well adapted to acid soils (pH = 5.5) as Andisols, but it is sensitive to phytotoxic aluminum (Al³⁺), causing a reduction on nutrient uptake. Nonetheless, calcareous amendments as calcium sulfate or gypsum (CaSO₄) are used to ameliorate the harmful effect of Al³⁺ on crops. The effects of this amendment on mineral content in leaves and roots of blueberry under Al-toxicity are remaining unknown. The aim of this work was to study the gypsum effect on mineral content of blueberry cultivars growing under acidic conditions and high Al³⁺. One year-old plants, a more Al-tolerant (Legacy) and Al-sensitive (Bluegold) blueberry cultivars, were grown in an Andisol (Al-saturation ~60%) amended with gypsum at 0 (control soil), 1000, 2000 and 4000 kg ha⁻¹ during 60 days. At end of experiment, gypsum addition increased significantly calcium (Ca) and magnesium (Mg) content in leaves, whereas sodium (Na) was reduced either in leaves and roots of both cultivars, especially at 2000 and 4000 kg ha⁻¹, compared to the control plants. A significant increase of phosphorus (P) and sulfur (S) content principally in roots was found in Bluegold. In contrast, Al content of leaves and root was significantly reduced in Legacy and Bluegold by gypsum addition, resulting in an improved Ca/Al molar ratio in leaves and roots when gypsum doses were higher (P = 0.05). Gypsum addition improved nutrient uptake especially in Al-sensitive cultivar, avoiding excessive Al accumulation in tissues of the two cultivars.*



S10.01-P -29

EFFECT OF PERENNIAL FODDER CROPS ON ROOT GROWTH OF SUBSEQUENTLY GROWN WHEAT

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Alfalfa (*Medicago sativa* L.), chicory (*Cichorium intybus* L.) and tall fescue (*Festuca arundinacea* Schreb.) followed by spring wheat were grown in a field trial in order to evaluate effects of perennial fodder crops on soil structure and root growth of subsequent crops. The experiment was undertaken at the Klein-Altendorf experimental station near Bonn, Germany on a Haplic Luvisol developed from loess. Root length density (RLD) and dry weight of wheat roots were determined by taking four monoliths of a soil volume of 2.5 l each from six soil layers (45-105 cm soil depth). Scanned roots were analyzed with WinRHIZO software. Biopores were counted visually in 40 cm soil depth on 0.25 m². Above 65 cm soil depth RLD and root weight of wheat after tall fescue was higher than after alfalfa and chicory. Beneath 65 cm soil depth no significant differences were detected. Wheat RLD and root weight after tall fescue was continuously decreasing with soil depth whereas there was little change with depth after chicory and alfalfa. This may be a result of lower bulk density in the upper soil layers after tall fescue having a dense, fibrous root system as well as more biopores generated by the taproot systems of alfalfa and chicory in deeper soil layers. The results support the hypothesis that deep rooting perennial fodder crops can enhance creation of biopores that facilitate root growth of following crops in the subsoil. These investigations are part of the DFG-funded research unit FOR 1320.



S10.01-P -30

EFFECT OF SOIL DEPTH AND MYCORRHIZA ON RHIZOSPHERE EXTENSION UNDER TWO CATCH CROPS

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*Rhizodeposition leads to intensive interactions between plant roots, microorganisms and soil constituent. However, little is known regarding the importance of rhizodeposition for microbial nutrient mobilization and consequently nutrient acquisition from subsoil. We hypothesize that in subsoil rhizodeposition is of higher importance for microbial nutrient turnover than in topsoil. Therefore, we conducted a laboratory experiment to evaluate (1) differences in rhizosphere extension of the two catch crops lucerne (*Medicago sativa*) and cichory (*Cichorium intybus*), (2) the effects of rhizodeposition on cellulose, protein and chitin turnover and (3) the contribution of mycorrhiza hyphae to rhizosphere extension between top- (0-30 cm) and subsoil (45-75 cm) of a Haplic Luvisol. Therefore, plants were grown in 3-compartment pots either filled with subsoil or topsoil, with either root or root+mycorrhiza exclusion in side parts, respectively. To obtain gradients of root-derived C, the side parts were cut into 2 mm thick slices. ¹⁴C and enzyme activities of β -glucosidase, β -N-acetylglucosaminidase and Leucin-aminopeptidase were analyzed in the obtained soil slices after ¹⁴C pulse labeling. The experiment showed that if mycorrhiza is excluded, rhizosphere extension was higher in subsoil, due to (1) lower microbial activity leading to slower decomposition of rhizodeposits and (2) different microorganisms that are less specialized for rhizodeposits. Mycorrhizal association had no influence on rhizosphere extension in subsoil, whereas hyphal transport of C increased the spatial influence of roots in the topsoil. Furthermore, turnover of cellulose and protein evaluated by β -glucosidase and Leucin-aminopeptidase activity, respectively did not increase due to the considered rhizodeposits.*



S10.01-P -31

EFFECT OF SOIL NUTRIENT AVAILABILITY ON NOCTURNAL WATER RELATIONS AND FINE-ROOT ACCLIMATION IN HYBRID ASPEN SEEDLINGS

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*To test whether saplings of hybrid aspen (*Populus tremula* L. × *Populus tremuloides* Michx.) show any significant variability in nocturnal water relations and fine-root acclimation with respect to nutrient availability, a growth chamber experiment was carried out. The main limiting element in the nutrient deficiency treatment (low-N) was nitrogen. In general, trees from the high-N treatment demonstrated significantly ($P < 0.05$) higher photosynthetic rate, leaf area, stem growth increment, tree and foliar biomass, leaf and fine-root nitrogen concentrations. At the same time, they had significantly ($P = 0.028$) lower fine-root biomass compared to the trees in the low-N treatment. A negative relationship between night-time water use percentage (NWU) and fine-root biomass per soil volume ($R^2 = 0.57$; $P = 0.029$) and strong positive relationship ($R^2 = 0.81$; $P = 0.002$) between NWU and specific root length (SRL) evidenced different fine-root acclimation strategies in two soil treatments. We assume, that increased SRL ($P = 0.011$) in nutrient sufficiency potentially allows acquire nutrients via mass flow more efficiently and to lower construction costs for fine-root biomass production. Increased NWU and SRL in high-N treatment suggest that nocturnal sap flow and/or transpiration flux could be beneficial for fast-growing tree species in fertile conditions, not vice versa.*



S10.01-P -32

EFFECTS OF DIFFERENT COMPOST DOSES ON THE MOST IMPORTANT PARAMETERS OF SOILS AND PERENNIAL RYEGRASS (LOLIUM PERENNE L.)

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The composting gives an excellent choice to recycle the organic wastes, which produced by the agriculture and industry. The compost is appropriate to apply in the nutrient management of horticulture and in soils having poor nutritional status. The application of the compost in optimal doses decreases the amount of the unnecessary materials get in the landfills. Research results published in the last years showed improvement in the processes of composting, as well as in the knowledge of conditions of compost utilization. The compost helps to supply the more increasing demand of the costumers for the quality of the agricultural products. Compost utilization experiment with different composts was set in our greenhouse. One of the pot experiments was set up to investigate the effect of compost given by different doses. The treatments were 0, 5, 10, 25 and 50% in volume ratio with an acidic soil, by one of the compost. The other was mixed to the soil in ratio of 0, 5, 10, 20, 30, 40 and 50% for determining more precise the optimal ratio. The indicator plant the dry matter production and the total P- and K-content of it measured. Plant available PK-content of soil was investigated by 0.01 M dm⁻³ CaCl₂ and AL extraction solution. All treatment increased the dry matter production. The optimal application doses of composts are different. The residual nutrient status of the soils was also different, showing that the relatively slow compost decomposition process is able to insure the nutrient demand of the plants.



S10.01-P -33

EFFECTS OF MOSS COVER ON SOME SOIL PHYSICAL AND CHEMICAL PROPERTIES

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Mosses as a primitive vegetation cover are referred as an energy and water transfer factor in soil bodies and therefore they play an important role in weathering and soil formation processes. Moss cover affects on physicochemical, biological, fertility, stability, and many other soil characteristics. For indicating the effect of moss cover on soil properties, we executed this study. So, the aim of this study was the comparison of some physical and chemical properties of adjacent pairs of soil samples with and without moss cover in Khayrod Kenar forest, Noshahr, Iran. After a preliminary investigation three suitable sites were determined and 18 soil samples were collected from three different depths (0-5, 5-10 and 10-15 cm). Physical and chemical analysis including particle size distribution, pH_e, E_{Ce}, bulk density, OC %, SP, CEC and water extractable cations and anions were determined according to standard methods. The results showed that the moss covered samples in comparison with uncovered areas, have a significantly higher organic carbon and moisture contents, cation exchangeable capacity and electrical conductivity, especially at the upper most 0-5 cm soil layer. Furthermore the existence of moss cover distinctly decreases soil bulk density. In addition to direct effect of moss on soil properties, the existence of moss on soil surface can affect the reciprocal relationship between these properties and improvement of one parameter have an augmentation effect on promotion of the relative parameter.



S10.01-P -34

EFFECTS OF NITROGEN ON PHOTOSYNTHESIZED CARBON INPUT INTO SOIL ORGANIC CARBON POOLS IN A RICE–SOIL SYSTEM

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*The input of plant-photosynthesized carbon (C) into soil plays an important role in global C cycling. A ¹⁴C-labelled microcosm experiment was carried out to quantify the input of photosynthesized C into soil C pools in a rice-soil system. Growing rice (*Oryza sativa* L.) was continuously fed ¹⁴C-labeled CO₂ (¹⁴C-CO₂) in a closed chamber without nitrogen (N) (N₀), or at different rates of N application (10 [N₁], 20 [N₂], or 40 mg N kg⁻¹ soil [N₃]). There was no significant difference in rice biomass C among the N treatments after labelling for 36 days. The amount of ¹⁴C in the soil organic C (¹⁴C-SOC) ranged from 25.07 to 233.18 mg C kg⁻¹, depending on the rate of N addition, accounting for 1.1% to 12.7% of the rice biomass C, respectively. The amounts of ¹⁴C in the dissolved organic C (¹⁴C-DOC) and in the microbial biomass C (¹⁴C-MBC), as proportions of ¹⁴C-SOC, were 1.1%–9.0% and 4.1%–35.2%, respectively. The ¹⁴C-DOC, ¹⁴C-MBC, and ¹⁴C-SOC as proportions of total DOC, MBC, and SOC, respectively, were 9.6%–10.9%, 6.7%–9.4%, and 0.2%–1.7%. Our results suggest that the application of N promotes the input of rice-photosynthesized C into the SOC pools and that this increase is greater at high N levels. Further studies are required to ascertain the functional significance of soil microorganisms (such as C-sequestering bacteria and photosynthetic bacteria) in the paddy system.*



S10.01-P -35

EFFECTS OF TREE DIVERSITY ON TRANSFORMATION AND TRANSLOCATION OF CARBON AND NITROGEN IN FOREST SOIL

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*Transformation and translocation of carbon and nitrogen in soils are affected by tree species composition. The tree species affect the dynamics and rates of rhizodeposition and its incorporation into microbial biomass and soil organic matter. A whole tree canopy $^{13}\text{CO}_2$ and $\text{Ca}(^{15}\text{NO}_3)_2$ pulse labeling of *Fagus sylvatica* and *Fraxinus excelsior* has been conducted to investigate the impact of species on C and N allocation within trees, belowground C translocation and incorporation in microbial biomass and soil organic matter. The labeling experiment was conducted on 3-4 m trees in a species rich broadleaf forest of Germany. Soil samples were taken in three depths at 10 cm distance from the tree and bulk soil organic matter $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ were determined. The C and N incorporation in plant tissue of leaves, stem and roots were measured. The microbial biomass and its isotope composition were determined by Chloroform-Fumigation-Extraction. *F. excelsior* showed a CO_2 higher assimilation rate and an increased relative C allocation into the soil as indicated by the $\delta^{13}\text{C}/\delta^{15}\text{N}$ of leaf, stem and root tissue in comparison to *F. sylvatica*. The species specific leaf metabolism and fine root allocation lead to a significant C allocation in quantity and quality into mineral soil up to 30 cm depth. However, the total portion of C and N allocated belowground does not exceed few percent of the label. Different C allocation patterns of ash and beech are one mechanism of niche differentiation, which preserves the species rich deciduous forests.*



S10.01-P -36

EFFECTS OF TRIPARTITE SYMBIOSIS AND DROUGHT STRESS ON ALFALFA ZINC UPTAKE IN STERILIZED AND UNSTERILIZED SOILS

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In order to ensure the success of low agrochemical input, effective soil management and soil biology must be taken into account. In one green house experiment in sterilized and unsterilized soils, symbiotic association effects between VAM fungi, Rhizobium bacteria and alfalfa plants under 10, 15 and 22 percentage moisture levels was studied. The research was laid out by factorial experiment in the form of Complete Randomized Block Design with 5 replications. The main effect of moisture levels became significant on Zn uptake at 1% probability level in the both sterilized and unsterilized soils. In the sterilized soil, VAM inoculation significantly increased uptake of Zn at 1% level but in the unsterilized soil it was significant at $p=0.05$. Double interaction of VAM \times moisture level had significant effect on Zn nutrition in the sterilized soil at 5% level but it wasn't significant in the unsterilized soil. In the both sterilized and unsterilized soils, the main effect of rhizobium bacteria, the synergistic effect between VAM and rhizobium, double interaction of rhizobium \times moisture level and also triple interaction of VAM \times rhizobium \times moisture level had not significant effects on mentioned parameter.



S10.01-P -37

EFFECTS OF WASTEWATER APPLICATION ON SOME OF SOIL PHYSICAL AND CHEMICAL PROPERTIES IN SHAHR-E-KORD, IRAN

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In many arid or semi arid parts of the world, treated wastewater has been used in irrigation. On the other hand, depending on soil properties, using municipal wastewater in agriculture can be benefit of hazard. So, wastewater quality is evaluated based on its effects on soils, plants, domesticated animals and human. This research was carried out as statistical plant (split plots based on randomized blocks) with three replications. Irrigation treatments (municipal wastewater and well-water) comprised of different levels of irrigation waters: water, wastewater and mix of water and wastewater in 40, 60, 80, 100 and 120% of water requirement were used based on soil moisture depletion. These treatments were used in 90 plots (3.75x5m) in corn farm located in Shahr-e-kord wastewater plant. After two month and using groundwater and three weeks after using treatments (eleven weeks after cultivation), some of soil physical and chemical such as bulk density, porosity, soil reaction and Electrical conductivity (EC) were determined in depth of 0-30 cm. According to analysis, Shahr-e-kord municipal wastewater increases soil EC and apparent density and decreases porosity and pH. Decreasing the porosity is related to wastewater organic colloid and clogging the soil porosity. Key words: Irrigation, soil physical and chemical properties, treated wastewater.



S10.01-P -38

ESTIMATING THE PARAMETERS OF A 3D ROOT DISTRIBUTION FUNCTION FROM ROOT OBSERVATIONS WITH THE TRENCH PROFILE METHOD

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Most macroscopic soil-plant models that describe flow and root uptake in 3 dimensions employ a parametric function to describe the 3D root distribution of a plant. Mapping the root distribution however remains extremely labor intensive and there is no easy way to parameterize a 3D root distribution function from root observations. A method is presented to fit a parametric root distribution function to root intersection data derived from the trench-profile method by maximizing likelihood estimation. The trench profile method was complemented with root length observations on a minimal number of soil cores to translate root intersection density into root length density. The approach was tested in the field on leek and cauliflower. In the first trench profile (halfway between two plants in a row, perpendicular to the planting row), a digital image was taken of the root intersections in the vertical plane, before creating a new vertical plane closer to the plant. This procedure was repeated until the plant position was reached. Images were analyzed to obtain the 3D coordinates of all observed root intersections. At the plant position, 6 to 8 ring cores (100 cm³ each) were sampled from the soil profile. Roots were extracted from the ring cores by wet sieving and analyzed for root length density. This sampling procedure was repeated three times for cauliflower during the cropping season. A similar protocol was used for leek, the only difference being that horizontal planes instead of vertical planes were created to locate root intersections.



S10.01-P -39

EVALUATION OF ARTIFICIAL VISION SYSTEM FOR NITROGEN DIAGNOSIS IN PLANTS OF MAIZE

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The leaf diagnosis is a methodology widely used in the plant nutrition, however, the sampling is made in an advanced development stage. By other side, the visual diagnosis depends on the evaluator's ability to identify the nutritional deficiencies. The AVS is a set of methods to interpreting images that allows the correction of the nutrient deficiency in the current cycle. This study evaluated the AVS method to identify deficiencies of nitrogen (N) in corn (Zea mays L.). The experiment was carried out in hydroponic condition with nutrient solution in a greenhouse in SP/Pirassununga/Brazil. The treatments were 0, 20, 40 and 100% of N, 4 replicates. Leaf samples were collected (old leaves and leaf 4) at the V4 stage to obtaining images by a 9600 DPI scanner as well as for chemical analyzes. The AVS techniques evaluated were: Fractal Dimension Volumetric, Gabor Wavelet (GW) and Fractal Dimension Volumetric using canonical analysis. The base, middle and tip of the leaves were analyzed for each technique using gray and color images. The increased of the nutrient concentration in the nutrient solution increased the levels of N in the leaves, consequently were observed specific visual symptoms of situations with absence or even low level of the nutrient. The AVS was able to identify all levels of nutrient deficiency. In the leaf 4, GW with color images resulted in best accuracy, showing 82.5% accuracy in the base of the leaves 4. The AVS was effective to diagnose the levels of N in corn leaves.



S10.01-P -40

**GENOTYPIC DIFFERENCES IN THE QUALITY AND QUANTITY OF DEFENSIVE COMPOUNDS
IN BETULA PENDULA LITTER REMAIN DURING DECOMPOSITION**

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Litter has the ability to modify the soil biota by amending the environment with nutrients as well as a magnitude of chemical compounds. We investigated how persistent the differences that were found in the chemistry of senescing leaves were during decomposition. We collected senescing leaves from a naturally regenerated birch forest in Finland with known genotypes. The leaves were quantified for lignin, condensed tannins, flavonoids, triterpenes and flavonoid aglycones, 60 secondary chemicals all together. Same analyses were done after 6 months decomposition at field conditions. Our results show that there are genotypic differences among the majority of the analyzed compounds most of which also persist during decomposition. This indicates that the quality of the plant material input onto the soil has a long lasting impact on the chemical properties of the soil. It also indicates that it is important to maintain the genetic diversity of the flora in order to keep the soil diverse enough to maintain a multiform soil biota.



S10.01-P -41

GROWTH OF FABA BEAN IN SALINE-SODIC SOILS: MONITORING OF LEAF DEVELOPMENT AND WATER USE DYNAMICS ENABLES THE QUANTIFICATION OF OSMOTIC AND IONIC REGULATION AT WHOLE-PLANT LEVEL

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Soil salinity reduces the growth of crops by a combination of osmotic stress and ion-specific toxicity mechanisms. The responses to salt are generally described in terms of the two phase model in which growth is initially reduced by osmotic stress and then Na⁺ toxicity. Despite the large volume of work on salt stress, the relative importance of these mechanisms to salt injury and the contributions of Na⁺ and Cl⁻ to salt stress are still not understood well. A high resolution image capture and analysis system was used to monitor the growth of the plants non-destructively and gas exchange measurements were used to examine the effects on photosynthesis. The results suggested that responses of crop growth to salinity stress may dependent on the severity of salt stress. Osmotic stress was the predominant cause of reduced growth at high levels of salinity, while specific-ion toxicity was more important under mild salinity stress. Fiesta maintained greater whole-plant tolerance to salinity by dual mechanisms of ion exclusion and osmotic adjustment, compared to Cairo. A reduction in C assimilation was partially due to non-stomatal effects, suggesting ion toxicity was an important reason.



S10.01-P -42

IMPACT OF TRANSGENIC BARLEY LINE H228.2A ON SOIL MICROORGANISMS

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Nowadays the use of genetically modified organisms (GMOs) in agriculture increases. There has been much debate over biosafety and adverse effects of GMOs. The main concern regarding environmental microbiology is possibility of horizontal gene transfer from transgenic plants to soil bacteria in natural environmental conditions. Natural transformation is important process, which has let bacteria to evolve and adapt to new habitats. Classical microbiology methods were used in this research to study quantitative changes of bacterial and fungal numbers in substrate and rizosphere from barley line H228.2A containing Rpg1 gene. Rpg1 gene provides resistance to stem rust fungus Puccinia graminis f. sp. tritici. Samples from substrate and rizosphere of parent barley Golden Promise was used as a control. Results indicated that numbers of CFU of cultivable microorganisms (total bacteria, glufosinate resistant bacteria, yeasts, fungi) in substrate and rizosphere of transgene barley were reduced in comparison with Golden Promise, but these changes were not statistically significant according to Tukey-Kramer test. In second part of research molecular methods were used to determine if horizontal gene transfer occurs from barley line H228.2a to soil bacteria. In this study using PCR no evidence of horizontal transfer was detected. It was concluded that transgenic barley line H228.2a does not significantly affect soil microorganisms.



S10.01-P -43

INFLUENCE OF A PHOSPHO-POTASSIC FERTILIZER SOLUTION ON YIELD AND QUALITY OF TRICUM DURUM ON MEDITERRANEAN SOIL

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The influence of a phospho-potassic fertilizer solution obtained from an aminoacid production process on wheat crops is studied. The positive influence these solution was most significant in grain that in leaf especially for P and K. Likewise the addition of the experiemental solution (but only in the highest doses) produce the highest yield and on the β -carotene content



S10.01-P -44

INFLUENCE OF LEAD TRANSFER WAY (ROOT OR FOLIAR) ON METAL SPECIATION AND BIOACCESSIBILITY. CASE OF CROPS CONTAMINATION BY ATMOSPHERIC FALLOUTS.

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Lead particulate matters (PM) are still emitted in the environment by metal recycling facilities and could become a risk for ecosystems after their deposition (Schreck et al., 2011; Cecchi et al., 2008). Actually, PM are taken up by plants through their root system (Uzu et al., 2009), but may also enter through aerial parts (Uzu et al., 2010). The mechanism involved in this foliar uptake is still unknown. Moreover, the consumption of crops exposed to atmospheric contaminants or polluted soils may represent a risk for human health. Then, in this study, we investigate the fate of Pb-rich micronic and submicronic particles in plants (lettuces and rye-grass) exposed to lead atmospheric fallouts or PM-contaminated soils. Lead contents were determined in plant shoots by ICP-OES after acid mineralisation. Metal speciation was investigated in plant leaves by EXAFS in ESRF Synchrotron. Moreover, metal bioaccessibility was determined by in vitro extractions with different gastric fluids according to the UBM ingestion test (Caboche et al., 2009) for the different plant samples to assess sanitary risk. Results show the influence of plant species (leaf characteristics, morphology...) and way of transfer (root or leaf transfer) in lead accumulation and speciation in shoots. The identification and quantification of lead speciation in edible parts of plants improve the understanding of differences observed for bioaccessibility results. This experiment provide new insights for sanitary risk assessment after ingestion of plants polluted by soil-plant or foliar transfer of lead carried by atmospheric fallouts.



S10.01-P -45

INVERSE MODELING OF ROOT WATER EXTRACTION BY MEANS OF A SINK TERM

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Understand the role of plants on soil water relations and thus on ecosystem functioning requires information about soil water fluxes and root-water-uptake is one of the most important related processes. The most common root-water-uptake modeling methods rely on root distribution parameters. However, the accurate measurement of such parameters or of root-water-uptake itself at field scale is not obvious, and assumptions have to be made in root-water-uptake models, which lead to imprecise model results. Therefore, we investigate the application of a simple water balance method to derive root-water-uptake patterns from highly resolved soil moisture measurements without the a priori assumption of root distribution parameters. The approach is based on inverse derivation of the sink term of the Richards' equation by a water balance approach. We compare model results from several numerical experiments with increasing random error in the synthetic soil moisture observation as well as soil textures and compare the accuracy of the results.



S10.01-P -46

IRON MOBILIZATION BY PHYTOSIDEROPHORES IN RELATION TO RHIZOSPHERE PROPERTIES

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Phytosiderophores (PS) are natural chelating agents that are exuded by the roots of grasses for the purpose of iron acquisition. Their behavior in the rhizosphere and efficiency in mobilizing iron from soils are still poorly understood. Previous studies addressing this issue were often done under conditions quite remote from those in the rhizosphere, e.g. at low soil solution ratios, potentially leading to partial depletion of the available pools of iron and other metals that compete for complexation by PS. Our present work aims to contribute to a more accurate quantification of the relevant processes and fluxes in the rhizosphere related to PS mediated Fe acquisition. Fe mobilization from several soils by the PS deoxymugeineic acid (DMA) was examined as a function of time, both with and without addition of a sterilant for preventing microbial degradation of the DMA ligand. The influence of soil solution ratio was studied, as well as of several rhizosphere parameters, including pH, ionic strength and temperature. In particular in soils of low Fe availability, Fe mobilization by DMA is severely compromised by mobilization of other metals including Cu, Ni Co, Zn and Mn. Fe mobilization rates have been quantified and will be discussed in relation to the aforementioned rhizosphere parameters.



S10.01-P -47

MAPPING OF ROOT DEPLETION ZONES IN RHIZOBBOXES USING THE DGT TECHNIQUE AND AUTORADIOGRAPHY

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Phosphorus (P) fluxes from the soil to the plant are studied using the Diffusive Gradient in Thin films (DGT) technique. DGT units consist of a sorption sink of ferrihydrite which is separated from the soil by a diffusive gel layer and protective filter paper. The DGT technique attempts to mimic P-uptake by plant, which is governed by diffusive transport and the phosphate concentration in the soil solution. In previous work, we showed that with the DGT method, P from the plant-accessible pool is sampled, while with conventionally used soil P tests (based on chemical extraction) P from non-labile pools is extracted. This is valid when P-uptake is limited by the P concentration in the soil solution and the rate of diffusive transport in the soil to resupply the P in solution from the solid phase (e.g. maize). The conventionally used soil P tests are better predictors for crops (e.g. rice) that only have a slow P demand or that have mechanisms to access a larger P pool (i.e. different root morphology or root exudates). In this experiment, maize and rice is grown in rhizoboxes, filled with ³³P labelled soils. At the end of the growing period, the soil is saturated and covered with filter paper, diffusive gel layer and a ferrihydrite gel, to allow progressive accumulation of P on the ferrihydrite gel, similar to the DGT deployment on soil samples. The ferrihydrite gels are analysed by autoradiography. This way, the P depletion zones around the roots can be mapped.



S10.01-P -48

METABOLIC PROFILING OF ROOTS AND ROOT EXUDATES OF DURUM WHEAT (TRITICUM DURUM DESF.)

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Plants release a wide variety of organic compounds and other nutrients into the rhizosphere. The root exudates influence resistance to pests, support beneficial symbioses, alter the chemical and physical properties of the soil, and inhibit the growth of competing plant species. A preliminary study was carried out to explore the metabolic profiling of root tissues and root secretion of two durum wheat (Triticum durum Desf.) cultivars (Creso and Pedroso) selected for contrasting root traits. Fifteen plants were grown in each pot (7 cm; height, 26 cm), which contained a soil mixture (soil:sand, 60:40; v/v). The pots were placed in a growth chamber (16/8 h light/dark, at 20/16 °C). The plants were taken out of the pots at the 3rd leaf stage without disturbance, and the plant roots were shaken gently to remove the root-zone (rhizospheric) soil. The experiments were carried out using a completely randomised design, with three replicates. Three pots with no seeds were included as the controls. The polar and non-polar metabolites of root and rhizosphere soil were analysed after extraction by GC-MS. The metabolites identified were subjected to principal component analysis to assess comparative similarities between samples thus forming the basis of a metabolic fingerprint.



S10.01-P -49

MODELING OF THE DIFFUSION OF VOCs EMITTED BY BARLEY ROOTS

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*It is now widely known that Volatile Organic Compounds emitted by plant roots play an important role in the rhizosphere. The aim of this research is to study the diffusion in soils of some VOCs emitted by barley roots (*Hordeum vulgare* L.) in order to evaluate their importance in the process of communication with other soil organisms. The studied VOCs are 2-pentylfuran, hexan-1-ol and 6-methyl-5-hepten-2-one. The experimental research consists of two parts. First, the behavior of Solid Phase Micro Extraction Fibers in presence of VOCs is analyzed. The small amount of VOCs emitted by barley roots and the specificity of the studied VOCs make the SPME fibers the most adapted sensors, even if they are not optimal to produce quantitative results. Next, SPME fibers are used to fix volatiles injected in a soil with a syringe. The samples are analyzed with a GC-FID. Two normalized soils, sand and sandy loam (types 2.1 and 5M, LUFA Speyer, Germany), are tested at different water contents. The SPME fibers are located at different distances around the injection point. Results will be used to calibrate mathematical equations of gas transport in porous media, the Dusty Gas Model and the Advective-Diffusive Model. These equations are solved by using the Finite Element Method.*



S10.01-P -50

**MODELLING PHOSPHORUS ACQUISITION FROM THE SUB-SOIL FOR DIFFERENT CROPS
WITH SPECIFIC CONSIDERATION OF BIO-PORES**

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The importance of nutrient supply from the sub-soil for crop growth is not well understood and may vary depending on the interaction between crop specific root systems, the characteristics of the turnover of the respective nutrient and soil properties. Simulation modelling provides a means to consider the complexity of the plant-soil system in an integrated way. However, approaches that describe the dynamics of phosphorus in combination with soil water, soil carbon and nitrogen and specifically consider the sub-soil and the bio-pores herein are scarce. The main objective of this work is to develop a field-scale cropping systems model which describes phosphorus mobilization and phosphorus fluxes from the sub-soil to the crops considering soil nutrient pools, the bio-pore system and the crop nutrient demand. A two step approach is followed in which results from controlled experiments on soil cores will be used to develop detailed process models of root development and phosphorus acquisition with a spatial resolution that resolves single roots. These are the basis for deriving simplified algorithms to be used in a cropping system model at the field scale. The latter model will be validated with extensive measurements of root growth from a multi-factorial field experiment. The presentation gives an overview on the structure of the model and the basic algorithms used. Preliminary results about the model behaviour to simulate changes in root length density and water uptake as affected by different soil properties in the sub-soil as determined by crop rotation are shown.



S10.01-P -51

MOLECULAR AND BIOCHEMICAL CHARACTERIZATION OF THE RHIZOSPHERE SOIL OF A CLOSED LANDFILL FOR ITS ENVIRONMENTAL RESTORATION

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A revegetation process of a closed urban solid waste landfill was initiated in 2009 for the environmental restoration of the site. The landfill is located in Foggia district in the North part of the Apulia region. Growth experiments in pots and in open field were carried out on eight plant species in order to select those that could be more appropriate in the particular extreme field conditions (climate, high slope of the walls, bad leachate control). In particular, plant growth was assessed in two different soil types (agricultural and leachate contaminated soil). Among the different species assessed, *Pistacia lentiscus* L. and *Puccinellia borreri* L. were selected because of their performance in the contaminated soil and mostly since they are typical native Mediterranean plant species. Rhizosphere and bulk soil of these two plant species, sampled from the pots, has been characterized by biochemical and molecular methods in order to highlight shift in the composition of the microbial community caused by the presence of leachate. Enzymatic activities (dehydrogenase, fluorescein diacetate hydrolysis, α -glucosidase and protease) and microbial biomass C were analyzed to evaluate the activity of microbial population of soils. The molecular characterization was carried out by the direct extraction of DNA, gene amplification of the 16S rRNA of the Eubacteria by PCR and specific groups such as the Actinomycetes and Ammonia-oxidizing bacteria. The amplification products were separated by DGGE under appropriate conditions of denaturation and the resulting genetic fingerprinting were analyzed using the software Bionumerics.



S10.01-P -52

NITROGEN SOURCES PARTITIONING BY CO-OCCURRING PLANT SPECIES WITHIN AN ALPINE LICHEN HEATH IN THE NORTHERN CAUCASUS

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*Due to their high taxonomic and functional diversity alpine plant communities in the Caucasus are useful objects for studying nitrogen sources partitioning by plant species under conditions of N limitation. Using in situ ^{15}N labeling and ^{15}N natural abundance methods we studied how different nitrogen sources were utilized by different plant species. The results indicated that in N-limited heath soil microorganisms were more efficient than plants in nitrogen uptake, taking up nitrogen actively as from inorganic as from organic sources. Nitrogen uptake by plants was much higher from inorganic sources than from amino acids, although separate species demonstrated different efficiency of element absorption. The maximal ^{15}N excess was typical for *Carex* sp., *Festuca ovina*, *Anemone speciosa* and *Campanula tridentata*, while much lower values were observed for *Antennaria dioica* and *Vaccinium vitis-idaea*. *Carex* sp. preferred $^{15}\text{N}\text{-NO}_3^-$, while *Festuca ovina* and *Campanula tridentata* absorbed $^{15}\text{N}\text{-NH}_4^+$ more efficiently. If nitrogen availability increased in fertilization experiment, some of plant species changed the preferences in nitrates or ammonium. Organic N uptake as an additional N source for plants has limited importance in the studied community. Only for two species (*Festuca ovina* and *Campanula tridentata*) increase of ^{13}C concentration in experiment with $^{15}\text{N},^{13}\text{C}$ -glycine has been observed. Symbiotic N_2 fixation by legume species is important for nitrogen supply in an alpine lichen heath community. ^{15}N natural abundance and ^{15}N dilution methods indicated that the percentage of plant N which is fixed from the atmosphere varied from about 40% to more than 90% for different legume species.*



S10.01-P -53

NUTRIENT UPTAKE BY WHEAT AS AFFECTED BY NITROGEN AND SULFUR APPLICATIONS UNDER WATER STRESS CONDITIONS

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The aim of this work was to study iron, nitrogen, phosphorus and sulphur uptake by wheat under the effect of ammonium or nitrate nutrition in two different soils namely clay and calcareous. Calcium nitrate and urea were used with or without sulphur application. Nitrapyrin (nitrification inhibitor) was used along with urea treatment to inhibit the nitrification of released ammonium. Ammonium nutrition increased Fe uptake, which was further, increased with sulphur addition. Fe percentage and uptake generally increased with increasing S and N applications; the effect of S was more than that of N in that respect. Results indicated an increase in the concentration and uptake of iron with added nitrogen and sulphur compared with control. Sulphur application to urea increased Fe concentration and its uptake compared to urea alone. Nitrification inhibitor increased Fe concentration in grains, which was further, increased with sulphur addition. Iron content seemed to be affected by different N-sources, sulphur and nitrification inhibitor treatment. Added urea stimulated Fe content in wheat grains as compared with calcium nitrate. Sulphur application was not effective in increasing Fe contents in wheat grains. Application of nitrification inhibitor increased Fe concentration in wheat grains. Urea + inhibitor had a predominant effect on N- uptake by wheat plant. Sulphur application resulted in an increase in N content as well as N- uptake in clay soil. Phosphorus-absorption was positively influenced by the addition of nitrification inhibitor.



S10.01-P -54

PLANT ROOT ASSOCIATED BACTERIA FOR ZINC MOBILIZATION IN WHEAT

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The activity of Plant Growth Promoting Rhizobacteria (PGPR) to mobilize indigenous soil Zinc (Zn) in Wheat rhizosphere was observed in a greenhouse experiment and compared with available from of chemical Zn source as ZnSO₄. The PGPR application alleviated the deficiency symptoms of Zn and invariability increased the total biomass (21%). The inoculation had a positive impact on root weight (75%), root volume (69%), shoot weight (12%) and showed the highest Zn mobilization efficiency as compared with the un-inoculated control. The PGPR colonized Wheat plants were more efficient in acquiring Zn from either added or indigenous source, than non-colonized plants. Zinc mobilization by PGPR was also confirmed in liquid culture medium. It was concluded that, selected PGPR strains can serve as efficient solubilizer of Zn, allowing farmers to avoid the use of costly chemical Zn fertilizer in Wheat crop.



S10.01-P -55

RECENT CHANGES IN SOIL FERTILITY, FERTILIZATION AND CROP PRODUCTION IN JAPAN

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Mishima et al. (2010) assessed crop fertilization in relation to crop production by using a soil surface nutrient balance that provides for fast and easy assessment (OECD 2008). However, the balance can indicate only the degree of surplus or deficiency of nutrients, not the acceptability of any surplus. To assess the appropriateness of nutrient application or nutrient surplus, the budgets of available nutrients in farmland soil should be considered. Status of and changes in fertilization, yield, balance, and budget in farmland soils in terms of nitrogen (N), phosphorus (P), and potassium (K) for the 7 crop groups in each of the 2 survey periods to assess the relationship between soil surface nutrient balance and available nutrient budget in soils are discussed.



S10.01-P -56

RELATIONSHIP BETWEEN TREE SEEDLINGS GROWTH AND CONTENT OF AL AND BASE CATIONS IN SOIL

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*Soil acidification with subsequent leaching of base cations and formation of some toxic Al forms was one of the major causes of serious forest damage in several mountainous areas in past. Although the input of the acidificants into the environment has decreased in recent years, the long-term effect of the anthropogenic acidification in the soil-plant system is still an important environmental problem. Soil acidification can be supported by unfavourable forest species composition, particularly by spruce monocultures growing. Nevertheless, the trees are also strongly influenced by soil environment and particularly by soil solution composition. The main aim of the presented work was to study the relationship between tree (*Picea abies* L. and *Fagus sylvatica* L.) seedlings growth and soil composition, particularly the content of Al and base cations (calcium and magnesium) in soil solution. A three-years pot experiment with different intensity and chemical composition of watering (pH, Al, Ca and Mg content) was established for this purpose. Several characteristics of individual treatments were monitored; namely seedlings vitality and mortality, the content of selected elements in the plant tissues, and composition of soil leachates. Soil was also collected after the experiment termination and analysed. There were found significant differences between individual treatments; the differences in vitality of spruce and beech seedlings and the content of Al in their tissues are most important. Generally, increased levels of Al addition caused limited growth of the seedlings. However, addition of base cations reduced the negative effect of Al.*



S10.01-P -57

SEASONAL CHANGES IN SOIL BULK DENSITY UNDER SEMIARID PATCHY VEGETATION

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Bulk density plays a key role in soil-plant interactions in drylands. Under plants, the accumulation of organic matter and bioturbation give rise to a decrease in bulk density, resulting in enhanced infiltration rates which in turn promote plant growth. Water limitation and these feedbacks produce a mosaic-like distribution of vegetated patches and bare areas acting as sinks and sources of runoff, respectively. Such mosaics are often associated with a microtopography of mounds developing under plants, in whose formation decreased bulk density also plays a major part. Seasonal variation of soil bulk density is poorly-studied in drylands and mainly attributed to the presence of expandable clay-minerals (smectites). We investigated spatial and temporal (intra- and interannual) variation of soil bulk density in two semiarid sites located in Almeria (SE Spain). In each site we analyzed six types of microsites comprising the complete cycle of formation and disintegration of the vegetated patches: inter-plant spaces, isolated young plants, fully-developed adult plants, senescent plants, and both well-preserved and eroded mounds. We found very significantly lower values of bulk density in winter than in summer, coinciding with higher soil water contents. This variation was microsite-dependent: winter decrease of bulk density was maximum under well-developed patches, but almost negligible in bare areas, and appeared to be not related to soil clay content. Based on these findings, we can infer that soil microrelief becomes steeper in winter than in summer, and the mounds under plants more protruding, which may result in variations in their efficiency as runoff sinks.



S10.01-P -58

SOIL-PLANT INTERACTIONS AND THEIR EFFECTS ON SOIL RESPIRATION IN A PASTURE OF THE ITALIAN ALPS

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The objective of this study was the investigation of plant-soil-topography interactions and of their effects on soil CO₂ efflux in a pasture of the Italian Alps. The study site is a 1.5 ha doline in Valchiavenna (Lombardy) used as cattle pasture, about 1900 m a.s.l., with the presence of Leptosols, Cambisols, Umbrisols, Podzols, and Phaeozems. The measurements of soil CO₂ rates were carried out in eight dates during the growing season (June-September 2010), using a portable infrared gas analyzer (PP-System) equipped with a dynamic chamber; thirty-five monitoring points were selected as representative of major soil, vegetation, and topographic features. The aboveground vegetation was removed before the beginning of the measurements. Along with soil respiration, soil surface temperature and soil water content were measured. A floristic survey was carried out at each monitoring point, to detect the abundance of all the species. A clustering procedure was used to identify the main vegetation types. The statistical analysis showed that the vegetation types (Nardetum, Seslerio-Semperviretum, earth hummocks, rich pasture, Bentgrass pasture) are significantly correlated to pedological (SOC, C/N), pedoclimatic (soil temperature and water content) and topographic (slope and aspect) factors which significantly affected CO₂ fluxes from the doline soils. By investigating the statistical relationships between soil respiration and the percentage cover of different plant species, we observed that the floristic composition was a good indicator of CO₂ fluxes from the soil, and may be used to map soil respiration in similar pastures.



S10.01-P -59

SPATIAL ANALYSIS OF SOIL FERTILITY IN IRRIGATED AREAS OF THE CERRADO REGION OF BRAZIL

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The soil fertility study provides grants that allow the occupation of naturally poor plant nutrition areas, increasing agricultural supplies. Thus, in order to spatially analyze the macro and micro nutrients interaction in relation to soil organic matter (OM) and pH, the principal component analysis (PCA) and geostatistics were used in a central pivot area with coffee, corn and bean in Cerrado region in Brazil. The macronutrients PCA indicated two principal components with 73.8% of the soil samples variance. The first principal component (PC) (46.1%) contains the influence of calcium and magnesium, with a direct relation to organic matter (OM) and pH, on specific small areas with corn and coffee. The second PC (27.7%) potassium and phosphorus showed an inverse relationship with pH and OM, also occasionally on the corn area. The micronutrients PCA identified three components with 80.1% of the variance. The first component (38.2%) indicates zinc and copper directly and inversely related to OM and pH, with higher concentrations mainly in the coffee area. The second component (61.0%), manganese pointed directly related to OM and pH on the bean area. The third component showed boron, also directly related to OM and pH in corn area. Thus, soil micronutrient contents showed an interaction with OM and pH for specific crops. However, soil macronutrient contents, are unevenly distributed on the area, appearing generally in very small specific points, which may indicate that the soil chemical attribute management of essential elements are deficient relate to the interaction distribution with OM and pH.



S10.01-P -60

SPATIO-TEMPORAL CHANGES OF SOIL MICROBIAL COMMUNITY AND ITS FUNCTIONAL DIVERSITY IN THE VICINITY TWO DESERT SHRUBS CANOPIES IN THE NEGEV DESERT, ISRA

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*Patchy desert shrubs magnify the horizontal heterogeneities of carbon-source and nutrient availability, significantly affecting soil microbial activity and distribution in arid ecosystems. In order to determine the dynamics of activity and functional diversity of soil microbial communities beneath perennial desert shrubs, the present study was initiated. Soil samples were collected from the 0-50 cm depth at 10 cm intervals beneath *Zygophyllum dumosum* and *Hammada scoparia*, and in the open spaces between them (as control) during the wet and dry seasons 2010. The results obtained had been found to elucidate that: (1) soil moisture exhibited a significant season and plant dependence, while (2) organic carbon (Corg) content was significantly affected by plant and soil depth; (3) Corg values recorded beneath shrubs were 5-132% higher than the control, and a decreasing trend along the vertical profile was observed at all localities; (4) CO₂ evolution rates and Cmic of microbial communities fluctuated between 0.02 and 5.36 µg CO₂-C g⁻¹ dry soil h⁻¹ and between 1.7 and 405.6 µg C g⁻¹ dry soil, respectively. Both seasonal values recorded beneath *Z. dumosum* were significantly higher in comparison to *H. scoparia* and control samples in the 10-50cm layers during the wet season. The total substrate utilization rates beneath the shrubs were higher in comparison to the control in most layers. The functional diversity of microbial communities beneath shrubs were significantly higher than the control in three soil layers during the wet season, while an opposite trend was observed during the dry season.*



S10.01-P -61

STABLE ISOTOPE PROBING OF THE RHIZOSPHERE COMMUNITY IN POPULUS TREMULOIDES MICHX. AND ALNUS CRISPA AIT.

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The western Canadian boreal forest is a mosaic of plant communities being reshaped by a variety of disturbances on the landscape, requiring the transition of endemic communities to those more suited to new conditions. Reforestation on peat could face an additional obstacle as a number of studies have produced results suggesting peat may display antibiotic properties. Considering differences in organic substrates typical to forests or peatlands, there is concern that peat will not support the diverse interactions within the soil microbial community consistent with forest development. This study uses stable isotope probing to investigate the microbial community in the rhizospheres of two pioneer species, Populus tremuloides Michx. (aspen), a species not known for strong associations with the soil microbial community, and Alnus crispa Ait. (alder), a species well known for mutualism with actinomycetes. Specifically, the objective was to determine how different organic carbon substrates influenced the rhizosphere microbial community and how this could be linked to plant growth. Seedlings were grown for 20 weeks in forest floor material, peat, and a combination of both. They were pulse labelled with $^{13}\text{CO}_2$ (g) and subsequently harvested for plant growth measurements. While analysis of plant growth covariates did not indicate any effect by organic carbon substrate on aspen growth, alder reported significantly less growth in peat treatments. The rhizosphere soils were extracted for compound-specific analysis of $\delta^{13}\text{C}$ in microbial phospholipid fatty acids using a gas chromatograph coupled to an isotope ratio mass spectrometer, which will be related to substrate type and plant species.



S10.01-P -62

STIMULATIVE EFFECT OF FIVE HUMIC SUBSTANCES ON SEED GROWTH OF HEMP (*CANNABIS SATIVA* L.), POPPY (*PAPAVER SOMNIFERUM* L.), PEPPER (*CAPSICUM ANNUUM* L.) AND RAPE (*BRASSICA NAPUS* SUBSP. *NAPUS*)

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Stimulatory effect of humic and fulvic acids from sources originated in the Czech Republic was verified on the germination and initial growth of selected agricultural crops: Cannabis sativa (Cannabaceae), Papaver somniferum (Papaveraceae), Capsicum annuum (Solanaceae), Brassica napus (Brassicaceae). Humic substances (HS) of diverse origin were used, namely humic acid isolated from lignite (B), cambisol (D), podzol (E) and purified humic acid Fluka (A), and fulvic acid from mountain spruce forest soil (C). HS were characterized by structural parameters (aromaticity, ratio of hydrophilicity/hydrophobicity, index of biological activity) determined by ¹³C NMR spectroscopy. According to our previous study the concentration of 200 mg/l of HS was used. Germination and growth tests were carried out in standard laboratory conditions. Seed germination, length of sprouts, sprout accretion and weight of dry sprouts were monitored. Comment on the results: 1. Potassium control had a significant effect on seed germination only, but not on the growth of seedlings. 2. In fact, HS had no impact on seed germination. Exception was the influence of substance E on the number of germinated seeds in peppers 111%±10% at the first day of the test. 3. Rape seedlings growth was inhibited by HS. 4. Significant difference in length and accretion of sprouts were found after using the substance B in poppy at the third day of the test (161%±30% and 175%±37%, respectively). 5. Weight of dry sprouts in cannabis was significantly influenced by all the used HS. The greatest increase was recorded in substance B 142%±30% and C 143%±35%.



S10.01-P -63

SUBSTITUTION OF TRIPLE SUPERPHOSPHATE (TSP) BY FARMYARD MANURE (FYM) AND ITS LOCAL PLACEMENT AFFECT ROOT GROWTH AND GRAIN YIELDS OF MAIZE IN WESTERN KENYA

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Root growth and consequently, enhanced nutrient acquisition can be stimulated by concentrating nutrients in the planting rows. Localizing P, for instance, causes root proliferation in the nutrient rich patches thereby improving its acquisition. Field experiments were conducted at three sites (Sega, Bokoli and Teso) in western Kenya during 2 seasons-2011 LR and SRs - to quantify (1) the interactions between FYM and TSP applications at different substitution rates on maize yields and (2) the effect of concentrating FYM in the planting rows on soil bulk density (SBD), root length density (RLD) and maize yields. The former was evaluated by substituting TSP by FYM at 0, 25, 50, 75 and 100 % of 26 kg P kg ha⁻¹ and the latter by broadcasting or locally applying 13 kg of P ha⁻¹ FYM to only 50 % or 25 % of the area around the planting rows. For the substitutions, yield increased with increasing proportion of FYM in the P application with sole FYM having significantly higher grain yields than sole TSP. Application of FYM at any rate and mode of placement had significant effects on the SBD and RLD as compared to the control. However, localized application of FYM at either 25 or 50% of the planting area did not differ significantly ($p < 0.05$) from broadcast, in terms of RLD and BD, a fact attributed mostly to the similar concentration of P in the soil solution. Further research can target localizing P from FYM at rates higher than 13 kg P ha⁻¹.



S10.01-P -64

THE CHEMICAL SUBSTANTIATION OF THE RELATIONSHIPS BETWEEN CERTAIN BIOMETRIC INDICATORS AND SOME PARAMETERS WHICH EXPRESS THE SOIL CLAY QUANTITY AND QUALITY

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The purpose of this paper is to substantiate, from the chemical point of view, some relationships between certain biometric indicators as conventional trunk age (CTA-30) and root distribution index (RDI), on the side and some indices which express the soil clay quantity (clay content) and soil clay quality (the contents of the principal clay minerals) on the other side, in the case of the soils from some fruit growing areas of Romania. This substantiation is made with the help of the correlations of some mineralogical parameters (illite and smectite contents of soil), with some indices which express some chemical properties (cation exchange capacity and available K₂O) of soils from some fruit growing plantations. These relations proves that the clay influence on the growth and evolution of the fruit – growing species (e.g. apple tree) can be considered as an indirect one, it being related to the quantitative and qualitative implications of the clay in the formation and evolution of some chemical (and physical) properties of the soil. According to these established relations, the values of some biometric indices is influenced by the soil illite content (RDI) or by the clay illite content (CTA-30), the bases of these relations being potassium implication on the growth and development of the fruit – growing species. Further researches will be extended also to Soya bean crops.



S10.01-P -65

THE EFFECT OF RHIZOSPHERE SOIL, AND MYCORRHIZAL INOCULATION ON WHEAT AND ONION GROWTH UNDER METHYL BROMIDE FUMIGATED AND NON-FUMIGATED FIELD CONDITION IN THE MEDITERRANEAN SOIL CONDITIONS

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The potential effect of rhizosphere soil were compared with selected mycorrhizae on wheat growth were investigated under field conditions for two successive years. Experiment was carried out on Menzilat soil series, which is located in Research Farm of Çukurova University/Turkey (Eastern Mediterranean region). 1000 spore per plant for selected mycorrhizae inoculum and mycorrhizae spore reach rhizosphere soil were placed 30 mm under the seeds. Wheat seed was sown in fumigated and non-fumigated plots with and without mycorrhizae, rhizosphere soil and phosphorus treatments. Experiment was carried out in two successive years. In generally plant growth and yield were not well in fumigated plots than non-fumigated one. The yield of plants grown in non-fumigated soils was higher than fumigated one. There were no significant differences between rhizosphere soil inoculation and mycorrhizal inoculation. However mycorrhizal inoculation increased plant yield. The difference in nutrient uptake in non-fumigated plot was considered to be related to indigenous mycorrhizal infection. The results revealed that soil indigenous mycorrhiza is persisting to contribute to the plant growth



S10.01-P -66

THE EFFECT OF SOIL COMPACTION ON NITROGEN UPTAKE BY WHEAT'S SHOOT AND ROOT

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Soil compaction results in reducing to absorb and storage of water and nutrient, poor ventilation and lack of enough grow of root plants. In order to assess the effect of compaction on nitrogen uptake by plant in two experimental stages performed in factorial completely randomized design with three replication. In this experiment the effect of soil compaction was studied in three levels (natural density, 10 and 20 percent), soil texture factor in two levels (sand and clay) and two-step growth of plant (14 and 60 days after planting) on nitrogen uptake of the plant. Chlorophyll content was significantly decreased with increasing compaction. Also increase soil compaction lead to decreasing the leaf nitrogen and chlorophyll content in the later week of planting. Soil compaction causes accumulation of total nitrogen in the root in clay soil, as the most total nitrogen of root with mean %1.76 contribute to %20 compaction in this texture. The reason may be reducing of the plant ability to uptake and transport of matters from roots to vessels and reducing shoot growth in response to hormonal message is generated at the root. Regarding these results it can be said: less nitrogen was used in compacted soils in the shoot resulting leads to decreasing of plant nitrogen. Also plant nitrogen is not directly in fluenced by soil texture but the interaction of soil compaction and soil texture can affect the plant nitrogen uptake.



S10.01-P -67

THE ENHANCEMENT OF SEWAGE SLUDGE BIOPOTENTIAL USING MIXED MICROBIAL POPULATIONS

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The technological process of drying the Kolubara basin lignite produces wastewater loaded with solid material. This wastewater is then being mixed with wastewaters originating from other sources of Kolubara basin. The product derived from wastewater treatment is sewage sludge (locally named - KEK), which is deposited onto a landfill and becomes a treat to the environment as such. The sewage sludge pile of deposited material KEK is spontaniously overgrown by various plant species. The aim of this research wast to examine the influence of mixed microbial populations (Biofor) on plant germination of species Sinapis alba, Avena sativa and Lactuca sativa regarding specific conditions existing in sewage sludge – KEK. Mixed microbial populations are consisted of isolated strains from rhizosphere of various plants. The results of chemical analysis of the studied sewage sludge indicate its acidic reaction, its shortage of carbonates, but also a high content of humus in it. Another outcome of these analisys has shown the low presence of available nitrogen, phosphorus, as well as potassium, but also that it is not loaded with high concentrations of heavy metals. The conducted microbiological analysis of sewage sludge have shown the dominante presence of bacteria in it, and the number of Azotobacter sp. indicates the absence of toxic substances from sewage sludge. The present study has shown that this enriched medium can be used as growing substrate for plants and therefore as recomendation to big industries of mining basins how to answer the growing need for sustainable development.



S10.01-P -68

TITLE: MAIZE-MANGO INTERCROPPING AND ITS EFFECT ON SOIL FERTILITY

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*In Yen Chau district, Northwest Vietnam steep slopes are used for growing cash-crops like maize to improve the income of local farmers. However, the deforestation of these steep slopes led to erosion and thus to degradation of soil fertility and consequently to a decline of maize yields. On some of these fields, mango trees (*Mangifera indica* L.) are intercropped with maize for two reasons: Besides the extra income from the sale of the fruits, the mango trees are supposed to improve soil fertility and to reduce erosion of the surrounding soil. However, no data on the hypothesis was available. Therefore, the aim of our study was to assess the effect of mango trees on soil fertility at six maize fields on steep slopes in Yen Chau district. The sites were similar in soil type and geomorphological parameters but differed in the age of the intercropping system. Soil was sampled in triplicates and in three depths (up to 30 cm). Total C & N and isotopic composition, cation exchange capacity, and available phosphorus and exchangeable cations were measured. While no significant difference in soil organic carbon between soil under the mango canopy (Sc) and in the maize field (Sf) was found, available nutrients were higher in Sc than in Sf (e. g. K: 216 mg kg⁻¹ vs. 171 mg kg⁻¹ in the 0-10 cm). Apparently, even without fertilization under the mango canopy, better nutrient recycling and the less output via harvest led to higher nutrient contents than in the maize field.*



S10.01-P -69

TRANSFER OF URANIUM ISOTOPES, THORIUM AND THEIR DECAY PRODUCTS FROM SOIL TO LETTUCE AND WHEAT IN FIVE DIFFERENT REGIONS OF THE FRENCH TERRITORY.

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Natural radionuclides namely uranium, thorium and their decay products, are the main source of human exposition to internal radiation. Indeed, these radionuclides are naturally present in soil and can be incorporated metabolically into plants and transferred to animals and human via the food chain. The soil-to-plant transfer factor is defined as the ratio between the activity in the plant and the activity in soil. The technical report series N°472 of IAEA (2010) contains many data from several countries, but their use is difficult due to a wide range of variations. A more precise evaluation of this factor would allow its use to predict the magnitude of contamination in case of accidental release. In this study, the activity concentrations of natural radionuclides, uranium isotopes (^{238}U and ^{235}U), thorium (^{232}Th) and their decay products are studied in five regions of the French territory. These regions are characterized by different activity concentrations in their soils due to their various geological backgrounds. The studied plants are wheat and lettuce both are widely consumed in France. The preliminary results show that the ^{238}U activities measured in wheat samples are strongly correlated with the activities measured in the soil, whereas in lettuce they are poorly correlated. However the ^{232}Th activities measured in lettuce are strongly correlated to the activities in soil. The calculation of the transfer factors allow the evaluation of the behaviours of the various radionuclides during plants uptake, which will ultimately allow the assessment of the radioactive disequilibrium in the decay series.



S10.01-P -70

VARIABILITY OF SOIL PROPERTIES AND PRODUCTIVITY OF FORESTS PLANTED ON AGRICULTURAL LAND

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*Transformation of land use type from agricultural to forest land becomes more important due to the national strategy for increase of CO₂ sequestration and improvement of land resources management. Mainly these areas are former farmland having low fertile soils as well as land characterized as marginal for agricultural production. Also fertile soils could be afforested if field configuration and location are not suitable for intensive farming. Therefore variability of soil properties might be important within the certain new-established forest plantations. The research objective was to evaluate the influence of some soil physical and chemical properties on productivity of stands of pine (*Pinus sylvestris* L.), spruce (*Picea albis* (L.) Karst.), and birch (*Betula pendula* Roth) established 15 – 20 years ago. Research plots were established in several locations with different soils and former land use types (arable land, grassland). The productivity of stands in terms of number of trees and wood volume was counted. Carbon stock in overground biomass and root system was estimated. These parameters were compared with the number of topsoil and subsoil properties (texture, bulk density, porosity, plant available water content, pH, plant available phosphorus, and potassium). Organic carbon and organic nitrogen stock in the soil, and C/N ratio under the planted forest were calculated.*



S10.01-P -71

WATER DEPLETION IN INTERCROPPING SYSTEMS: A CASE-STUDY IN WESTERN THAILAND

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Agriculture on infertile, shallow or steep soils in the humid tropics often leads to a low efficiency due to a combination of high leaching rates and shallow root development of annual food crops. On these soils, erosion and declining soil quality are problematic. Contour hedgerow intercropping systems have been proposed as an alternative to traditional agricultural practice with a single crop, as they are effective in reducing run-off and controlling soil erosion. However, competition for water and nutrients between crops and associated hedgerows may reduce the overall performance of contour hedgerow systems. In order to make it a good alternative for traditional monocropping systems, the nature and mechanisms driving this competition need to be understood. Therefore, monitoring of the water fluxes in the soil-plant-atmosphere system is necessary. Electrical resistivity tomography (ERT) is a valuable technique to assess the distribution and dynamics of soil moisture in the field. In this study, we will present the results of water content monitoring under 3 different agricultural treatments on a test field in Ratchaburi province, Thailand during the growing season. First, the issue of temperature dependence of the ERT measurements will be dealt with. Then a calibration relation for water content will be established using TDR measurements in a nearby calibration pit. Finally, the water content distribution and water depletion patterns with time for the different agricultural treatments will be compared in order to show whether or not competition for water plays an important role in the functioning of these systems.



S10.01-P -72

WATER STRESS INDUCED REDUCTION OF TRANSPIRATION AND EFFECTS ON RADIAL GROWTH OF BEECH

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Beech is a highly drought sensitive tree species likely to suffer from the climatic conditions prognosticated for the current century. Hydrological modelling of the soil water availability can help to assess a possible future increase in water stress for beech stands. The evapotranspiration term plays a central role in modelling the water budget of forest stands. Often, (semi)-empirical equations are used for estimating the potential evapotranspiration, from which the actual evapotranspiration is derived as a function of the water supply in the soil (reduction function). Although this approach is widely applied, measured values for the parameterisation of such reduction functions are scarce. The objective of our research is to derive parameters for reduction functions for spruce and beech. We continuously measured soil water potential (down to the permanent wilting point) and stem diameter in various forests in Germany. We derived the parameters (critical values of soil water potential) for the reduction functions from the daily amplitudes in these measurements. We then analysed whether the identified critical values could explain the growth signal observed in tree rings (i.e., number and size of sequences of individual cells along tree rings). In a first investigation – using spruce trees – a reduction in cell diameters was observed when the soil water potential fell below critical values. It is planned to conduct this correlation analyses also for beech and thereby to validate the critical values of the reduction function derived from the daily amplitudes of soil water potential and stem diameter.



S10.01-P -73

**WILD PLANTS, PLASTICITY OF MINERAL NUTRITION AND MYCORRHIZA IN
HETEROGENEOUS SOIL CONDITIONS OF COASTAL HABITATS**

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It is widely accepted that a majority of cultivated plants require narrow concentration range of a particular mineral for optimal growth and productivity. Shortage of only one mineral nutrient can significantly reduce yield. However, in natural habitats, availability of minerals is spatially and temporarily highly variable. In addition, both abiotic (e.a., moisture, salinity) and biotic (e.a., fungi, bacteria) soil factors increase overall heterogeneity. The present paper examines a hypothesis that wild plants are extremely well-adapted to temporal and spatial heterogeneity of soil mineral nutrients in coastal habitats. The data from several field and laboratory studies will be presented to examine the hypothesis. It appears that plants native to coastal habitats are adapted to heterogeneity by metabolic plasticity allowing for optimum nutrition in conditions of changing mineral supply and soil salinity. Particular adaptive characteristics are an ability for selective uptake and deposition of nutrients together with protection against endogenous osmotic stress through accumulation of compatible solutes. Mycorrhizal symbiosis appears to have a role in protection of plants against suboptimal abiotic factors. Further studies will be needed to reveal particular physiological and molecular mechanisms of plant adaptations to variations in soil mineral nutrient availability with a potential use in plant breeding programs towards more nutrient-efficient plants.



S10.01-P -74

**WINTER COVER CROPS AND TIME OF PLANTING ON OVAL-LEAF FALSE BUTTONWEED
(SPERMACOCE LATIFOLIA AUBL.) POPULATION**

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^[1]Agricultural Research Institute of Parana State ~ Polo Regional de Pesquisa ~ Ponta Grossa ~ Brazil ^[2]State University of Ponta Grossa ~ Agronomic ~ Ponta Grossa ~ Brazil

*The study was carried out to evaluate the influence of cover crops and of black beans (*Phaseolus vulgaris*) planting time in the population of oval-leaf false buttonweed in Ponta Grossa, state of Paraná, Brazil. The experimental design was a completely randomized split-block with four replications, with cover crops as the main plot factor and time treatments stripped across the cover crops treatments. The main plots were constituted by the cover crops black oats (*Avena strigosa*), radish (*Raphanus sativus*), joined black oats with common vetch (*Vicia sativa*) and a fallow treatment; the subplots were two dates of planting (beginning and ending of recommended time). The buttonweed population was evaluated before planting, before herbicide post-emergence application and at harvest. Black beans was planted in October 03 and November 08. The weeds were controlled with herbicides. There was not significant difference in the buttonweed population among the cover crops suggesting little effect of mulching on emergence of false buttonweed. There was difference on weed population between time of planting. A higher weed population before planting was observed on the second date. A higher weed population before herbicide post-emergence application and at the harvest time was observed on the first date. The lower weed population during the crop growing time at the second planting date was attributed to the elimination, with the burndown herbicide, of the main weed flush emergence before planting. On the first planting date the main flush of weed emergence occurred during the crop growing time.*



S10.01-P -75

YIELD-TRANSPIRATION RELATIONS OF SAKHALIN KNOTWEED (FALLOPIA SACHALINENSIS) IN A LYSIMETER EXPERIMENT

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Climate conditions, water and nutrients availability are the driving factors for plant development and production. Transpiration and yield are strongly affected by abiotic stress as water scarcity, nutrient limitations. Determination of yield-transpiration relations is essential for a better understanding of plant-soil interactions. In our project the Fallopia sachalinensis L. var. CANDY, a potential new crop for biogas production is investigated. It is a fast-growing plant with a high annual yield and currently there is a lack of information about its water consumption. The aim is to evaluate its water use and biomass production under different soil water availability and the effect of nitrogen fertilization on the yield-transpiration relation. To describe the process involved in the soil-plant-atmosphere system semi-controlled environmental conditions are required. We established the plants in lysimeters under a light transmissive roof. The water is supplied automatically in relation to the volumetric soil water content (SWC 7%, 10% and 14%) with a basic fertilization of 50kg N/ha and Hoagland solution. To evaluate the fertilization effect, well watered plants (SWC 14%) have been fertilized with calcium ammonium nitrate (N) at rate 0, 50, 100 and 150kg N/ha. At leaf level the ecophysiological plant performance is investigated with a gas exchange system to determine transpiration rate and CO₂ exchange and linked to the experimental water balance and the yield.



S10.02-P - NEW TECHNOLOGIES TO DETERMINE THE SOIL INFLUENCE ON WINE GRAPE AND OTHER QUALITY CROPS

Friday 06 July 2012 from 17:00 to 18:30. Room Poster Areas

S10.02-P -1

LAND EVALUATION MODEL "ALBARIZA" FOR PREDICTING VINEYARD PRODUCTIVITY

María Anaya-Romero, Seville - Spain

S10.02-P -2

ANALYSIS OF VINEYARD RESPONSE IN FIELDS AFFECTED BY EPHEMERAL GULLYING USING AN HYDROLOGICAL MODEL AND MULTISPECTRAL AERIAL IMAGES

María Concepción Ramos, Lleida - Spain

S10.02-P -3

DISTRIBUTION OF PHOSPHORUS AND POTASSIUM (AL-METHOD) IN VINEYARDAS OF EASTERN CROATIA

Daniel Rasic, Osijek - Croatia

S10.02-P -4

GRASSED VINEYARDS, CONSEQUENCES IN SOIL PARAMETERS AND PRODUCTION, MUST AND WINE

Maria Jose Marques, Madrid - Spain

S10.02-P -5

HOMOGENEOUS ZONES WITHIN THE VINEYARD FOR SEPARATE GRAPE-HARVESTING: A CASE STUDY ON THE APPLICATION OF AN EMI PROXIMAL SENSOR

Simone Priori, Firenze - Italy

S10.02-P -6

INTEGRATED USE OF INNOVATIVE TECHNOLOGIES AND STANDARD PEDOLOGICAL SURVEY FOR CHARACTERIZING THE VARIABILITY OF VINEYARD SOILS

Nadia Vignozzi, Firenze - Italy

S10.02-P -7

MOBILITY OF SELECTED TRACE ELEMENTS IN THE AGROSYSTEM SOIL - GRAPEVINE (LEAVES) - WINE FROM HUSI AREA, ROMANIA

Ramona Huzum, Iasi - Romania



S10.02-P -8

REACTIVITY AND SURFACE PROPERTIES OF CARBONATES IN SOILS FROM A TYPICAL ITALIAN WINE-PRODUCING AREA (MONFERRATO - NW ITALY)

Marcella Catoni, Grugliasco (TO) - Italy

S10.02-P -9

SOIL CHARACTERISTICS AS PART OF AN INTERDISCIPLINARY STUDY TO DESCRIBE THE "TERROIR" OF THE CARNUNTUM WINE GROWING AREA, AUSTRIA

Andreas Baumgarten, Vienna - Austria

S10.02-P -10

SOIL POTASSIUM AND MAGNESIUM AVAILABILITY AS RELATED TO PROPERTIES OF VINEYARD SOILS

Giuseppe Valboa, Florence - Italy

S10.02-P -11

THE STUDY OF SOIL MICROBIAL ACTIVITY ASSOCIATED TO GRAPEVINE PLANTS GROWN UNDER DIFFERENT WATER STRESS BY MEANS OF GEOCHIP MICROARRAYS

Stefano Mocali, Firenze - Italy

S10.02-P -12

USING A.R.P. PROXIMAL SURVEY TO MAP CALCIC HORIZON DEPTH IN VINEYARDS

Simone Priori, Firenze - Italy



S10.02-P -1

LAND EVALUATION MODEL "ALBARIZA" FOR PREDICTING VINEYARD PRODUCTIVITY

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Despite the economic importance of vineyards in Europe the wine sector is facing severe challenges from increased global competition. In this paper, within the framework of the Land Evaluation Decision Support System MicroLEIS DSS, an agronomic model called Albariza was developed to secure grape production in Andalusia region, Southern Spain. The input land variables considered for modelling were: slope, soil depth, clay content, bulk density, hydraulic conductivity, calcium carbonate and cation exchange capacity. Furthermore, vineyard cultivators and wine making experts played an important role in the research work, defining and collecting the output variable called land suitability index for vineyard production. The Albariza model was built by using a Multiple Linear Regression (MLR) with data collected from 21 selected benchmark sites representative of the Denominations of Origin (DO) of Jerez-Xérès-Sherry and Manzanilla-Sanlúcar de Barrameda. The regression coefficient (R^2) obtained in the calibration of Albariza model was equal to 0.722. Finally, the validation was carried out by using new input data from representative soils of vineyards located in others DO in Andalusia region such as Antequera-Málaga, Montilla-Moriles, Ronda and Condado-Aljarafe. The validation showed the high accuracy of the model and its capacity to discriminate the most suitable sites for vineyards productivity in new cultivation scenarios. The methodologies and information generated in this research can be extrapolated to other Mediterranean areas. Therefore, in a longer term, the impact of the present research would help to improve the competitiveness of the European viticulture sector at the global level.



S10.02-P -2

ANALYSIS OF VINEYARD RESPONSE IN FIELDS AFFECTED BY EPHEMERAL GULLYING USING AN HYDROLOGICAL MODEL AND MULTISPECTRAL AERIAL IMAGES

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This work is addressed to analyse the influence of micro-topographic features that favour water flow concentration on the development of ephemeral gullies and its impact on vines development throughout the analysis of NDVI (Normalised Difference Vegetation Index). The study was carried out in a vineyard planted with Chardonnay, following a 1,5 x 3m pattern. The vineyard is located in a NE Spanish Mediterranean climate area (1.769722 E, 41.53111 N). Soil erosion was estimated for the year 2010 using SWAT model. The soil map of the DO Penedès (DAR, Generalitat de Catalunya), together with a very detailed soil survey (including organic carbon, soil particle distribution, bulk density, electrical conductivity and soil depth) was used for the input model. Climatic information was taken from the Els Hostalets de Pierola observatory (Meteocat). The NDVI for the vineyard was derived from a multispectral aerial image 0.5m-resolution acquired at the beginning of August 2010. The areas in which the ephemeral gullies were formed were the ones where the lowest NDVI values were observed (near 0.15). A negative significant relationship was found between the eroded volume and the NDVI. Although the sediment yield for those areas were not the highest recorded in that analysed year, the successive soil loss in those areas contributes to the progressive loss of soil fertility, negatively affecting crop development. In some of these areas, vine roots outcrop due to soil erosion.



S10.02-P -3

DISTRIBUTION OF PHOSPHORUS AND POTASSIUM (AL-METHOD) IN VINEYARDS OF EASTERN CROATIA

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Wine growing area of Croatia is divided in the continental and litoral region. Each region is divided into sub-regions, wine growing areas and wine growing positions. Since 2003-2011 soil sampling (two depths: 0-30 / 30-60cm) from 2945 ha of vineyards situated in Eastern Croatia (Slavonija and Podunavlje sub-regions, Srijem, Baranja and Erdut wine growing areas) have been made with aim of testing main agrochemical characteristics including status of plant available phosphorus (P) and potassium (K) determined by the AL-method. By this study has been covered 60% of vineyard areas of four counties of the region as follows: Osijek-Baranya, Vukovar-Syrmium, Virovitica-Podravina, and Brod-Posavina. In general, 33% of tested area were poor in AL-soluble P and K in the surface soil layer (<12 mg P₂O₅/100 g and < 19 mg K₂O/100g). However, in the deeper soil layer 55% and 59% of the tested area were in this category of availabilities of P and K, respectively. Also, 33% and 12% of tested soil area (0-30cm depth) were rich in P and K (>20.1 mg P₂O₅/100 g and > 30.1 mg K₂O/100g). Based on this investigation soil K status in vineyards of the region is less favorable for grapevine growing compared to P status, mainly because of considerably lower contribution of rich K soil. Fertilization of vineyards with correspondingly amounts of P and K fertilizers based on soil test results, are needed for additional increases of grapevine yields and quality under conditions of Eastern Croatia.



S10.02-P -4

GRASSED VINEYARDS, CONSEQUENCES IN SOIL PARAMETERS AND PRODUCTION, MUST AND WINE

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*Cover crops in a high quality vineyard (Madrid, Spain) influence soil moisture, nutrient content and consequently vineyard production and must and wine parameters. The annual rainfall in the study area is 386 mm. Three treatments were tested: (1) Traditional tilling, chisel plow, (2) permanent false brome cover (*Brachypodium distachyon*; Bd), which was allowed to self-sow annually, and (3) rye (*Secale cereale*), mowed in spring and re-seeded again in winter. Four years after grassing significant increases in organic matter, nitrogen and phosphorus content were realized in soils with cover crops, however no changes were detected in potassium content. The soil moisture was similar at the beginning of the vineyard vegetative development. The traditional tillage treatment tended to produce soils with higher moisture from April to September at the surface (10 cm and 35 cm depth). Nevertheless, the soil moisture in this treatment was similar than that of grass-covered treatments after the harvest and during the dormant phase. The annual runoff rate was higher in tillage treatment. Bd yielded drier soil at the surface (10 cm) during the vine development and grapes maturation phases. Regarding viticulture parameters, this Tempranillo variety experienced a reduction in grape yield in Bd that increased over time, suggesting a cumulative competition effect. There was a drop in the number of berries/cluster but not a reduction in berries weight. Slight differences were found among treatments in pH, acidity or % volume of musts, as well as in some wine parameters over time.*



S10.02-P -5

HOMOGENEOUS ZONES WITHIN THE VINEYARD FOR SEPARATE GRAPE-HARVESTING: A CASE STUDY ON THE APPLICATION OF AN EMI PROXIMAL SENSOR

Priori Simone^{*[1]}, Martini Edoardo^[2], Biagi Massimiliano^[3], Andrenelli Maria Costanza^[1], Agnelli Alessandro^[1], Bucelli Pierluigi^[1], Pellegrini Sergio^[1], Costantini Edoardo A.c.^[1]

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Successful adoption of precision viticulture at the farm level depends on the appreciation of vineyard spatial variability. When management, climate and cultivar are homogeneous, soil properties result primal for the wine peculiarities and quality. Three vineyards, about 4 hectares in size, placed within the "Chianti Classico" wine district (Tuscany, Italy) were surveyed by an electrical induction proximal sensor, namely EM38-MK2 (Geonics Ltd.). With this work, we tested the potential of the proximal EMI survey to upgrade and improve a traditional soil map (scale 1:20,000), and to subdivide the vineyard into homogeneous zones (HZs) for a separated grape-harvest. ECa resulted significantly correlated with two soil functional properties for vine, namely gravel and available water content (AWC). Each vineyard was subdivided into 2 HZs on the basis of the median value of the ECa1 (0-75 cm) measured by the EM38-MK2, and each zone was separately harvested, obtaining a grape yield of about 9 tons per zone. The grape of each zone was separately vinified by the farm cellar, using the same ordinary methods for all the zones. After a wine-ageing of 6 months in wood barrels, the wines were analyzed and tasted by wine-tasting experts. The wine produced in HZs with different ECa1 values showed significant differences, especially in terms of colour intensity, dry extract, structure and general evaluation.



S10.02-P -6

INTEGRATED USE OF INNOVATIVE TECHNOLOGIES AND STANDARD PEDOLOGICAL SURVEY FOR CHARACTERIZING THE VARIABILITY OF VINEYARD SOILS

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The focus of precision viticulture is the site-specific management of vineyards; for this reason, the knowledge of the crop spatial-temporal behaviour and of environment characteristics is needed. This knowledge is crucial to detect appropriate cultural techniques and for managing diverse vineyard areas differently. This paper reports the results of a research work carried out in a premium wine farm of the Siena Province (Tuscany, Italy) where the standard pedological survey was integrated with innovative technologies of investigation, such as the geoelectrical survey by means of ARP (Automatic Resistivity Profiling) and multitemporal analysis of multispectral images for normalized difference vegetation index (NDVI) determination. Soil moisture was monitored during the veraison-yield period by means of FDR sensor (Diviner 2000 - Sentek Pty Ltd). The NDVI values during three consecutive years (2008-2010) were consistent with air temperature and precipitation data recorded during the veraison-harvest period. Resistivity maps were able to clearly identify areas with constant low NDVI values throughout the monitoring years, namely highly resistive or highly conductive zones. Such results proved that similar vegetative response were caused by contrasting soil properties. Actually, areas characterised by the same NDVI value showed different soil properties and functional characters, as well as AWC, CEC and soil internal drainage. Thus, the use of proximal and remote sensors has to be necessarily integrated with the traditional pedological survey for properly interpret the resistive signal and therefore also the plant vigour.



S10.02-P -7

MOBILITY OF SELECTED TRACE ELEMENTS IN THE AGROSYSTEM SOIL - GRAPEVINE (LEAVES) - WINE FROM HUSI AREA, ROMANIA

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Key words: trace elements, wine, grapevine, soil, bioavailability, Husi, ICP-MS. The mobility of trace elements in the soil–grapevine–wine system represents an interesting and major research topic regarding the terroir concept. The mean concentrations of trace elements in agrosystems are generally low. Selected elements (such as Cu, Zn, Mn, Fe) are bioessential for plant growth, being considered micronutrients, while others (e.g. Cd, Pb, Cr, Ni, As) have toxic effects and are often referred to as contaminants. Co is not essential to plant growth but is required by animals and human beings. The bioavailability and mobility of considered trace elements between soil and plant is controlled by pedogeochemical processes in close relation to geogenic and anthropogenic sources. Soil samples, grapevine leaves and wine were collected from Husi area, one of the oldest and a famous wine-growing region in Romania. This terroir is situated between 46° 67' latitude N and 28° 05' longitude E, in the Central Moldavian Plateau. In this study 32 soil samples from 0-20 cm depth, 32 leaf samples and 6 wine samples were analyzed for selected ten trace elements: As, Cd, Co, Cu, Cr, Fe, Mn, Ni, Pb, Zn by ICP-MS. The results show a decreasing concentration from soil towards wine samples, respecting the same order of abundances. According to legislation in force, only few elements (As, Cr, Cu, Ni) exceed the reference values for soils, as for example 67,8 mg/kg for Cu. This work was supported by the European Social Fund in Romania (grant POSDRU 47646).



S10.02-P -8

REACTIVITY AND SURFACE PROPERTIES OF CARBONATES IN SOILS FROM A TYPICAL ITALIAN WINE-PRODUCING AREA (MONFERRATO - NW ITALY)

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Carbonates are important constituents of vineyard soils in areas such as Langhe and Monferrato, in North-western Italy. Wine and grape quality is affected by soil carbonate content, because calcium is an essential nutrient, but excess of carbonates often induces chlorosis. The total amount of carbonate is however not sufficient to determine its influence on plant health, which seems to be more correlated to the active lime content. This agronomic parameter is a simple but crude index of carbonate reactivity. The aim of this work was to couple the evaluation of active lime to the chemical reactivity of carbonates and to surface properties of soils developed on late Miocene (5.33–15.97 Ma BP) surfaces from the Monferrato area. Carbonate reactivity was calculated by the initial rate method using a pH-stat apparatus, while N₂ adsorption analysis was performed to evaluate surface parameters. The profiles all evolved on marly parent material and, according to the WRB, they were Haplic Regosols, Orthoentric. The texture ranged from loam to silty clay loam and total carbonate contents varied between 28 and 59%. The contents of active carbonate both in the fine earth and in the clay fraction were related to chemical reactivity ($r^2=0.638$, $r^2=0.669$, respectively), which was in turn linked to surface parameters. While total carbonate affected soil mesoporosity, with increasing amounts of active carbonate microporosity increased, thereby justifying their high reactivity and indicating that, besides being an index for plant wellness, active lime was strongly related to soil structure in this wine-producing area.



S10.02-P -9

SOIL CHARACTERISTICS AS PART OF AN INTERDISCIPLINARY STUDY TO DESCRIBE THE “TERROIR” OF THE CARNUNTUM WINE GROWING AREA, AUSTRIA

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During a three-year period, starting in 2009, the vineyards of the Carnuntum region in eastern Austria have been investigated with respect to their “terroir” characteristics and dominating viticultural functions. A major part of this interdisciplinary study has been a detailed soil mapping and actual survey of soil parameters with regard to soil hydrology, soil physical properties and soil chemistry with a focus on nutrient availability. Furthermore, the mineralogy and clay mineralogy of both soil and bedrock have been analysed. Additionally, climatology parameters on a meso and micro scale, a geological compilation and detailed mapping of the quaternary loess and loam cover of the region have been carried out. Based on the data obtained by the investigations and the results of a questionnaire about the local vineyard settings, the individual experiences and the traditional know-how of the growers, thematic and synoptic maps have been developed to serve as supporting tool both for growers and consultants. On the one hand, viticultural practice like choosing stock and varieties or soil management can now be adapted; on the other hand the “terroir” characteristics can be described in more detail. Furthermore, results will provide the base for a follow-up study which will include the biology of the vine and chemical and sensoric analysis of the wines. The study is co-financed by the Rubin Carnuntum winemakers with financial support of the Leader program of the European Commission.



S10.02-P -10

SOIL POTASSIUM AND MAGNESIUM AVAILABILITY AS RELATED TO PROPERTIES OF VINEYARD SOILS

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Soil nutrient availability plays a key role in soil fertility, by affecting plant growth and yield response. The main purpose of our work was to assess soil potassium and magnesium availability as related to properties of different vineyard soils from Central Italy. Soil profiles representative of seven soil types were sampled and analysed for texture, pH, carbonate content, cation exchange capacity (CEC), exchangeable bases, total organic carbon (OC) and nitrogen contents. Soil K and Mg availability was evaluated according to the exchangeable and the water-soluble contents, on both soil profiles and soil samples collected over a three-year period in the “fruit-set”, “veraison” and “harvest” vineyard stages. Results showed a wide variability in Soil K and Mg contents. Data from the three-year monitoring also revealed changes in K and Mg contents with time, which nevertheless did not follow defined trends. On average, exchangeable K varied from low to high, exchangeable Mg from normal to very high. The resulting Mg/K ratio ranged from slightly high (possible limitations to K uptake), to slightly low (possible limitations to Mg uptake). The ability of soil to release sorbed cations to solution showed a relation with clay content and cation saturation of CEC. For both K and Mg, the water soluble content decreased with decreasing cation saturation, while the ratio of soluble to exchangeable content decreased with increasing clay content.



S10.02-P -11

THE STUDY OF SOIL MICROBIAL ACTIVITY ASSOCIATED TO GRAPEVINE PLANTS GROWN UNDER DIFFERENT WATER STRESS BY MEANS OF GEOCHIP MICROARRAYS

Mocali Stefano^{*[1]}, Priori Simone^[1], Fabiani Arturo^[1], Maré Caterina^[2], Cattivelli Luigi^[2], Vignozzi Nadia^[1], Bucelli Pierluigi^[1], Costantini Edoardo^[1]

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Nowadays the wine sector is facing severe challenges from increased global competition to climate changes. The relationship between wine composition, aroma, taste and soil properties have been demonstrated to be related to the different soil physical and hydrological qualities. However the impact of soil bacterial communities on soil functions, grapevine growth and wine quality has been poorly studied, especially under water deficit conditions. The objective of this work was to determine the impact of water stress on functioning of soils associated to grapevine plants through the determination of some microbial properties such as microbial respiration, microbial C-biomass and microbial community diversity assessed by means of Denaturing Gradient Gel Electrophoresis (DGGE). Furthermore the potential functional diversity of the soil microbiome will be evaluated by GeoChip microarray analyses. Soil samples from two different sites (BRO11 and BRO12) in Tuscany (Italy), cultivated with the same grapevine cultivar Sangiovese, were collected and analyzed. The two soils types presented the same pedogenetic characteristics but the values of soil umidity, determined by FDR (Frequency Domain Reflectometry) sensors, indicated a higher hydric deficiency in soil BRO12 as compared to BRO11. However the ratio between the two stable carbon isotopes $^{13}\text{C}/^{12}\text{C}$ ($\delta^{13}\text{C}$) of the last three years measured in the alcohol of the wines showed significantly higher values in BRO12 than in BRO11 (-28,3‰ and -24,4‰, respectively), indicating the presence of a moderate stress in soil BRO11. The role of both genetic and functional diversity of soil bacterial community on soil functioning and processes will be discussed.



S10.02-P -12

USING A.R.P. PROXIMAL SURVEY TO MAP CALCIC HORIZON DEPTH IN VINEYARDS

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The investigation of spatial variability of soil water retention capacity and depth is essential for a correct and economical planning of water supply of a vineyard. The advantage of measuring soil electrical properties by proximal sensors is the ability to operate with mobile and non-destructive tools, quicker than the traditional soil survey. A.R.P. (Automatic Resistivity Profiling) is a mobile soil electrical resistivity (ER) mapping system conceived by Geocarta (Paris, France), and it is comprised by a couple of transmitter sprocket-wheels, which inject current within the soil, and three couples of receiver sprocket-wheels, which measure the voltage-drop at three different depths, about 0-50, 0-100 and 0-170 cm. Ten vineyards of "Villa Albius" farm in Sicily region (southern Italy) were chosen to carry out the A.R.P. survey, for a overall surface of 45 hectares. The vineyards were located in a wide Plio-Pleistocene marine terrace, characterized by a few meters level of calcarenite, overlying partially cemented by calcium carbonate yellow sands. During the A.R.P. survey, 12 boreholes were described and sampled for the laboratory analysis and other 6 boreholes were carried out to validate the map. All soils showed a calcic horizon (Bk, BCK or Ck) with the upper limit at variable depths. The depth of calcic horizon (Dk) of each boreholes resulted significantly correlated to ER, especially with the ER0-100 ($R^2 = 0.83$). Dk map was interpolated using the regression kriging and validated by the boreholes ($R^2 = 0.71$) and with a NDVI map of the same vintage ($R^2 = 0.95$).



S10.03-P - INFLUENCES OF TREE SPECIES ON FOREST SOILS

Tuesday 03 July 2012 from 17:00 to 18:30. Room Poster Areas

S10.03-P -1

'INTERACTIONS OF UNDERSTORY COVER, MICROSITE PARAMETERS AND TREE RECRUITMENT ALONG A TEMPORAL AND SPATIAL DISTURBANCE GRADIENT IN THE AUSTRIAN NORTHERN LIMESTONE ALPS'

Gisela Pröll, Vienna - Austria

S10.03-P -2

AFFORESTATION OF FORMER CROPLAND IN DENMARK: EFFECTS OF TREE SPECIES AND TIME ON SOIL CARBON.

Teresa Gómez Bárcena, Copenhagen - Denmark

S10.03-P -3

BIOGENIC TRANSFORMATION OF CLAY MINERALS IN FOREST-STEPPE SOILS

Alexander Shinkarev, Kazan - Russian Federation

S10.03-P -4

DO TREE SPECIES IN TEMPERATE FORESTS REALLY INFLUENCE SOIL CARBON?

Lars Vesterdal, Frederiksberg C - Denmark

S10.03-P -5

EFFECT OF TREE IDENTITY AND DIVERSITY ON THE BELOWGROUND MICROBIAL COMMUNITY

Andrea Scheibe, Jena - Germany

S10.03-P -6

EFFECTS OF SHORT ROTATION FORESTRY ON SOIL FAUNAL COMMUNITY DEVELOPMENT

Nalika Swarnamali Senevirathna Rajapaksha, Preston - United Kingdom

S10.03-P -7

EFFECTS OF TREE SPECIES DIVERSITY ON EARTHWORM COMMUNITIES IN EUROPEAN FORESTS

Hans De Wandeler, Leuven - Belgium



S10.03-P -8

EFFECTS OF TREE SPECIES ON FINE ROOT BIOMASS

Timo Domisch, Joensuu - Finland

S10.03-P -9

EVALUATION OF RELATIONS BETWEEN SOIL PROPERTIES AND SEVERITY OF DAMAGES OF SPRUCE (PICEA ABIES (L.) H.KARST) STANDS IN 2010 IN LATVIA

Arta Bardule, Salaspils - Latvia

S10.03-P -11

IMPACT OF HYBRID ASPEN (POPULUS TREMULOIDES X P.TREMULA) ON SOIL MICROBIAL POPULATIONS

Lelde Grantina, Riga - Latvia

S10.03-P -12

IMPACT OF TREE SAPLINGS ON THE KINETIC ENERGY OF RAINFALL – THE IMPORTANCE OF STAND DENSITY, SPECIES IDENTITY AND TREE ARCHITECTURE IN SUBTROPICAL FORESTS IN CHINA

Christian Geißler, Tübingen - Germany

S10.03-P -13

INFLUENCE OF CANOPY STRUCTURE ON THE SPATIAL HETEROGENEITY OF THROUGHFALL DERIVED DISSOLVED AND PARTICULATE ORGANIC MATTER FLUXES IN FOREST ECOSYSTEMS

Sebastian Bischoff, Jena - Germany

S10.03-P -14

INFLUENCE OF TREE SPECIES ON SOM STABILIZATION IN AFFORESTED PASTURES USING CALORIMETRY, THERMAL ANALYSIS AND ¹³C-CPMAS NMR.

Nieves Barros Pena, Santiago de Compostela - Spain

S10.03-P -15

IS THE CHANGING MINERAL NUTRIENT DEMAND OF FOREST STAND GROWTH REFLECTED IN THE POTASSIUM AND CALCIUM STATUS OF THE SOIL?

Shuai Yan, Vienna - Austria



S10.03-P -16

*LEAF LITTER DECOMPOSITION OF FOUR DIFFERENT DECIDUOUS TREE SPECIES -
RESOURCE CHEMISTRY, STOICHIOMETRY AND MICROBIAL COMMUNITY COMPOSITION*

Katharina Maria Keiblinger, Vienna - Austria

S10.03-P -17

*LITTERFALL QUANTITY AND QUALITY AND NUTRIENT STATUS IN A YOUNG STAND UNDER
NORWAY SPRUCE AND BROADLEAVED SPECIES*

Masoud Bazgir, Ilam - Iran, Islamic Republic of

S10.03-P -18

*MICROBIAL FUNCTIONAL DIVERSITY AS INFLUENCED BY DIFFERENT TREE SPECIES IN
MEDITERRANEAN FOREST SOILS*

M. Cristina Moscatelli, Viterbo - Italy

S10.03-P -19

*MIXED SPECIES NUTRITIONAL INTERACTIONS: SOIL C AND N AT THE INTERFACE
BETWEEN NEIGHBORING EUROPEAN BEECH AND DOUGLAS-FIR STANDS*

Seid Muhie, Copenhagen - Denmark

S10.03-P -20

*MULTI-ISOTOPIC TRACING (26MG, 44CA, 15N AND 2H) – A TOOL TO BETTER
UNDERSTAND BIOGEOCHEMICAL CYCLES IN FOREST ECOSYSTEMS*

Gregory Van Der Heijden, Nancy - France

S10.03-P -21

*SEASONAL VARIATION ON THE INTERACTION BETWEEN TREE SPECIES AND SOIL
MICROORGANISMS*

Carolin Thoms, Jena - Germany

S10.03-P -22

*SOIL CARBON DYNAMICS UNDER PINUS KORAIENSIS AND QUERCUS ACUTISSIMA
FOREST FLOORS IN RELATION TO NITROGEN ADDITION*

Ro Hee-Myong, Seoul - Korea, Republic of

S10.03-P -23

*SOIL MICROBIAL AND FAUNAL COMMUNITIES ASSOCIATED WITH DIFFERENT TREE
SPECIES: CAUSES AND CONSEQUENCES*

Sue Grayston, Vancouver - Canada



S10.03-P -24

THE EFFECTS OF DIFFERENT TREE SPECIES ON SOIL BIOTA AND SOIL CHEMICAL PROPERTIES AT THE TWO-AGED STANDS

Byung Bae Park, Seoul - Korea, Republic of

S10.03-P -25

TREE DIVERSITY EFFECT ON PHOSPHORUS AVAILABILITY IN SUBTROPICAL FOREST ECOSYSTEMS IN SOUTHERN CHINA

Björn Todt, Freiburg - Germany

S10.03-P -26

TREE SPECIES EFFECTS ON SEEPAGE FLUXES IN SOIL IN A TROPICAL AFFORESTATION

Matthias Sprenger, Koblenz - Germany

S10.03-P -27

TREE SPECIES-SPECIFIC EFFECTS ON SOIL PROPERTIES IN DECLINING MIXED OAK FORESTS

Jose M. Avila, Seville - Spain

S10.03-P -28

TREE-INDUCED VARIABILITY IN BOREAL FOREST SOIL FERTILITY, RUSSIA

Maria Orlova, Moscow - Russian Federation

S10.03-P -29

TURNOVER OF ORGANIC MATTER AND CARBON ACCUMULATION IN COEVAL FORESTS OF PINUS PINEA AND FAGUS SYLVATICA

Anna De Marco, Napoli - Italy

S10.03-P -30

UNIQUE CHARACTERISTICS OF HIGH ACTIVITY OF NITROGEN FIXATION IN DECOMPOSING LITTER AND NITRIFICATION IN MINERAL SOIL OF JAPANESE CEDAR (CRYPTOMERIA JAPONICA)

Keizo Hirai, Morioka, Iwate - Japan

S10.03-P -31

VARIATION IN THE IMPACT OF TREE SPECIES ON SOIL PERMEABILITY

Kathy Chandler, Lancaster - United Kingdom



S10.03-P -1

'INTERACTIONS OF UNDERSTORY COVER, MICROSITE PARAMETERS AND TREE RECRUITMENT ALONG A TEMPORAL AND SPATIAL DISTURBANCE GRADIENT IN THE AUSTRIAN NORTHERN LIMESTONE ALPS'

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*Disturbance events are increasingly affecting intact protective forests in mountain regions in the Northern Limestone Alps, causing significant economic damage due to loss of ecosystem goods and services. Humus dynamics of Follic Histosols and Rendzic Leptosols is of particular concern, since water retention and nutrient turnover is frequently limited to the organic layer only. Hence, rapid reforestation is necessary to re-establish the protective functions of mountain forest ecosystems. However, extreme site conditions, usually combined with dense ground cover, often pose a problem for natural tree regeneration. In this study we focus on the performance of artificial and natural tree recruitment (*Acer pseudoplatanus*, *Picea abies*, *Fagus sylvatica*, *Abies alba*, *Larix decidua*, *Sorbus aucuparia*, *Sorbus aria* and *Pinus sylvestris*) along a chronosequence and longitudinal section of disturbance areas on Follic Histosols and Rendzic Leptosols in the Northern Limestone Alps, Austria. Tree performance is analysed with respect to different microsite and soil parameters, the ground cover of different vegetation types and browsing damages. Additionally, we are interested in determining the effects of vegetation dynamics and tree recruitment, respectively on humus dynamics in relation to disturbance type and -age. Results of the study provide a basis for reforestation planning and a sustainable management of disturbance sites. The project is funded by the European Regional Development Funds of the European Union and national sources.*



S10.03-P -2

AFFORESTATION OF FORMER CROPLAND IN DENMARK: EFFECTS OF TREE SPECIES AND TIME ON SOIL CARBON.

Gómez Bárcena Teresa^{*[1]}, Vesterdal Lars^[1], Gundersen Per^[1]

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*Surplus of agricultural products and the increasing demand for environmental services has induced the conversion of cropland to plantation forests. Several environmental services change as a result of such land-use change, e.g. water recharge, nitrate leaching, and soil properties, but also carbon sequestration effects have attracted research efforts due to its role in climate change mitigation. However, the question remaining is whether tree species selection influences C sequestration following conversion of cropland to forest. In Denmark, monocultures of oak (*Quercus robur*) and Norway spruce (*Picea abies*) have been common in afforestations during the last decades. Here, we present a combined chronosequence/re-sampling study from a former cropland area (Vestskoven) that was successively afforested with both species over the past 40 years. This area is well suited for tree species effect studies as it has homogeneous soil conditions and includes differently aged stands providing time scales. Previous carbon stock data from these stands showed differences in carbon storage in forest floors but not in soil carbon storage between tree species, within a time span of 30 years. This finding contrasts with the expected differences in soil carbon storage under fast growing coniferous species with lower litter decomposition rates compared to broadleaves (Norway spruce vs. oak). Ultimately, we aim to investigate whether new data from re-sampling the same chronosequences approximately 12 years after show evidence for a tree species effect on soil carbon or if differences are still constrained to forest floors.*



S10.03-P -3

BIOGENIC TRANSFORMATION OF CLAY MINERALS IN FOREST-STEPPE SOILS

Shinkarev Alexander*^[2], Shinkarev Alexey^[3], Giniyatullin Kamil^[4], Krinari George^[5], Islamova Galija^[6], Lygina Taliya^[7]

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We studied virgin forest-steppe soils derived from a uniform parent material. By complex of modern methods it is shown, that fixation of organic substance in forms resistant to H₂O₂ treatment is related to change of actual structure of clay aggregates. At interaction of clay minerals with the products of transformation of plant residues in A horizon of forest-steppe soils such organic-mineral complexes as composites are formed. Penetrating into slits between thin particles of layer silicates and between smectite layers, organic molecules output from X-ray-diffraction a considerable part of crystalline substance, breaking a constancy and (or) plane-parallel arrangement of its interlayer distances. Remaining principally crystal phases, these original organic-silicate compositions can not bring the contribution to X-ray-diffraction of the oriented preparations. Formation organic-smectite complexes with hybrid structure, disorder on c axis, is the usual and universal mechanism of clay transformation at soil formation in forest-steppe conditions. It limits possibilities of X-ray-diffraction for smectite quantification in natural organo-clays. Therefore, the labile interlayer spaces should be studied using the independent methods. Smectite quantification by an adsorptive-luminescent method (Eirish et al. 1975) and by thermogravimetric analyses (Nieto et al., 2008) can be the useful tool as a complement to X-ray-diffraction determinations of expandable clay content in soils. The first method is based on ability of smectites to adsorb rhodamine after dispersion and peptization of clay particles by sodium pyrophosphate, the second – on measuring the weight loss between 100 and 450 °C of samples solvated with ethylene glycol and previously saturated in Mg.*



S10.03-P -4

DO TREE SPECIES IN TEMPERATE FORESTS REALLY INFLUENCE SOIL CARBON?

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The influence of tree species on forest soil properties has for a long time been studied by ecologists. Recently, the role of soil carbon (C) pools and their dynamics for mitigation of greenhouse gases has highlighted the need for information on tree species effects. Existing knowledge of tree species effects on soil C stocks and dynamics in temperate forests mainly originates from studies of soil conditions in paired stands, under singles trees or in common garden designs. The limited support for generalization of tree species effects partly owes to the paucity of multi-species balanced common garden designs since tree species effects are easily confounded with effects of site-related factors such as climate and soil type. Previous studies suggest that tree species planted within the same sites may differ in soil C, but the main variability was found in forest floor C pools. This picture suggests a weaker effect on mineral soil C, but may be partly ascribed to the fact that most studies of the slowly changing soil C pool were carried out in common garden experiments younger than 40-50 years. A few studies indicated that the distribution of C between forest floor and mineral soil rather than total C stocks differ among tree species. In case of C sequestration, we need to focus more on processes controlling C stocks, and to study forms and stability of C in conjunction with stocks of bulk C. This talk will address current knowledge and knowledge gaps and suggest issues for future cooperation.



S10.03-P -5

EFFECT OF TREE IDENTITY AND DIVERSITY ON THE BELOWGROUND MICROBIAL COMMUNITY

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*This study investigated the effect of different tree species on the microbial community structure in a deciduous forest soil using phospholipid fatty acid (PLFA) profiles and a tree cluster approach. At two different sites in the Hainich National Park, Germany in May 2008 were 100 tree cluster of three different tree species (*Fagus sylvatica*, *Fraxinus excelsior*, *Carpinus betulus*, *Tilia spec.*, *Acer spec.*) selected. In the centre of each cluster top soil from 0 to 10 cm depth was collected and PLFAs were extracted and quantified. The highest overall PLFA concentrations were found at the pure ash (*Fraxinus excelsior*) clusters (69.19 $\mu\text{g g}^{-1}$ soil (dry weight)). However, here also the highest variation between sites was found (sd 47.33 $\mu\text{g g}^{-1}$). In contrast, the lowest PLFA concentrations and smallest variation between sites were found at pure beech (*Fagus sylvatica*) clusters (17.58 $\mu\text{g g}^{-1}$ (sd 4.46) soil (dry weight)). The effect of tree diversity on the microbial community structure was only small. We conclude that tree identity and site conditions are more important factors determining the soil microbial community structure than tree diversity per se.*



S10.03-P -6

EFFECTS OF SHORT ROTATION FORESTRY ON SOIL FAUNAL COMMUNITY DEVELOPMENT

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Short Rotation Forestry (SRF) was recently introduced to the UK as a method to increase biomass production. However, specified SRF species have raised concerns about potential impacts to the environment. A vital, but largely unidentified aspect of SRF is the quality and quantity of litter, and its impact on soil fauna, of which the earthworm community is an important component. Earthworms have impacts on soil biogeochemistry of these systems, and the tree species can impact on the associated earthworm community. The major aim of this study was to determine the effects of SRF species on earthworm diversity and population. A series of laboratory experiments and an earthworm survey at Forestry Commission SRF trial sites were used. Overall survey results suggested that the SRF species can affect soil fauna depending on soil type, climate and land-use history, e.g. six years of *Eucalyptus nitens* development on a former agricultural loamy soil had significantly ($p < 0.05$) increased earthworm density (152 m⁻²) compared with similarly derived *Eucalyptus gunnii* (47 m⁻²) and control (51 m⁻²). But, similar *Eucalyptus* developments on a grassland sandy soil had not significantly changed earthworm populations. Laboratory feeding experiments with both hatchling and mature *Lumbricus terrestris*, a deep burrowing species, showed that the litter of native SRF species such as Birch (*Betula pendula*), Ash (*Fraxinus excelsior*) and Alder (*Alnus glutinosa*) supported earthworm production (growth and reproduction) more than naturalised Sycamore (*Acer pseudoplatanus*) and Sweet-Chestnut (*Castanea sativa*). However, *E. nitens* litter supported earthworm production similar to that of native SRF species.



S10.03-P -7

EFFECTS OF TREE SPECIES DIVERSITY ON EARTHWORM COMMUNITIES IN EUROPEAN FORESTS

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The belowground food web holds a big part of the associated biodiversity in forest ecosystems and plays a major role in essential ecosystem processes, e.g. litter decomposition and nutrient turnover. So far, important interactions between diversity and composition of above- and belowground food webs have been observed. However the effects of tree species diversity on the belowground food web are so far not conclusive. This study aims at elucidating the effect of tree species mixtures, species diversity and trait diversity on the composition of the earthworm communities in European forests. Experimental platforms of planted tree species diversity assemblages in Finland (Satakunta) and Germany (Biotree) are therefore intensively sampled for earthworms using the combined mustard extraction/hand sorting method. First results are reported and discussed and diversity effects are evaluated with overyielding tests.



S10.03-P -8
EFFECTS OF TREE SPECIES ON FINE ROOT BIOMASS

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Diverse mixed forests can induce niche partitioning between species resulting in higher biomass and productivity compared to single tree species forests. Most of the studies into the diversity effects on biomass and productivity have focussed on the above-ground parts of grassland ecosystems. Much less is known about the diversity effects on forests, and on below-ground parts of the ecosystems. In forest ecosystems, the root systems, especially fine roots play a significant role in carbon and nutrient cycling and allocation, since up to 75% of the carbohydrates produced by forest trees are allocated below-ground for building and maintaining fine root systems. Our aim was to study below-ground niche partitioning in European forest stands by comparing fine root biomass partitioning between monocultures and mixed forests. We hypothesised that fine root biomass is higher in mixed forests compared to forests of single tree species due to more effective utilisation of soil resources in mixed forests. The soil sampling was conducted on boreal and temperate experimental sites of the TreeDivNetwork (Satakunta, Finland and BIOTREE Kaltenborn, Germany), and fine roots (= 2 mm) were separated from the soil. Fine roots of understorey plants were separated from tree roots. The species composition within the individual tree root samples was determined using near-infrared spectroscopy (NIRS). The results are presented and discussed. This study is part of the EU-funded FunDivEurope project (www.fundiveurope.eu).



S10.03-P -9

EVALUATION OF RELATIONS BETWEEN SOIL PROPERTIES AND SEVERITY OF DAMAGES OF SPRUCE (PICEA ABIES (L.) H.KARST) STANDS IN 2010 IN LATVIA

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Severe damages of spruce stands were found during recent years in several countries of the Baltic sea region. Characteristic indications of these damages are trees with small increments and brownish drying tops distributed across the whole compartment. During the first year only forests on drained organic and poor mineral soils suffers. In second and third year, according to experiences gained in Lithuania, the damages moves to other stand types. The scope of the study is to evaluate, how soil properties affects severity and distribution of damages and if there are particular soil characteristics prohibiting the damages. Results of the study approves that soil properties affects severity of damages of spruce stands. Significant positive correlation found between the damage index and organic carbon and total nitrogen stock in soil, which are positively correlating with thickness of organic soil layer. This means that more severe damages occur on organic soils. Moreover severity of damages increases with increase of groundwater level. However none of tested soil properties was identified as main cause of the damages. The only chemical element, which demonstrated moderately strong negative correlation with the damage index, is potassium. This means that additional reserves of potassium in topsoil layer might improve growth conditions and compensate temporary or permanent deficient of potassium due to fluctuations of groundwater level. Comparison of soil exchangeable acidity pH(KCl) approved, that damages of spruce stands distributes in case of both extremes – if soil is too acidic and too basic.



S10.03-P -11

IMPACT OF HYBRID ASPEN (*POPULUS TREMULOIDES* X *P. TREMULA*) ON SOIL MICROBIAL POPULATIONS

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Interest about using energy rich wood in industrial needs increases. One of the most used tree species is hybrid aspen, which is an artificial cross between European aspen (*Populus tremuloides*) and North-American trembling aspen (*Populus tremula*). Hybrid aspen is able to give rapid growth and high biomass production causing higher loss of nutrients and mineral elements in soil. Such conditions may decrease the soil microbial diversity. The aim of the research was to determine the impact of hybrid aspen on soil microorganisms. Four plantations of hybrid aspen and European aspen were investigated. The age of the plantations in Kalsnava was 45 years, in Iecava - 15 years, in Ukri and in Ogre - 10 years. The methods used in work were enumeration of microorganisms (plate counts on three media) and molecular methods (PCR, ARDRA, molecular identification of fungal isolates). Sequencing was done in CBS KNAW. It was concluded, that only bacterial CFU numbers on TSA and yeasts and bacterial CFU numbers on MEA were statistically significantly higher in European aspen stands in Kalsnava in comparison to the hybrid aspen stand. Significant differences were not detected in other stands. Mean CFU numbers of cultivable filamentous fungi and results of ARDRA did not show significant differences in any of the sampling plots. Several analyzed parameters showed statistically significant differences comparing different soil sampling depths having higher values in upper soil layer. Identified filamentous fungi represented following genera – *Acremonium*, *Exophiala*, *Geomyces*, *Giberella*, *Hypocrea* / *Trichoderma*, *Leptosphaeria*, *Metarhizium*, *Mortierella*, *Nectria*, *Paecilomyces*, *Penicillium*, *Trichoderma*, *Trichosporon*.



S10.03-P -12

IMPACT OF TREE SAPLINGS ON THE KINETIC ENERGY OF RAINFALL – THE IMPORTANCE OF STAND DENSITY, SPECIES IDENTITY AND TREE ARCHITECTURE IN SUBTROPICAL FORESTS IN CHINA

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For estimating the influence of plant architectural traits on the erosivity of throughfall we studied throughfall kinetic energy (KE) under tree saplings in a plantation-like experiment in the humid subtropics. Our analyses of rainfall and throughfall KE are based on measurements by means of calibrated splash cups. Two experiments were carried out: one focusing on density effects and the second testing for species-specific effects and effects of species mixtures. The morphology of the saplings was characterized by measuring important architectural traits. For statistical analysis we used mixed effects models. In both models rainfall KE was identified as the most important effect on throughfall KE. Overall, rainfall KE per area was reduced by 59% below the canopy of the studied saplings. We found a significant effect of sapling density on throughfall KE. The main cause for this circumstance is the relation between free throughfall and release throughfall. As free throughfall possesses a far higher KE than release throughfall originating from saplings, a lower density results in a higher total throughfall KE. Moreover we could show that the influence of density on throughfall KE decreases with increasing sapling height due to lateral growth and canopy closure of the saplings. Throughfall KE was significantly different between species. We attribute this to species-specific differences in crown architectural traits. These traits influence throughfall KE contrarily and interact with each other. Depending on its magnitude, one crown trait can possibly superimpose contrary effects of others.



S10.03-P -13

INFLUENCE OF CANOPY STRUCTURE ON THE SPATIAL HETEROGENEITY OF THROUGHFALL DERIVED DISSOLVED AND PARTICULATE ORGANIC MATTER FLUXES IN FOREST ECOSYSTEMS

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The forest canopy represents one of the most important compartments of wooded ecosystems. It plays a key role not only in case of the input of nutrients into forest soils, but also on its heterogeneous dispersal. Especially throughfall precipitation influences the dispersal and the variability of nutrient input. In context of the German Science Foundation (DFG) founded 'Biodiversity Exploratories' (see <www.biodiversity-exploratories.de> for further information) we compared small footprint LiDAR (Light Detection And Ranging) data of the canopy structure of three central German forest sites (spruce plantation, age class forest beech, and a 'close to nature' beech stand) with spatial information on throughfall volume and chemistry. LiDAR allows a three dimensional description of the complex forest canopy structure which determines the distribution of light, atmospheric turbulences, as well as microclimatic differences. This small scale variability might not only influence the spatial distribution of throughfall volume, but also the amounts of dissolved and particulate organic nutrient fractions carried along to the forest floor at a certain point. Those fractions are suggested to be partly derived from microbial processes located in the phyllosphere of the canopy via dry and wet deposition. Therefore we correlated precipitation information obtained from transects of 20 bulk samplers per experimental plot with structural parameters such as surface area index, euphotic zone, north-/ south-facing crown area, or canopy gaps.



S10.03-P -14

INFLUENCE OF TREE SPECIES ON SOM STABILIZATION IN AFFORESTED PASTURES USING CALORIMETRY, THERMAL ANALYSIS AND ¹³C-CPMAS NMR.

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*The influence of tree species in relation to soil C dynamics was studied in the temperate forest of southern Europe in a network of 120 paired plots established to construct three well-replicated chronosequences of the most common tree species in humid temperate systems. Calorimetry and Differential Scanning Calorimetry (DSC) were used as novel techniques to elucidate how afforestation affects the nature of SOM and soil microbial metabolism. ¹³C-CPMAS NMR is applied to improve the interpretation of calorimetric and thermal analysis data. The contribution of the soil litter plus mineral soil to the mean C sequestration ranged from 8 to 18 % (*Eucalyptus nitens* > *Pinus radiata* > *Eucalyptus globulus*). The humid temperate climate and the sandy loam texture of the soils favoured large losses of SOC from the uppermost mineral soils during the 10 yr after afforestation. The higher loss of SOC in the pine soil than in the eucalypt soil was attributed to the lower litter decomposition rate and the lower belowground litter input from associated vegetation. DSC and ¹³C-CPMAS NMR results revealed rapid degradation of different C types after afforestation and differences in the OM properties gained at the end of the rotation that could be assigned to the different tree species employed. The microbial degradation was monitored by calorimetry to yield the calorimetric ratio of the soil basal metabolism, together with the active biomass. These indexes were sensitive to detect the degradation of different C compounds in soils under different tree species.*



S10.03-P -15

IS THE CHANGING MINERAL NUTRIENT DEMAND OF FOREST STAND GROWTH REFLECTED IN THE POTASSIUM AND CALCIUM STATUS OF THE SOIL?

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The nutrient demand of tree growth is predominantly met by uptake from the nutrient pool of the mineral soil. This study focuses on K and Ca pools in order to learn more on the temporal dynamics of plant nutrients in Quercus dominated forests in northeastern Austria. Three soil types (according to WRB: eutric cambisol, calcic chernozem and haplic luvisol) were considered representative for the area and sampled. Nine permanent, Quercus petraea dominated, plots were selected for our study. We (i) quantified exchangeable cations K, Ca as well as CEC in the soils of our study area, (ii) calculated macronutrients pool of K and Ca in aboveground biomass and (iii) identified the effects of stand age on exchangeable cations. The exchangeable cations pool in the top 50 cm of the soil were 882 – 1,652 kg ha⁻¹ for K and 2,661 to 16,510 kg ha⁻¹ for Ca. CEC in different plots ranged from 34 to 190 $\mu\text{mol g}^{-1}$. The nutrient pool in aboveground biomass ranged from 29 to 181 kg ha⁻¹ for K and from 56 to 426 kg ha⁻¹ for Ca. Our study showed that the nutrient pools in the mineral soil are sufficient to support the tree growth. Stand age had no significant influence on mineral nutrient levels in the soil. The levels of nutrients in particular K and Ca in our study areas are reasonably high and do not indicate the necessity for additional fertilization under current silvicultural practices.



S10.03-P -16

**LEAF LITTER DECOMPOSITION OF FOUR DIFFERENT DECIDUOUS TREE SPECIES -
RESOURCE CHEMISTRY, STOICHIOMETRY AND MICROBIAL COMMUNITY COMPOSITION**

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Little is known about how the variance in resources in terms of carbon (C), nitrogen (N), phosphorus (P) ratios affects the microbial community involved in leaf litter decomposition. To elucidate how resource chemistry and stoichiometry affect the decomposition process of various litter types, beech (Fagus), oak (Quercus), alder (Alnus) and ash tree (Fraxinus) leaves were sampled in an Austrian forest (Schottenwald, 48°14'N16°15'E; MAT=9°C; soil type: dystic cambisol; soil C:N=16) at the different seasons (winter, spring, summer and autumn) in 2010. Our aim was to follow changes of leaf litter chemistry, stoichiometry and microbial community structure and to quantify element losses to answer the following hypotheses: (i) tree species affect decomposition processes, (ii) narrow litter C:nutrient ratios favour nutrient release, (iii) recalcitrant litter degrades more slowly and (iv) microbial biomass stoichiometry changes with community composition. Different litters varied in their stoichiometry, with C:N ratios between 16 (alder) and 46 (beech) and C:P ratios between 309 (ash) and 1234 (alder). During decomposition microbial community changed. Tree species had a significant impact on microbial community composition: highest amounts of actinomycetes were observed for alder, while arbuscular mycorrhizae were lowest for oak. An increase in fungi and actinomycetes was observed during decomposition in almost all tree species as well as a decline in gram negative bacteria. Generally our results revealed an enhancement in fungal to bacterial ratios, supporting the increasing importance of fungi towards later decomposition stages.



S10.03-P -17

LITTERFALL QUANTITY AND QUALITY AND NUTRIENT STATUS IN A YOUNG STAND UNDER NORWAY SPRUCE AND BROADLEAVED SPECIES

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*Abstract: In Europe, because of previous intense forest use in the past centuries, the plantation of coniferous stands, especially Norway spruce with high production potential has been a common strategy. However, the characteristics of Norway spruce such as susceptibility to windfall, forest dieback and soil acidification have caused negative ecological impacts at many sites. Conversion of conifers into deciduous or mixed stands has been suggested in order to improve ecological conditions and biodiversity of forest ecosystems. In this study, six broadleaved species were planted at the same site, thus being subjected to similar condition in terms of soil type, land use history and climate. The aim of this research was to study of foliar nutrient status and nutrient return to the forest floor through litterfall 11 years after conversion of Norway spruce (*Picea abies* (L.) KARST.) into a mixed stand with common alder (*Alnus glutinosa* (L.) GAERTN.), european beech (*Fagus sylvatica* L.), pedunculate oak (*Quercus robur* L.), silver birch (*Betula pendula* ROTH.), goat willow (*Salix caprea* L.) and rowan (*Sorbus aucuparia* L.). Our results revealed that tree species had a different foliar nutrient status and an effect on nutrient input fluxes through litterfall. For example, litter nutrient contents (N, Ca, Mg, K) were highest under alder, rowan and willow. Total litterfall and nutrient fluxes from leaf litter were highest under rowan. Our results demonstrate that, on poor sites, plantation of pioneer species, especially rowan, may improve the nutrient status of the forest floor through higher input in litterfall.*



S10.03-P -18

MICROBIAL FUNCTIONAL DIVERSITY AS INFLUENCED BY DIFFERENT TREE SPECIES IN MEDITERRANEAN FOREST SOILS

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*Tree species are considered as important factors which influence the diversity of soil microorganisms, they settle the quality and amount of the available resources, compete with microorganisms for nutrients. Microbial functional diversity has several definitions, it is defined, operationally, as the numbers, types, activities and rates at which a suite of substrates are utilized by the bacterial community, or it can be described as the composition of microbial communities needed to perform and maintain ecosystem processes in the soil such as decomposition and mineralization. To assess the functional diversity of soil microbial communities, enzyme activities and community level physiological profile techniques are two valid experimental approaches widely reported in the current literature. The present work was carried out at Monte Rufeno Natural Reservation and the substrate is classified as a Dystric Cambisol (acid soil with a cambic horizon). The main dominant species are Eastern White Pine (*Pinus strobus*), Chestnut (*Castanea sativa*), Oak (*Quercus cerris*) all of the same age. Microbial functional diversity was assessed using enzyme activities and CLPP-MicroResp approach. Eight enzyme activities were chosen as representative of Carbon, Nitrogen, Phosphorous and Sulfur cycles. The carbon substrates employed in MicroResp were selected on their ecological relevance and for the importance of root inputs for microbial metabolism. They consisted of carbohydrates, aminoacids, carboxylic acids, and phenolic acids. The aim of this work was to evaluate the effect of the different tree species on the size, metabolic activities and functional diversity of soil microbial communities for each site.*



S10.03-P -19

MIXED SPECIES NUTRITIONAL INTERACTIONS: SOIL C AND N AT THE INTERFACE BETWEEN NEIGHBORING EUROPEAN BEECH AND DOUGLAS-FIR STANDS

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Information on tree species-soil interactions is vital to forest management and ecosystem biogeochemistry. Effects on forest soil chemistry and nutrition under monocultures of broadleaves, conifers, and their mixtures have been documented to a limited extent for tree species common to European forestry. However, the current shifts in forest management practices (i.e. close-to-nature forestry) in Europe, particularly in Denmark and North Germany, require an understanding of mixed species influences on soil nutrients and ecosystem biogeochemistry. In the future planning for close-to nature forestry, beech stands admixed with Douglas-fir is one of the suggested forest development types. In the absence of well-designed mixture trials, monoculture common garden sites may be used to provide an understanding of mixed species effects as in those sites the species effect is not confounded with site-related factors. Thus, adjacent beech and Douglas-fir stands were found at three Danish common garden research sites that had been established across a fertility gradient. Sampling points were laid at varying intervals along three equally spaced and parallel transects that connected centers of the two stands and positioned perpendicular to the boundary line to incorporate the variability in litterfall input depending on the relative influence of the two species. Forest floor, 0-5cm, 5-10cm, and 10-20cm depth soil samples were taken at each sampling point for determination of SOC, total N, pH, and NO₃-N. The results will document whether leaf litterfall exchange between beech and Douglas-fir has synergetic, additive, or antagonistic effects on these soil properties.



S10.03-P -20

MULTI-ISOTOPIC TRACING (26MG, 44CA, 15N AND 2H) – A TOOL TO BETTER UNDERSTAND BIOGEOCHEMICAL CYCLES IN FOREST ECOSYSTEMS

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Magnesium and calcium are two major nutrients and have been, in many forest ecosystems, depleted from the soil due to high acid deposition during the XXth century. In these ecosystems on the verge of deficiency, it is of importance to understand nutritional processes to help forest managers sustain the production, ecological and social functions of forests by sustaining forest soil fertility. Isotopic ratios give insight on processes at the ecosystem scale and in particular tree nutrition in forest ecosystems. However natural Mg and Ca isotopic fractionation in ecosystems is often too small to allow precise flux estimations. Using isotopically enriched material enables to label ecosystem compartments and trace fluxes between those compartments. In April 2011 an in situ tracing experiment was carried out at the Breuil-Chenue experimental site in the Morvan Mountains (Burgundy, France). Twenty liters of tracing solution (26Mg, 44Ca, 15N and 2H) were sprayed on the ground in a 30-yr old beech plot over an 80 m² area. Soil solutions were collected with tension cup and zero-tension lysimeters, soil core samples were collected and soil CEC extractions were carried out using as extractant, ammonium acetate (1M), and biomass samples (bole cores, branches and leaves) were collected every 28 days. Multi-isotopic tracing is a powerful tool and may help characterize soil hydrology, nutrient displacement by percolating water, compute fluxes in forest ecosystems which could not be estimated with the traditional approach and better comprehend plant nutrition.



S10.03-P -21

SEASONAL VARIATION ON THE INTERACTION BETWEEN TREE SPECIES AND SOIL MICROORGANISMS

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We investigated the link between aboveground and belowground diversity in the Hainich National Park, a temperate deciduous forest ecosystem in Central-Germany. Previous result demonstrated that tree species indirectly affect the soil microbial community in autumn. Soil parameters like pH and soil nutrients were most important drivers for the microbial community, however, these parameters were strongly affected by plant traits like litter chemistry. Here we studied seasonal effects on the soil microbial community. Soil layers from depths of 0 – 5 cm were sampled along a gradient of increasing tree species diversity at the end of May, the time of highest carbon turnover in the rhizosphere. Phospholipid fatty acids (PLFA) were extracted from the soil and PLFA-profiles were compared to the autumn sampling. In spring the effects of sampling site were even more pronounced than in autumn whereas the effect of diversity on the microbial community was considerably low. Sites with highest tree diversity had higher abundances of almost all individual PLFAs and they comprise higher fine root biomass from trees colonized by arbuscular mycorrhizal fungi. Seasonal differences between the sampling dates were small. Autumn samples held slightly higher proportions of bacteria (Gram+, Gram-, actinomycetes) on sites with only beech and low tree species diversity. Our results suggest that the abundance of arbuscular mycorrhizal fungi might have a stronger effect on the microbial community than tree diversity.



S10.03-P -22

*SOIL CARBON DYNAMICS UNDER PINUS KORAIENSIS AND QUERCUS ACUTISSIMA
FOREST FLOORS IN RELATION TO NITROGEN ADDITION*

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Nitrogen addition influences leaf litter decomposition and soil organic carbon (SOC) characteristics. We investigated the influence of nitrogen addition on the fate of soil C and d13C in forest soils under two contrasting tree species (Pinus koraiensis and Quercus acutissima) at Mt. Taehwa. To do so, we applied urea ((NH₂)₂CO) to the soil surface of the stainless column (50 cm deep and 7.6 cm in diameter) at the rate of 500 mg N kg⁻¹ in June 2011. After 3 months, soil profile samples were collected from the column to determine total C concentrations and the corresponding d13C. Irrespective of tree species, compared to control plots, total C concentrations increased in the surface layer (0-20 cm) but decreased in the subsurface layer. In contrast to total C concentration profiles, their corresponding d13C values showed opposite pattern. Key words: litter, soil organic matter, carbon sequestration, Pinus koraiensis, Quercus acutissima, d13C



S10.03-P -23

SOIL MICROBIAL AND FAUNAL COMMUNITIES ASSOCIATED WITH DIFFERENT TREE SPECIES: CAUSES AND CONSEQUENCES

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Tree species are thought to exert significant effects on soil microbial and faunal communities and processes through aboveground influences such as litter deposition and microclimate alteration and belowground inputs of root litter and exudates. The aim of this review is to examine the studies to date describing both symbiotic and free-living communities of soil microorganisms and fauna under distinct tree species and how these differences relate to variation in soil characteristics, humus forms and nutrient cycling processes. We will evaluate current knowledge of soil microbial and faunal diversity under different tree species. We will discuss the character of carbon loss from trees, rhizodeposition, litterfall, root turnover and how variations in quality and quantity of these inputs affect the belowground community. We will also consider how other physiological and morphological traits or characteristics of trees, (e.g. litter chemistry, root: shoot biomass, coniferous vs. deciduous), may create these distinct communities. We will also investigate the consequences of variation in soil organisms for key soil processes such as decomposition, carbon fluxes and nitrogen cycling.



S10.03-P -24

THE EFFECTS OF DIFFERENT TREE SPECIES ON SOIL BIOTA AND SOIL CHEMICAL PROPERTIES AT THE TWO-AGED STANDS

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We investigated the effects of different tree species on soil organisms and soil chemical properties at the two-aged stands for long term in Korea. Pinus koraiensis and P. rigida were planted in 1925 and 1930, respectively, after clearcutting the mixed stands. Two or three times low-thinnings were applied on the sites since the planting. Both P. koraiensis and Abies holophylla seedlings were planted under the P. koraiensis stands in 2000 and under the P. rigida stands in 1990, respectively. Soil chemical properties and soil biota were compared with two by two factorial design. The soil properties were influenced by over-story species composition, but not by under-story species. Soil pH, nitrate, phosphorus, potassium, calcium and nitrogen concentrations were significantly higher at P. koraiensis stands than at P. rigida stands, but any differences were not measured between under-story species. As similar to soil properties, most of soil organisms were influenced by over-story species, but only fungi abundance was influenced by under-story species. The abundance of bacteria, bacterivorous nematodes, oribatida, and mesostigmata were higher at P. rigida than at P. koraiensis, but oppositely the abundance of herbivorous and omnivorous nematodes were lower at P. rigida than at P. koraiensis. This study suggested tree species differences for long term influenced on both soil chemical properties and soil organisms, but different under-story species for relatively short term could not influence on them. However, more studies are needed to investigate the mechanisms how under-story and over-story species influence on soil and biota characteristics.



S10.03-P -25

TREE DIVERSITY EFFECT ON PHOSPHORUS AVAILABILITY IN SUBTROPICAL FOREST ECOSYSTEMS IN SOUTHERN CHINA

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Plants have developed a diversity of mechanisms and symbiotic interactions to acquire different forms of soil-P. Species-diverse forests may therefore maintain soil availability and P-cycling at a higher level than species-poor forests. Tree diversity has shown different effects on P-availability at the plot level. Recent studies indicated that neighbourhood tree diversity influences foliar- and litter-P and soil-P availability at the individual tree level. Here, P-availability was determined for 27 plots (30x30m) of subtropical broad-leaved forest varying in tree species diversity in Gutianshan National Nature Reserve, Zhejiang Province, China. Foliar-P levels varied among the tree species by a factor of eight, compared to a factor of 3 for N, and C/P ratios were very high, on average 2100. Per plot 9 soil cores, one from each 10x10 m subplot, were extracted and samples bulked by soil depth (0-5, 5-10, 10-20cm). The effects of species and functional diversity on Hedley fractions of soil-P in these samples are being analysed. Preliminary analyses have shown that concentrations of total soil-P are very low (40-224µg g⁻¹, n=36) and a large proportion of P is in organic form. In addition, the influence of neighbourhood tree species diversity on individual subject trees will be examined for three evergreen and deciduous tree species from mono-specific and hetero-specific neighbourhoods. In addition to soil samples, P-concentrations in leaves and fine roots of target species and neighbours will be determined. Results of both, plot level and neighbourhood level tree species diversity on soil-P fractions and P nutrition will be presented.



S10.03-P -26

TREE SPECIES EFFECTS ON SEEPAGE FLUXES IN SOIL IN A TROPICAL AFFORESTATION

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Biodiversity was shown to influence ecosystem processes including the water cycle. We i) estimated soil water fluxes and assessed the effects of ii) tree species identity and iii) tree diversity on water fluxes in an experimental tree plantation in Sardinia (Panama). The study was conducted during the wet seasons of 2007 and 2008 on plots of native tree monocultures ($n = 2$ per species) and mixtures of three or six native tree species (each $n = 6$). We determined area-representative incident rainfall and plot-representative throughfall and soil water contents and modeled evapotranspiration based on Penman-Monteith. Soil water fluxes were calculated with a soil water budget model considering water input, output, and soil water storage changes or modeled with the mechanistic model Hydrus-1D. Calculated water fluxes with the two models matched well for all plots ($r = 0.92$, $p < 0.001$). In monocultures, mean downward soil water fluxes (\pm SE) through the 65 cm-depth plane were highest below *Hura crepitans* (6.62 ± 0.14 mm d⁻¹) and lowest below *Luehea seemannii* (6.18 ± 0.17 mm d⁻¹). The three- and six-species mixtures showed seepage rates of 6.26 ± 0.09 and 6.29 ± 0.09 mm d⁻¹, respectively, indicating that there was no significant effect caused by tree diversity. Seepage rates were driven by the transpiration of the varying biomass among the plots ($r = 0.615$, $p = 0.002$). Thus, a mixture of trees with different growth rates will lead to moderate seepage rates, compared to monocultures of either fast growing or slow growing tree species.



S10.03-P -27

TREE SPECIES-SPECIFIC EFFECTS ON SOIL PROPERTIES IN DECLINING MIXED OAK FORESTS

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*Under a Global Change scenario, substantial changes in the structure, composition and health of forest communities are expected. Because trees of different species or health status can differ in their impacts on ecosystem function, modifications at the community level could translate into important changes in main biogeochemical cycles. The main objective of our study was to characterize the “footprint” of individual trees on soil properties in forests of Southern Spain affected by the decline of the dominant species, cork oak (*Quercus suber*). Specifically, we explored the variation in the ecosystem effects of cork oaks with different levels of decline, and compared the effects of this dominant species with that of coexisting tree species (*Quercus canariensis* and *Olea europaea* var. *sylvestris*). We established six 60 x 60 m² plots, three in mixed *Quercus suber* – *Quercus canariensis* forest and the other three in mixed *Quercus suber* – *Olea europaea* forest. Each plot was divided in 49 sample points at 10-m intervals. Soil pH, organic matter content and nutrient availability (N, P, Ca, Mg, K) were analyzed in each sample point and related to the composition and health of the tree community using neighborhood models. We found that trees of different species and health status had distinctive “footprints” on soil properties. These results suggest that changes at the community level caused by the decline and death of *Q. suber* could translate into important alterations of main biogeochemical cycles in mixed Mediterranean forests.*



S10.03-P -28

TREE-INDUCED VARIABILITY IN BOREAL FOREST SOIL FERTILITY, RUSSIA

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Our study focuses on variability in the dynamic parameters of soil fertility induced by trees in old-growth forests on different soil forming rocks in different climate zones in Russia. Study sites are located in northern (Murmansk region, Republic of Karelia), middle (Karelian and Komi Republics) and southern taiga (Valday area). Soil samples were taken from the main horizons below the crowns of trees (Norway spruce, Scots pine, Siberian fir, Siberian pine, birch), and between the crowns. Particle size distribution, bulk density, total and bio-available nutrients, weight of organic layers, and mass of 1000 needles were determined. Comparison of tree species effects on soil forming on similar parent material showed that the concentrations of total nitrogen, and bio-available calcium and manganese were significantly higher in the organic horizon, and the acidity lower, below the crowns of late successional species like Norway spruce and Siberian fir than those below Scots pine, Siberian pine, birch as well as between the crowns. The concentration of bio-available Al in the organic horizons below Scots pine and Siberian pine were highest. The illuvial horizons were more acidic and rich in total carbon, nitrogen and bio-available nutrients below the coniferous tree crowns. We attribute these differences to influence of trees on soil through the nutrient inputs by litterfall, stemflow, and canopy throughfall, spatial re-distribution of precipitation and solar radiation related to age, density and length of tree crowns, and quality of residues (nutrients and secondary metabolites) regulating decomposition and mineralization of the organic matter.



S10.03-P -29

TURNOVER OF ORGANIC MATTER AND CARBON ACCUMULATION IN COEVAL FORESTS OF PINUS PINEA AND FAGUS SYLVATICA

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*Forest ecosystems act as a substantial carbon sink and store about 40% of all soil C. The amount of organic matter sequestered in the soil depends on the quantity of plant litter delivered to the soil as well as to the extent of litter decomposition. Therefore, carbon storage and turnover vary spatially and temporally under the influence of climate. Microbial biomass and activity are the main determinants of soil organic matter turnover. The aim of this study was to assess, along the soil profile, soil carbon accumulation and organic matter turnover in a 40-old coniferous forest and in a coeval broadleaf deciduous forest. The *P. pinea* forest is located at Mount Vesuvius (mean annual rainfall: 910 mm; mean annual temperature: 14.2°C); C content in the organic layer (litter) was 1117 g/m² and sharply decreased along the soil profile to 86 g/m² in the uppermost soil (0-5 cm) and 42 g/m² in the deeper layer (30-40 cm). The *Fagus sylvatica* forest is located in the southern Apennines (Appennino Campano-Avellino, mean annual rainfall: 3625 mm; mean annual temperature: 8,6 °C); C content in the organic layer was 842 g/m² and steadily decreased to 502 g/m² in the uppermost soil (0-5 cm) and 224 g/m² in the deeper soil (30-40cm). The active fungal biomass and microbial respiration were higher in the soil of the pine forest than in that of the beech forest. The data suggest that the beech forest is a larger sink of Carbon than the pine forest.*



S10.03-P -30

**UNIQUE CHARACTERISTICS OF HIGH ACTIVITY OF NITROGEN FIXATION IN
DECOMPOSING LITTER AND NITRIFICATION IN MINERAL SOIL OF JAPANESE CEDAR
(CRYPTOMERIA JAPONICA)**

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Japanese cedar (*Cryptomeria japonica*) is one of the most important conifers planted Japan. Those planted area was up to 4.5 million ha and it occupied about 43% in total planted area. It was well known that the soil of Japanese cedar stand has much content of base elements, especially exchangeable Ca with high pH and those contents increase along stand age. To clear the effect of these properties on soil microbial activity, nitrogen fixation and nitrification were determined in Japanese cedar soil. Nitrogen fixation activity of decomposing leaf litter in cedar, oak (*Quercus serrata*) and red pine (*Pinus densiflora*) installed using litter bag on the floor at Japanese cedar and deciduous broad-leaved stand was measured. Higher nitrogen fixation activity, 39 – 63 C₂H₄ nmoles h⁻¹ g⁻¹, was only observed in cedar, but negligible, < 1, in other species at both stands. Net mineralization rate and nitrification ratio (nitrification / mineralization rate) in cedar soil determined by lab. incubation were summarized from literature. Net mineralization is 3.3 mgN kg⁻¹ d⁻¹ ranged from 0.4 to 8.8, and mean value among soil types was not different. Mean nitrification ratio is 70%, and value was over 50% in 70% of total studies. Field incubation was also conducted in cedar stand at small catchment through year. As lab experiment, we observed high nitrification ratio in 86.4± 2.4 %. We considered that high activity of nitrogen fixation in litter and nitrification in mineral soil was particular aspect of Japanese cedar soil.



S10.03-P -31

VARIATION IN THE IMPACT OF TREE SPECIES ON SOIL PERMEABILITY

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Trees can contribute to ecosystem service provision in a number of ways. One example is water purification and it is being increasingly recognised that farm woodland and streamside tree buffer strips may have an important role to play in tackling diffuse pollution from agriculture. Trees can enhance soil permeability as the presence of both living and decayed roots create large pores in the soil, which have been shown to transmit water many times faster than through the rest of the soil matrix. Trees can therefore be used to reduce overland flow that may carry pollutants into watercourses. Despite this, there has been little investigation into how this influence on soil permeability may vary between tree species. Differences may result from variation in rooting structures; however, because different tree species support different soil fauna communities, variation in associated soil fauna may also affect soil permeability as burrowing fauna also create large pores in the soil. Here we will present the results of a study being undertaken at an experimental site in Scotland. Soil surface hydraulic conductivity was measured and compared for Scots Pine and sycamore woodland. We hypothesised that soil permeability under a conifer species would be lower than under a broadleaved species; however, initial results indicate that soil permeability is higher under Scots Pine woodland compared with sycamore woodland at the site. Further investigation of the underlying causes of variation will be discussed, focusing on the key processes that affect the presence of large pores in the soil.



S11.01-P - IMPACT OF CLIMATE CHANGE ON SOIL BIOCHEMICAL ACTIVITY WITH SPECIAL EMPHASIS ON SOIL RESPIRATION

Monday 02 July 2012 from 17:00 to 18:30. Room Poster Areas

S11.01-P -1

BIOLOGICAL ESTIMATION OF SOILS OF SUBTROPICAL ZONES OF AZERBAIJAN

Naila Orujova, Baku - Azerbaijan

S11.01-P -2

A KINETIC APPROACH TO IDENTIFY CARBON MINERALIZATION IN AMINO ACID-TREATED SOILS

Farshid Nourbakhsh, Isfahan - Iran, Islamic Republic of

S11.01-P -3

A NOVEL MICROWAVE-ASSISTED TECHNIQUE TO ESTIMATE SOIL MICROBIAL BIOMASS NITROGEN

Farshid Nourbakhsh, Isfahan - Iran, Islamic Republic of

S11.01-P -4

ABUNDANCE AND SPECIES COMPOSITION OF EARTHWORMS UNDER DIFFERENT SOIL USE

Anita Gal, Godollo - Hungary

S11.01-P -5

AMINO ACID CONCENTRATION CONTROLS N MINERALIZATION IN CALCAREOUS SOILS

Farshid Nourbakhsh, Isfahan - Iran, Islamic Republic of

S11.01-P -6

BIOLOGICAL CHARACTERISATION OF HUMUS PROFILES ALONG A CLIMOSEQUENCE OF SUBALPINE FOREST SOILS

Graefe Ulfert, Hamburg - Germany

S11.01-P -7

EFFECT OF LOW TEMPERATURE AND SOIL TYPE ON DECOMPOSITION OF SOIL ORGANIC MATTER AND PLANT RESIDUE

Marina Azzaroli Bleken, Aas - Norway



S11.01-P -8

EFFECTS OF CHANGING CLIMATE PARAMETERS ON PHENOL OXIDASE ACTIVITY IN A MEDITERRANEAN SHRUBLAND SOIL.

Ana Maymó, Moncada - Spain

S11.01-P -9

HEAT WAVES AND SOIL MEDITERRANEAN MICROBIAL COMMUNITIES: DIFFERENTIAL INFLUENCE OF DROUGHT, HIGH-TEMPERATURE AND PERTURBATION DURATION

Berard Annette, Avignon - France

S11.01-P -10

IMPACT OF WINTER CLIMATE CHANGE AND SOIL PROPERTIES ON SOIL MICROORGANISMS AND DECOMPOSITION OF PLANT RESIDUES

Stefan Lukas, Witzenhausen - Germany

S11.01-P -11

INFLUENCE OF LONG-TERM N-FERTILIZATION AND TEMPERATURE ON THE ACTIVITY AND COMPOSITION OF THE N₂ AND N₂O FORMING BACTERIAL COMMUNITY IN FEN PEAT SOIL

Jürgen Augustin, Müncheberg - Germany

S11.01-P -12

INTRA-ANNUAL VARIATION IN THE N MINERALIZATION CAPACITY OF AFFORESTED SOILS

Carmen Trasar-Cepeda, Santiago de Compostela - Spain

S11.01-P -13

IS MINERAL-BOUND SOIL ORGANIC MATTER SENSITIVE TO TEMPERATURE CHANGES?

Jocelyn Lavalley, Fort Collins - United States

S11.01-P -14

ISOLATION, CLONING AND CHARACTERISATION OF A NOVEL PHYTASE GENE FROM PSEUDOMONAS PUTIDA STRAIN P13

Mohammad Reza Sarikhani, Tabriz - Iran, Islamic Republic of

S11.01-P -15

SEASONAL VARIATION IN THE ACTIVITIES OF HYDROLASE ENZYMES ASSOCIATED WITH P AND S CYCLES IN AFFORESTED AND AGRICULTURAL SOILS

Félix Zorita, Santiago de Compostela - Spain



S11.01-P -16

TEMPERATURE SENSITIVITY OF N₂O AND CO₂ EMISSION FROM SOIL AS DEPENDENT ON OXYGEN AVAILABILITY AND SUBSTRATE AMOUNT

Evgeniya Blagodatskaya, Pushchino - Russian Federation

S11.01-P -17

TEMPERATURE-DRIVEN GROWTH RESPONSE OF THE FUNGAL AND BACTERIAL COMMUNITY IN SOIL

Stephanie Reischke, Lund - Sweden

S11.01-P -18

TEMPERATURE-SENSITIVITY OF SUBSOIL CARBON TURNOVER IN AGRICULTURAL SOIL

Ngonidzashe Chirinda, Tjele - Denmark

S11.01-P -19

TEMPORAL CHANGES IN DISSOLVED ORGANIC CARBON AND EXTRACELLULAR PHENOL OXIDASE ACTIVITY IN CONVENTIONAL AND NO-TILL PADDY SOIL UNDER DIFFERENT INCUBATION TEMPERATURE CONDITIONS

Ro Hee-myong , Seoul - Korea, Republic of

S11.01-P -20

THE EFFECT OF CLIMATE WARMING ON ABOVEGROUND AND BELOWGROUND INTERACTIONS IN PEATLANDS: THE SEASONAL NUTRIENT PARTITIONING BETWEEN MICROBES AND PLANTS

Luca Bragazza, Ferrara - Italy



S11.01-P -1

BIOLOGICAL ESTIMATION OF SOILS OF SUBTROPICAL ZONES OF AZERBAIJAN

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Biological properties are important indicators of soil fertility. The biological activity (fermentative activity, numbers of microorganisms, intensity of nitrification, ammonification, CO₂ emission and cellulose decomposition) were studied in gray-brown (Irragic Gypsic Calcisols), meadow-serozem (Irragic calsisols), meadow-forest alluvial (Irragic Mollic Luvisols) and yellow-gley soils (Irragic Gleyic Luvisols) in the subtropical zone of Azerbaijan under virgin soils, crop rotation and permanent crops. On this basis of a complex of biological parameters the integrated parameter of biological condition of soils (IPBCS) has been determined. The biological estimation of irrigated gray-brown soils in crop rotation varies within 63-100%, but permanent crops of 65-73%. In the meadow-serozem soils, the highest IPBCS (100%) are observed in the crop rotation; in the virgin soils they are lower by 15% and permanent crop they are lower by 35%. In the irrigated meadow-forest alluvial soils the IPBCS varies within 67–100% in the crop rotation, but permanent crops of 49–60%, in the yellow-gley soils 70–100% and 53–77%, respectively. The IPBCS in the virgin soils and in the crop rotation varies from 82 to 100% and these soils may be qualified as soils with very high biological activity. Under permanent crops, the IPBCS varies within 60–70%, which corresponds to high and moderate biological activity. It was shown that properly chosen crop rotation on irrigated lands make it possible to preserve the fertility of the meadow-forest alluvial and yellow-gley soils and to improve the fertility of the gray-brown and meadow-serozem soils.



S11.01-P -2

A KINETIC APPROACH TO IDENTIFY CARBON MINERALIZATION IN AMINO ACID-TREATED SOILS

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Soil microbial respiration is derived predominantly from carbohydrate and protein decomposition. The objective of this study was to identify the kinetic behavior of C mineralization in amino acid-treated soils. For this purpose, L-glutamine, Glycine, L-asparagine, L-histidine and L-arginine were added to two calcareous soils at an optimum concentration which was previously determined in a preliminary study. A control treatment (without application of amino acid) and glucose amendment were also considered, separately. Soils were incubated at 25 °C and 50% water holding capacity. The CO₂ respired were measured periodically at 15, 30, 45, 60, 90, 120, 150, 180, 210, 240, 270, 300, 330 and 360 minutes following incubation. Results indicated that a first-order kinetic model ($C_m = C_0[1 - e^{-kt}]$) conformed well to all data. Where, C_0 is potentially mineralizable C, k is mineralization rate constant, C_m is the actual C mineralized at each time (t). Expectedly, the lowest and the greatest C_m values were observed for control and glucose-amended soils, respectively. Among the amino acids, L-glutamine and L-histidine resulted in the greatest and lowest rates of C mineralization during 360 minutes, respectively. In contrast, the greatest C_0 value (520 mg C kg⁻¹) was observed for L-glutamine while, the lowest rate was detected for glycine (252 mg C kg⁻¹). The initial potential rates of C mineralization indexed by kC_0 revealed similar trend as that of C_0 . Overall, according to the time span, the rate of C evolution from the amino acids in the two calcareous soils can be sequenced as: L-glutamine>Glycine>L-arginine>L-asparagine>L-histidine.



S11.01-P -3

A NOVEL MICROWAVE-ASSISTED TECHNIQUE TO ESTIMATE SOIL MICROBIAL BIOMASS NITROGEN

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Soil microbial biomass is thought to be a functional pool of soil nitrogen as well as an enzyme generator which participate in soil biological processes. Many attempts have been made to measure soil microbial biomass and various techniques have been developed, consequently. Regardless of their accuracy and precision, the techniques are generally labor-intensive and time consuming. Chloroform fumigation-based techniques are further uncomfortable and therefore lyses of soil microbial biomass by an alternative procedure like microwave energy can be taken as a shortcut to estimate soil microbial biomass nitrogen (MBN). We measured soil MBN by fumigation-extraction technique (FE) in 22 calcareous soils. Wide range of MBN was found. In a parallel experiment, the soils moistened and irradiated with 1200 J g⁻¹ microwave energy. The irradiated soils were immediately extracted by 0.5 M K₂SO₄ and total inorganic N was measured in the extracts. A significant linear relationship was observed ($MBN = 1.06 MWN + 0.46$; $r = 0.76$ $P < 0.001$), where MWN is microwave-induced N mineralization. Overall, we concluded that the enhanced inorganic N in soil (that is named microwave-induced N mineralization) is proportional to the size of soil microbial biomass and hence can be used as an estimation of MBN in calcareous soils.



S11.01-P -4

ABUNDANCE AND SPECIES COMPOSITION OF EARTHWORMS UNDER DIFFERENT SOIL USE

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The EU Soil Protection Strategy stated the eight threats for European soils. These were the following: erosion, decline in soil organic matter, soil contamination, soil sealing, soil compaction, decline in soil biodiversity, soil salinisation, floods and landslides. Among these, we mainly focused on the decline of soil biodiversity. The aim of our investigations was to measure soil biodiversity and biological activity using earthworms as indicators on areas under different land use and in different stages of degradation (tillage, grassland, forest, ecological farming). We carried out the investigations between 2007 and 2009, twice a year (spring and fall). Earthworm abundance and biomass were determined according to ISO 23611-1 standard, species were determined according to the key for Hungarian earthworm species. Based on our results we can conclude, that less degraded/disturbed areas show greater abundance and species diversity than areas heavily degraded/disturbed.



S11.01-P -5

AMINO ACID CONCENTRATION CONTROLS N MINERALIZATION IN CALCAREOUS SOILS

Nourbakhsh Farshid^[1], Salari Najmeh^[1]

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Amino acids are one of the largest inputs of dissolved organic N in soils and hence can contribute effectively in N mineralization process. We hypothesized that amino acid concentration may control the rate of N mineralization process in calcareous soils which naturally possess little amounts of bioavailable N. The objective of this study was to investigate the effect of amino acid concentration on the rate of N mineralization in amino acid-amended calcareous soils. For this purpose 50 g of two calcareous soils were treated with 5 ml of L-arginine, L-glutamine, Glycine, L-asparagine and L-histidine solutions containing concentrations of 10, 20, 40, 60 and 100 mM of the amino acids. The range corresponds to the amounts that are naturally found in the rhizosphere. Soils were incubated at 25 °C and 50% water holding capacity for 24 h and inorganic N released were extracted and measured. Results indicated that all amino acids caused N mineralization. The rate of N mineralization was a linear function of amino acid concentration. The greatest and lowest values of mineralized N were observed consistently in L-arginine and L-asparagine amended soils, respectively. L-histidine behaved similarly to that of L-arginine while, glycine revealed great similarities to L-asparagine. Overall, we concluded that different amino acids can contribute differently to the N mineralization process even under similar concentrations.



S11.01-P -6

BIOLOGICAL CHARACTERISATION OF HUMUS PROFILES ALONG A CLIMOSEQUENCE OF SUBALPINE FOREST SOILS

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Global warming primarily affects topsoil processes such as organic matter turnover observable as changes of the humus form. We studied the influence of pedoclimate on the biological and morphological development of humus profiles in spruce forests on basaltic latite debris in the Southern Alps (Val di Fassa, Trentino, Italy). Four sites were selected differing in exposure (south-facing, north-facing) and altitude (1600 m, 1900 m) allowing paired comparisons (same altitude, different exposure vs. same exposure, different altitude). Measurements included abundance, species composition and vertical distribution of microannelids as well as polyphasic biochemical fingerprinting of soil microbial communities by denaturing gradient gel electrophoresis and phospholipid fatty acid analysis. The vertical distribution of microannelid abundance and microbial biomass showed similar patterns and provided evidence that the organic layer is the hotspot of biological activity in the studied humus profiles. Highest similarities in community structure were found to be between sites with same exposure. Along the elevation gradient to higher altitude the humus forms at south-facing sites shifted from Mull to Amphi. At north-facing sites a shift from Moder to Mor took place. The thickness of the organic layer increased inversely to the thickness of the A horizon along the gradient of decreasing mean annual temperature indicated by the sequence Mull, Amphi, Moder, Mor. The same gradient is shown by the activity of microannelids predominantly located in mineral horizons at the Mull site and exclusively in the organic layer at the Mor site. Implications for organic matter stability under warming scenarios are highlighted.



S11.01-P -7

EFFECT OF LOW TEMPERATURE AND SOIL TYPE ON DECOMPOSITION OF SOIL ORGANIC MATTER AND PLANT RESIDUE

Bleken Marina Azzaroli^[1], Kristensen Kritstian T.^[2], Hansen Sissel^[3], Frøseth Randi Berland^[3]

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On stockless organic farms green manure is commonly used to improve soil fertility. The potential N losses from frequent mulching with legume rich green manure might be large, but few investigations have been done on turnover of such plant material under cold climate conditions. The aim of our study was to investigate how low temperature and soil type affects: a) the N mineralization from plant residue b) the decomposition of soil organic matter with or without addition of fresh plant residues. Our working hypothesis is that low temperature alters the C/N ratio of the net mineralization products, and that this effect depends on the quality of the substrate. The results will be used to improve the modelling of organic matter turnover and N mineralization. An incubation trial was performed in the autumn 2011 using a clay soil and a sandy soil with and without ¹³C labelled clover leaves. The samples were incubated at 1°C, 4°C, 9°C or 15°C with sampling performed on day 0, 3, 8, 15, 30, 52 and 80. Samples for gas analysis were kept in airtight chambers with NaOH brine for collecting CO₂. The isotopic ratio of CO₂ evolved was used to estimate the priming effect (extra decomposition of soil organic C after addition of easily-decomposable organic substance to the soil), and determined by using a gas chromatography isotope ratio mass spectrometer. The soil samples were analysed for NO₃⁻ and NH₄⁺. Preliminary results will be presented.



S11.01-P -8

EFFECTS OF CHANGING CLIMATE PARAMETERS ON PHENOL OXIDASE ACTIVITY IN A MEDITERRANEAN SHRUBLAND SOIL.

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^[1]CIDE ~ Soil Degradation and Conservation ~ Moncada ~ Spain

Despite their mediating role in important soil processes such as soil organic matter dynamics and carbon turnover, soil phenol oxidases (PO) have been measured in a small subset of soil enzyme studies. This limited data is even scarcer when mediterranean calcareous shrubland soils are considered. Studies were conducted with two Mediterranean shrubland soils to evaluate the potential influence of precipitation and temperature changes, upon PO activity. We examined, during a two-years period, the response of soil cores to experimental warming (3°C increase) and decreased precipitation regime (10% decrease) comparing with 'Normal' Mediterranean conditions. We used laboratory incubations in two climatic chambers. At the end of the experiment, there were assayed and compared PO activities from the two chambers soils. Previous to PO evaluation, we adapted and adjusted the procedure for PO activity determination for our soil samples. To ensure that potential enzyme activity was properly estimated, the effects of the amounts of enzyme extract, substrate concentration, incubation time, pH and temperature were investigated. The optimized method involves quantitative measurement of the ABTS+ released when 0.08 g of soil is incubated with 900 µL of a Modified Universal Buffer (MUB) solution (buffered at pH 2) at 30°C for 10 min. The highest activity of PO was obtained when using ABTS concentration of 5 mM. PO activity was linearly increased with an increasing amount of the enzyme between 0.02 and 0.25 g of soil. When soil cores were exposed to warmer temperatures and the volume of irrigation inputs decreased, PO activity increased.



S11.01-P -9

HEAT WAVES AND SOIL MEDITERRANEAN MICROBIAL COMMUNITIES: DIFFERENTIAL INFLUENCE OF DROUGHT, HIGH-TEMPERATURE AND PERTURBATION DURATION

Ben Sassi Meriem^[1], Jérémie Beguet^[2], Pierre Renault^[1], Fabrice Martin-Laurent^[2], Annette Berard^{*[1]}

^[1]INRA/UAPV ~ EA-EMMAH ~ Avignon ~ France ^[2]INRA ~ EA-MS-Geosol-CMSE ~ Dijon ~ France

According to extrapolations and models reported by IPCC, higher air temperature, decreases in the magnitude of precipitation events and prolonged droughts have been predicted for the Mediterranean regions. These events may affect the microbial growth and activity and thereby the biodiversity and the functions of soil. In this work, we studied short-term and long-term impacts of severe drought and high temperature (drought, drought-heat and heat perturbations) on a Mediterranean soil microbial structure (taxonomic and functional). Different durations of perturbation (2, 7, 14, 21 and 28 days) were performed. Short-term effects were studied one day after the end of each perturbation. Long-term impacts of a 21 days perturbation period were assessed for 42 days after the end of perturbation. The physiological profile of the community was performed with the MicroRespTM method and the taxonomic structure was evaluated using Automated Ribosomal Intergenic Spacer Analysis (ARISA) and Ester-Linked Fatty Acids (EL-FAMES). At the short-term, perturbation duration had an effect on microbial community. The results showed that both taxonomic and functional structures change after 21 days of perturbation (threshold duration?). At the long-term, these patterns revealed no resilience of the taxonomic structure in the case of the heat perturbation, whereas this structure was resilient in the case of the drought-heat perturbation. In contrast, catabolic diversity of microbial community was no resilient in the two cases. In this Mediterranean context, the effects of heat perturbations seemed to be more important than the effects of the drought perturbations on soil catabolic function and structure.



S11.01-P -10

IMPACT OF WINTER CLIMATE CHANGE AND SOIL PROPERTIES ON SOIL MICROORGANISMS AND DECOMPOSITION OF PLANT RESIDUES

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Climate scenarios predict increasing temperatures and higher precipitation rates in late fall to early spring, both holding the potential to modify carbon and nutrient dynamics in soils by altering snow pack thickness and soil frost events. When soils are frozen, a small amount of unfrozen water allow microorganisms to remain active at temperatures up to -10 °C. The knowledge of the influence of clay content on unfrozen water and decomposition processes in frozen soil is rare. Therefore, we investigated the microbial use of maize straw as a common crop residue in two arable soils of different clay contents (13 and 34%) and both soil types were placed at two locations with a difference in mean annual temperature of approximately 1 °C. Microcosms with sieved soil were mixed with chopped maize leaf straw (C/N 17) at a rate of 1 mg C g⁻¹ dry soil, un-amended microcosms served as control. First results showed an actual temperature difference of 0.4 °C between both locations. Independent of the location, at the end of the experiment samples with 13% clay lost 44% (\pm 4) of the initial water content whereas soil with 34% clay lost only 23% (\pm 5). An inverse relationship between soil temperature and carbon mineralization was observed. Both maize-amended and un-amended samples with 13 and 34% clay content at the "colder" location had 3 to 4 times higher C mineralization rates. Slightly higher soil temperature increased microbial incorporation of maize-derived N in soil with 13% clay.



S11.01-P -11

INFLUENCE OF LONG-TERM N-FERTILIZATION AND TEMPERATURE ON THE ACTIVITY AND COMPOSITION OF THE N₂ AND N₂O FORMING BACTERIAL COMMUNITY IN FEN PEAT SOIL

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Emission of N₂ and the greenhouse gas N₂O is often influenced by N-fertilization and several other factors like the soil temperature. We wanted to examine, whether this is also the case for fen peatlands. Therefore, temperature gradient measurements (-5, 0, 5, 15, 25 °C) were carried out by a helium incubation technique at undisturbed soil cores (250 cm³) which were taken from a long-term N-fertilization experiment (over a period of 50 years) on a fen peat grassland site in winter. The fertilized treatment (480 kg N ha⁻¹) revealed significant higher N₂ fluxes than the unfertilized control. Moreover, the N₂:N₂O ratio was increased in the fertilized treatment. However, in contrast to the N₂ formation, the release of N₂O did not follow the temperature gradient. Furthermore, the response to the temperature gradient differed between both treatments. Investigation of the denitrifying bacterial community by T-RFLP analysis of the nitrous oxide reductase gene (*nosZ*) showed clear differences in the community structure between the fertilized and the control plot. Similar results were found by cultivation techniques. Selective isolation and physiological characterization of denitrifying bacteria revealed differences in the community composition as well as in the abundance. Particularly, the number and portion of denitrifying strains able to grow at 0 °C differed between both treatments. In sum, the long-term N-fertilization led to shifts in the denitrifying bacterial community of the examined fen peat grassland, which seems to have effect also the N₂O and N₂ fluxes along the temperature gradient of that habitat.



S11.01-P -12

INTRA-ANNUAL VARIATION IN THE N MINERALIZATION CAPACITY OF AFFORESTED SOILS

García-Campos Elena^[1], Trasar-Cepeda Carmen^{*[2]}, Gil-Sotres Fernando^[2], Leirós M. Carmen^[2]

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*The idea that forest vegetation contributes to reducing atmospheric CO₂, by favouring the accumulation of organic carbon in plant biomass and soil, has driven the transformation of agricultural land into forest land in the last two decades. Although the change in vegetation and the abandonment of agricultural activities should have strong impacts on the processes involved in organic matter mineralization, very few studies have investigated the modifications in this process generated by afforestation. Therefore, given the importance of processes that affect N mineralization, as regards the availability of this element in soils in which land use change involves cessation of the use of nitrogenous fertilizers, in the present study we investigated seasonal variations in the N mineralization capacity of forest soils and the agricultural soils from which they were derived. Six soils were collected from three sampling sites, three of which were cropped with maize and three were afforested with different tree species: one with *Quercus rubra* L and two with *Populus alba* L. Periodically during one year, samples of the upper 30 cm of each soil (subdivided into 0-10, 10-20 and 20-30 cm layers) were collected for determination of the N mineralization capacity. The results show that afforestation leads to a reduction in the content of nitrates and an increase in ammoniacal forms, relative to cropped soils. As regards N mineralization, there was no clear pattern of variation attributable to afforestation, and in general, the effects associated with agricultural activities were more important than those associated with seasonal variations.*



S11.01-P -13

IS MINERAL-BOUND SOIL ORGANIC MATTER SENSITIVE TO TEMPERATURE CHANGES?

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Soil organic matter (SOM) in intimate association with mineral surfaces represents a large portion of the earth's stabilized carbon (C). The effect of global climate change on the dynamics of this 'chemically-stabilized' SOM will determine a major feedback to the global C cycle. Despite this, we do not know how increasing temperatures will affect chemical stabilization. Arrhenius kinetics suggests that SOM pools that decompose most slowly will be most sensitive to temperature. We ask, does chemically stabilized SOM follow Arrhenius kinetics or does some other process govern its temperature response? Here we present a synthesis of current knowledge on temperature sensitivity of mineral-associated SOM, and our current research on the topic. Preliminary results from laboratory-based adsorption/desorption experiments and field-based ¹³C tracer experiments support the idea that some reactions are very responsive to warmer temperatures, but others are relatively insensitive. We present our results within the context of a literature synthesis that bolsters the idea of different types of chemical stabilization and associated temperature sensitivities and discuss the implications of these novel findings.



S11.01-P -14

ISOLATION, CLONING AND CHARACTERISATION OF A NOVEL PHYTASE GENE FROM PSEUDOMONAS PUTIDA STRAIN P13

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^[1]University of Tabriz ~ Soil Science ~ Tabriz ~ Iran, Islamic Republic of ^[2]NIGEB ~ Plant Biotechnology ~ Tehran ~ Iran, Islamic Republic of ^[3]MRI ~ Federal Research Institute of Nutrition and Food ~ Karlsruhe ~ Germany

A novel phytase gene was isolated by genomic library screening from Pseudomonas putida P13 isolated from Iran soils in Sperber medium with 5-bromo-4-chloro-3-indolyl phosphate. The full-length gene consists of an open reading frame of 750 bp and encodes a protein consisting of 249 amino acids. The molecular weight of the semi-purified enzyme was estimated to be 26 kDa by sodium dodecyl sulfate-polyacrylamide gel electrophoresis analysis. The amino acid sequence shows maximum identity (80%) to major facilitator superfamily from Pseudomonas putida. The gene encoding the phytase was expressed in Escherichia coli and the purified recombinant phytase had a specific activity for sodium phytate of 281 U mg⁻¹. The optimum conditions for phytate hydrolysis were estimated to be 60 °C and pH 5.0. The Km value for phytate at pH 5 and 37°C was 0.237mM, with a Vmax of 0.281 mmol min⁻¹ mg⁻¹. This is the first report to isolate a phytase gene from Pseudomonas putida.



S11.01-P -15

SEASONAL VARIATION IN THE ACTIVITIES OF HYDROLASE ENZYMES ASSOCIATED WITH P AND S CYCLES IN AFFORESTED AND AGRICULTURAL SOILS

Zorita Félix*^[1], Gil-Sotres Fernando^[2], Leirós M. Carmen^[2], Trasar-Cepeda Carmen^[2]

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In the past two decades the EU has provided subsidies to promote the transformation of marginal land to forest land. The aim of this policy was to help mitigate climate change, by favouring the accumulation of organic carbon in plant biomass and soil, thus favouring the action of the soil as a C sink. However, although it is known that afforestation will affect the general metabolic activity of soil, the amount and direction of such changes have scarcely been studied. The input of essential elements (such as P and S) to the soil decreases when agricultural land is afforested, as less fertilizer (if any) is applied to the land. In the present study, we compared the seasonal variation in the activities of enzymes associated with the P and S cycles in afforested soils and cropped soils. For this purpose, samples of the upper 0-10, 10-20 and 20-30 cm layers of three forest soils and the three agricultural soils from which they were derived, were sampled periodically throughout one year, to analyse the activities of phosphomonoesterase, phosphodiesterase and aryl-sulphatase. Afforestation appeared to increase the activity of all three enzymes investigated, although not in all cases, especially when the results were expressed per unit of carbon. On the other hand, the phosphomonoesterase activity displayed the highest degree of seasonal variation, especially in the cropped soils; the variations in the other enzyme activities were much lower.



S11.01-P -16

TEMPERATURE SENSITIVITY OF N₂O AND CO₂ EMISSION FROM SOIL AS DEPENDENT ON OXYGEN AVAILABILITY AND SUBSTRATE AMOUNT

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^[1]Russian Academy of Sciences ~ Institute of Physicochemical and Biological Problems in Soil Science ~ Pushchino ~ Russian Federation ^[2]Chinese Academy of Sciences ~ Institute of Atmospheric Physics ~ Beijing ~ China ^[3]University of Aberdeen ~ Institute of Biological and Environmental Sciences ~ Aberdeen ~ United Kingdom ^[4]Karlsruhe Institute of Technology ~ Institute for Meteorology and Climate Research, Atmospheric Environmental Research ~ Garmisch-Partenkirchen ~ Germany

The drivers of temperature sensitivity of decomposition of soil organic matter are dependent on the substrate amount, quality and on the availability of N which presents in soil both in mineral and in organic forms. The affinity of microbial enzymes to N-containing organic substances in oxic and anoxic microzones coexisting in soil may respond differently to temperature increase. Our study aimed to determine how substrate amount and quality affect the temperature dependency of enzymatic processes leading to the production of CO₂ and N₂O under aerobic and anaerobic conditions. Three substrates of decreasing availability: 1) glucose with potassium nitrate, 2) glycine, 3) phenylalanine were applied to soil at series of concentrations and were incubated at 21 and 1% of O₂ content. The Michaelis-Menten kinetics was determined by initial rates of N₂O and CO₂ emission at 10 and 20°C. Our study revealed the situations when the metabolism of simple substrates (glycine and glucose) at low concentrations was more efficient at lower temperature. A higher temperature sensitivity of N₂O emission at low versus high substrate amount was observed for mineral form of N under anaerobic conditions. Contrary to that, the anaerobic N₂O emission in organic N treatments was more temperature sensitive at high versus low substrate amounts. At low substrate input the emission of greenhouse gases was even larger during decomposition of N-containing organic substances as compared with mineral N forms. We conclude that oxygen availability and N forms control the direction of temperature effect on greenhouse gases emission at low substrate amounts.



S11.01-P -17

TEMPERATURE-DRIVEN GROWTH RESPONSE OF THE FUNGAL AND BACTERIAL COMMUNITY IN SOIL

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Temperature dependence is of considerable importance for organic matter decomposition, especially in the context of future climate change. Fungi and bacteria are the dominant decomposer groups in soil, but we know little about effects of temperature on the relative importance of these organisms in soil. To study the effect of temperature on fungal and bacterial growth in soil we designed a laboratory experiment where three different C-substrates (glucose, straw and alfalfa) were added to a grassland soil and incubated at 0 to 25°C at 5°C increments. Leucine and acetate-in-ergosterol incorporation technique were used to measure bacterial and fungal growth, respectively, at a single standardized temperature (15°C). Samples incubated at 15 to 25°C were sampled regularly during 14 days, while at 0 to 10°C samples were taken during 56 days. Straw addition stimulated fungal growth rate more than alfalfa and glucose at all temperatures, except at 0°C. At 0°C no substrate addition stimulated fungal growth. Addition of alfalfa and glucose had little or no stimulating effect on fungal growth, but strongly stimulated bacterial growth rates at all temperatures. All growth curves showed that the response-time of the increase, decrease and peak growth rates depend on the temperature. Although the bacterial and fungal growth responses to labile C additions were highly temperature dependent, there were only minor differences in the relative importance of the two groups due to temperature.



S11.01-P -18

TEMPERATURE-SENSITIVITY OF SUBSOIL CARBON TURNOVER IN AGRICULTURAL SOIL

Chirinda Ngonidzashe^{*[1]}, Elsgaard Lars^[1], Thomsen Ingrid K.^[1], Lægdsmand Mette^[1], Heckrath Goswin^[1], Petersen Bjørn M.^[1], Olesen Jørgen E.^[1]

^[1]Aarhus University ~ Agroecology ~ Tjele ~ Denmark

Subsoils generally have a higher proportion of recalcitrant carbon (C) and a more constant temperature regime as compared with topsoils. There is limited knowledge on subsoil C dynamics and notably on temperature-sensitivity of microbial degradation (respiration) of recalcitrant and labile C compounds. This study aimed to investigate soil C dynamics in topsoil and subsoil horizons at upslope and footslope positions. Undisturbed soil samples were collected in metal cores (100 cm³) from 2-5.5 cm and 38-41.5 cm at upslope and footslope positions in a Danish winter wheat field on a sandy loam soil. Soil moisture was adjusted to $pF = 2$ and undisturbed soils were sub-cored into smaller cores (2.75 cm³). Small soil cores from each depth (top and sub soil) and each sampling position (upslope and footslope) were placed in 28-ml test-tubes and incubated in six replicates on a temperature-gradient-block at seven selected temperature levels (i.e., 5, 10, 15, 20, 25, 30 and 34°C). CO₂ emissions from each test-tube were measured at three times over 24 h, and the resulting respiration rates were calculated by linear regression. Results showed a higher temperature sensitivity in the topsoil ($Q_{10} = 2.1$) than in the subsoil ($Q_{10} = 1.7$) horizon. For footslope soils the Q_{10} was 2.1 and 2.4 in the topsoil and subsoil, respectively. Since the upslope position was subject to tillage-induced erosion and the footslope to soil deposition, the sampled subsoil at the footslope position could be buried topsoil. Interactions between substrate availability and temperature-sensitivity may be involved in the observed Q_{10} responses.



S11.01-P -19

TEMPORAL CHANGES IN DISSOLVED ORGANIC CARBON AND EXTRACELLULAR PHENOL OXIDASE ACTIVITY IN CONVENTIONAL AND NO-TILL PADDY SOIL UNDER DIFFERENT INCUBATION TEMPERATURE CONDITIONS

Min-jin Lee^[1], Seok-in Yun^[1], Jong-Sung Kim^[1], Tae-kyu Lee^[1], Hee-myong Ro^{*[1]}

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Dissolved organic carbon (DOC) in soils has affected global C flux by discharging DOC into the water systems. Phenol oxidase is known to regulate decomposition of recalcitrant organic carbon with a positive relationship with dissolved organic carbon in peatland. We investigated the temporal changes in DOC and phenol oxidase activity in rice paddy soils. To do so, we collected soil samples (0-20 cm) from conventional (CT) and no-till (NT) paddy soils. Total organic carbon concentrations were 13.1 and 30.6 g kg⁻¹, respectively. We conducted a series of batch incubation of soils treated with chopped rice straw (0.25 %, soil dry-mass basis) under waterlogged condition (1 cm ponding) at 20 and 30 °C for 50 days. Each soil sample was collected periodically and analyzed for DOC concentrations in the soils and the overlying water, and phenol oxidase activity in soils. Dissolved organic carbon concentrations in soils were not greatly affected by temperature for both CT and NT soils, but decreased with time. Throughout the incubation, DOC concentrations were higher in NT soils than in CT soils. On the other hand, DOC concentrations in the overlying waters of CT and NT soils increased with time and were higher at 30 °C than at 20 °C. Overall, phenol oxidase activities increased slightly with time for both CT and NT soils and were higher in CT soils than in NT soils.



S11.01-P -20

THE EFFECT OF CLIMATE WARMING ON ABOVEGROUND AND BELOWGROUND INTERACTIONS IN PEATLANDS: THE SEASONAL NUTRIENT PARTITIONING BETWEEN MICROBES AND PLANTS

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^[1]University of Ferrara ~ Department of Biology and Evolution ~ Ferrara ~ Italy ^[2]Ecole Polytechnique Fédérale de Lausanne (EPFL) ~ Laboratory of Ecological Systems (ECOS) ~ Lausanne ~ Switzerland

Bogs are nutrient-poor ecosystems strictly dependent on atmospheric inputs so they can be a good model for understanding the effects of climate change on interactions between plants and soil microbes. Here, we investigate the seasonal dynamic of microbial activity in four Swiss bogs along an altitudinal gradient so as to simulate a natural gradient of soil temperature. Peat microbial biomass carbon (C) and nitrogen (N), soil enzymatic activity, total dissolved nitrogen (TN) and organic carbon (DOC) as well as polyphenol concentration in pore water were periodically assessed during an entire plant growing season. We report a significant difference in the seasonal trend of C/N quotient in microbial biomass in relation to the altitude and the abundance of different plant growth forms, i.e., ericoids and graminoids. Increasing polyphenol concentration in pore water is reflected in a higher amount of exchangeable organic nitrogen in peat. On the other hand, the positive relationship between vascular plant production and DOC concentration in pore-water seems to indicate a primary role of root exudates in affecting DOC concentrations. The relative activity of C, N and P acquiring enzymes differ along the altitudinal gradient in relation to the quality of dissolved organic matter. A greater abundance of ericoids at lower altitude is reflected in a different microbial community structure. Our preliminary data suggest the presence of important aboveground-belowground feedback in terms of nutrient acquisition, which can potentially destabilize the ability of peatlands to act as C sinks if vascular plants become more competitive than peat-forming mosses.



S11.02-P - SOIL BIODIVERSITY AND ECOSYSTEM SERVICES

Wednesday 04 July 2012 from 17:00 to 18:30. Room Poster Areas

S11.02-P -1

A STUDY ON THE RELATIONSHIPS BETWEEN SOIL MESOFAUNA AND SCLEROTIA IN LOW PH FOREST SOILS OF JAPAN

Anzilni Fathia Amasya, Hachioji - Japan

S11.02-P -2

ARBUSCULAR MYCORRHIZAL FUNGAL COMMUNITIES IN THE HYPOXIC SOILS OF NATURAL CO₂ SPRINGS

Nataša Šibanc, Ljubljana - Slovenia

S11.02-P -3

BIOCHEMICAL POTENTIAL AND MOLECULAR IDENTIFICATION OF MICROORGANISMS ISOLATED FROM SOIL AND DIFFERENT ORGANIC WASTES

Karolina Oszust, Lublin - Poland

S11.02-P -4

COMMUNITY STRUCTURE OF SOIL NEMATODES IN SOYBEAN AND CORN FIELDS UNDER LONG-TERM CROP ROTATION SYSTEM

Fengjuan Pan, Harbin - China

S11.02-P -5

DEVELOPMENT OF A TARGETED PROTEOMICS APPROACH FOR MEASUREMENT OF GLYCOSIDE HYDROLASE FUNCTIONAL REDUNDANCY IN SOILS

Stephen Callister, Richland, WA - United States

S11.02-P -6

EARTHWORM AND COVER CROPS CONTRIBUTION TO ENHANCE SOIL ORGANIC MATTER IN NOTILLAGE SOYBEAN PRODUCTION IN JAPAN

Masakazu Komatsuzaki, Ibaraki - Japan

S11.02-P -7

EFFECT OF LARGE SCALE PRODUCTION OF ENERGY CROPS ON FUNGAL COMMUNITY IN TOPSOIL LAYER

Petr Hedenec, České Budejovice - Czech Republic



S11.02-P -8

EFFECT OF RAINFALL-INDUCED SOIL GEOCHEMISTRY DYNAMICS ON GRASSLAND SOIL MICROBIAL COMMUNITIES

Karelyn Cruz-Martinez, Berkeley - United States

S11.02-P -9

EFFECTS OF CONSERVATIVE PRACTICES ON BACTERIAL DIVERSITY AND DENITRIFYING GENES EXPRESSION IN INTENSIVE AGRICULTURE

Roberta Pastorelli, Bologna - Italy

S11.02-P -10

EFFECTS OF OLIVE OIL PRODUCTION WASTEWATER ON SOIL ARTHROPODS IN TWO DIFFERENT CULTIVATION SCENARIOS IN ISRAEL AND PALESTINE

Markus Kurtz, Landau - Germany

S11.02-P -11

EXPLORING THE CADMIUM "SYMPATHIZER" BACTERIA THROUGH A SOIL METAGENOME APPROACH.

Maria Teresa Ceccherini, Firenze - Italy

S11.02-P -12

GENOME SEQUENCING OF TWO EXOELECTROGENIC BACTERIA ISOLATED FROM SOIL AND ASSESSMENT OF THEIR METABOLIC PROFILE BY MEANS OF PHENOTYPE MICROARRAYS

Stefano Mocali, Firenze - Italy

S11.02-P -13

GENOMIC AND TRANSCRIPTOMIC TOOLS TO REVEAL THE IMPACT OF LAND USE ON BACTERIAL α -GLUCOSIDASE DIVERSITY AND EXPRESSION

Emilio Benitez, Granada - Spain

S11.02-P -14

GLOMALIN-RELATED SOIL PROTEIN AND ITS IMPORTANCE IN ALUMINIUM EXCLUSION MECHANISM OF PLANTS GROWING IN ACID SOILS

Alex Seguel, Temuco - Chile

S11.02-P -15

GRASSLAND DIVERSITY RESTORATION ON EX-ARABLE LAND BY SOIL INOCULATIONS

De Deyn Gerlinde B., Wageningen - Netherlands



S11.02-P -16

IMPACT OF DIFFERENT LAND USES ON SOIL BIOLOGICAL AND BIOCHEMICAL PROPERTIES: SALIX SHORT ROTATION COPPICE COMPARED WITH INTENSIVE AGRICULTURAL SYSTEM, GRASS STRIPS AND ALLUVIAL FOREST.

Marie Stauffer, Vandoeuvre-les-Nancy - France

S11.02-P -17

ISOLATION, IDENTIFICATION AND SCREENING OF CELLULOLYTIC MICROORGANISMS FROM SOIL AND ORGANIC WASTE

Magdalena Frąc, Lublin - Poland

S11.02-P -18

LITHOLOGICAL CONTROL ON SOIL CHEMISTRY AND MICROBIAL DIVERSITY

Nicola Ashton, Manchester - United Kingdom

S11.02-P -19

MICROARTHROPOD AND CILIATED PROTOZOA SOIL COMMUNITIES IN SIX CENTRAL ITALIAN BEECH FORESTS

Cristina Menta, Parma - Italy

S11.02-P -20

NEMATOFAUNA STUDY FOR SOIL MONITORING, RISK ASSESSMENT AND SOIL CHARACTERIZATION. RESULTS FROM THE FRENCH NATIONAL "BIOINDICATORS PROGRAMME."

Cecile Villenave, Montpellier - France

S11.02-P -21

PLFA EXTRACTION – PROBLEMS ASSOCIATED WITH THE PREPARATION OF SOIL SAMPLES WITH UNKNOWN WATER CONTENT AND THE EFFECT OF FREEZE DRYING

Andrea Watzinger, Tulln - Austria

S11.02-P -22

PRELIMINARY INVESTIGATION ON THE MICROBIAL AND GENETIC SOIL DIVERSITY: EFFECT OF PEDOGENIC SUBSTRATE

Loredana Canfora, Roma - Italy



S11.02-P -23

QUANTIFYING CARBON ROUTING FROM MAIZE INTO BACTERIAL AND FUNGAL BIOMASS IN AN AGRO-ECOSYSTEM

Ellen Kandeler, Stuttgart - Germany

S11.02-P -24

RESIDUAL EFFECT OF DE-OILED OLIVE MILL WASTE AMENDMENT ON ENZYME ACTIVITIES IN A DEGRADED MEDITERRANEAN SOIL UNDER FIELD CONDITIONS

Antonio López Piñeiro, Badajoz - Spain

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SEARCHING FOR MICROBIAL INDICATORS OF SOIL STABILITY AGAINST REPEATED HEAVY METAL CONTAMINATION EVENTS

Aritz Burges, Derio - Spain

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SHORT AND LONG TERM EFFECTS OF IRRIGATION WITH TREATED WASTEWATER ON SOIL MICROBIAL COMMUNITY STRUCTURE AND FUNCTION

Dror Minz, Bet Dagan - Israel

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SIGNIFICANCE OF ABIOTIC AND BIOTIC PARAMETERS ACROSS MICRO- AND MACRO-NICHE GRADIENTS. THE SPECIAL CASE OF GYPSUM DOMINATED SOILS.

Adrian Unc, Las Cruces, New Mexico - United States

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SOIL AND CROP RESPONSES IN LEGUME/BARLEY INTERCROPPED SYSTEMS

Antonio Gelsomino, Reggio Calabria - Italy

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SOIL COMPACTION IN TEMPERATE FOREST SOILS INDUCES METHANOGENIC ARCHAEA AND METHANE EMISSIONS

Beat Frey, Birmensdorf - Switzerland

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SOIL ENZYMOMICS: WHAT CAN BE DONE NOWADAYS?

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SOIL FAUNA AS A FOREST SOIL QUALITY INDEX

Ewa Blonska, Krakow - Poland

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SOIL FUNCTIONAL DIVERSITY: DO CLPP AND ENZYMES TARGET THE SAME MICROBIAL PROCESSES?

M. Cristina Moscatelli, Viterbo - Italy

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SOIL PROTEOMICS: INTERFERENCE OF SOIL SOLID PHASES ASSESSED BY MODEL STUDIES

Giancarlo Renella, Florence - Italy

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SPATIO-TEMPORAL CHANGES OF SOIL ALGAE AND ITS REFLECTION BY VIS-NIR SPECTROSCOPY OF THE SOIL

Marie I. Ludwig, Trier - Germany

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STRESS TOLERANCE ASSAYS AND GENETIC DIVERSITY OF SINORHIZOBIUM MELILOTI FIELD POPULATION

Sanja Sikora, Zagreb - Croatia

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THE EFFECT OF FERTILIZER ON THE ABUNDANCE AND DIVERSITY OF FUSARIUM SPP. IN SOYBEAN FIELD

Xu Yanli, Harbin - China

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THE FATE AND ECOLOGICAL RELEVANCE OF EXTRACELLULAR DNA IN SOIL

Giacomo Pietramellara, Florence - Italy

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UNRAVELLING SOIL FUNGAL COMMUNITIES FROM DIFFERENT MEDITERRANEAN LAND-USE BACKGROUNDS

Erica Lumini, Torino - Italy



S11.02-P -1

A STUDY ON THE RELATIONSHIPS BETWEEN SOIL MESOFAUNA AND SCLEROTIA IN LOW PH FOREST SOILS OF JAPAN

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Mesofauna occupy all trophic levels within the soil food web and affect primary production directly by root feeding and indirectly through their contribution to decomposition and nutrient mineralization (Coleman, et.al., 2004). Soil mesofauna are often categorized by specific feeding behaviours, often depicted as microbial feeders (Ruessand, et.al., 2005). This study aimed to describe the relationship between mesofauna and sclerotia, the resting bodies of mainly fungal ectomycorrhizal species, in the low pH forest soils. Nine repeats of soil samples were collected from Fagus forest in Nagano, Akita and Aomori prefectures, Japan, during July – August 2011. Litter and humic layers within a 20x20cm plot were weighed in the field while A horizons for mesofauna collection and soil analysis were collected using a cylinder with the volume of 400cm³ and 800cm³, respectively. Soils in A horizons were collected within 10cm in depth. Soil mesofauna were collected using modified Tullgren method for 7x24 hours under a 5 watt light bulb, kept in a constant 24°C room temperature. The mesofauna found were species from Acari, Collembola, Coleoptera, Diptera, Diplopoda, Chilopoda, Symphyla, Nematoda, and Hymenoptera. Acari showed the highest relative abundance followed by Collembola and Coleoptera. Sclerotia were spherical black with an approximate diameter range of 0.5–1.5mm, and an average density of 1.5 gkg⁻¹ soil. The sites with most abundant Acari were followed by the lowest abundance of Collembola and sclerotia, while the site with lowest abundance of Acari was where the highest abundance of Collembola and medium amount of sclerotia were found.



S11.02-P -2

ARBUSCULAR MYCORRHIZAL FUNGAL COMMUNITIES IN THE HYPOXIC SOILS OF NATURAL CO₂ SPRINGS

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Natural CO₂ springs (mofettes) are specific and extreme ecosystems, characterized by high soil CO₂ and reduced soil O₂ concentrations, leading to a locally hypoxic environment. This leads to a long-term abiotic selection pressure which changes both above-ground plant and below-ground microbial communities. Arbuscular mycorrhizas (AM) represent the most widespread terrestrial symbiosis and play central roles in terrestrial ecosystem functions, yet information on AM fungal communities from mofette areas is limited. The quantification of AM fungal root communities sampled in the Stavešinci mofette area (NE Slovenia), confirmed the presence of unique AM fungal communities across a range of soil CO₂ concentrations. Here we examine whether AM fungal phylotypes, unique to locations with high CO₂ concentrations, are local specialists or widespread generalists, able to tolerate a range of different soil conditions. In addition we investigated AM fungal community interactions with host plants and abiotic soil factors under this extreme environmental stress (hypoxia). Results show that some fungi are more strongly associated with local variations in the soil environment, particularly hypoxia, than with the distribution of their host plants, confirming previous work.



S11.02-P -3

BIOCHEMICAL POTENTIAL AND MOLECULAR IDENTIFICATION OF MICROORGANISMS ISOLATED FROM SOIL AND DIFFERENT ORGANIC WASTES

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The present research was conducted to find out the utilization effect of microorganism that may be likely adapted for the hydrolysis in first methane fermentation stage. For this purpose different habitats like soil, dairy sewage sludge and fruit wastes were screened, using selective media. Our aim was to isolate microorganisms that are capable of complex organic compounds decomposition into simple ones with production of such enzymes as: amylase, protease, pectinase and cellulase. Followed the most numerous c.f.u.'s nine hydrolytically effective strains of bacteria, moulds and yeast were tested. Additionally a rapid method for the microbial cellulases detection was conducted on agar plates medium (2% cellulose) using Gram's iodine during five days culture. Biochemical potential using BIOLOGTM system was evaluated with FF plates for fungi, YT and GEN-III for yeast and bacteria species, respectively. Molecular identification using comparative rDNA sequencing was carried out, comparing the LSU-D2 region for fungi and 16S rDNA fragments for bacterial strains. The Microseq-ID software was used for performing sequence matching and creating Neighbor-Joining trees. The genetically identified strains belonged to the genus: Aeromonas, Morganella, Leuconostoc, Aspergillus, Candida and Pichia. Individual strains varied in their ability to attack various C-source substrates in appropriate Biolog Plates, and presented potential efficiency in decaying cellulose. Its biochemical characterisation indicated that all of presented strains may play a role as a decomposers of different materials, and may be useful in organic wastes degradation process. Scientific work was funded from the budget for science by National Centre of Research and Development in Poland.



S11.02-P -4

COMMUNITY STRUCTURE OF SOIL NEMATODES IN SOYBEAN AND CORN FIELDS UNDER LONG-TERM CROP ROTATION SYSTEM

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Soil nematodes were the richness invertebrate and widely distribute in the soil. Soil nematode community structure was detected in a long-term crop rotation system at National Observation Station of Hailun Agroecology System, Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences. In soybean-wheat-corn rotation system (SWC), total of 35 genus nematodes were found in soybean field and in maize field. In the continuous cropping system, total of 33 genera were found in soybean field and 37 genera were found in corn field. In soybean-corn rotation system (SC) total of 40 genus nematodes were found in soybean field and 39 genera were found in corn field. Bacterivores were dominant trophic group, plant parasites were the second and fungivores were the third trophic group, and omnivores- predators were the least trophic group in all cropping system. In soybean field, the fungivores were higher in soybean rotation system than in soybean continuous system. The bacterivores were higher in continuous cropping system than in soybean rotation system at the early growing stage. The plant parasites were higher in soybean continuous cropping than in soybean rotation system. In corn field, the fungivores were not changed with the crop rotation systems; the bacterivores were higher in soybean-corn rotation system than in corn continuous cropping; plant parasites were highest in soybean-corn rotation system. Key words: Corn, Community structure, Soil nematodes, Soybean



S11.02-P -5

DEVELOPMENT OF A TARGETED PROTEOMICS APPROACH FOR MEASUREMENT OF GLYCOSIDE HYDROLASE FUNCTIONAL REDUNDANCY IN SOILS

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We are developing a targeted proteomics approach for measuring the functional redundancy of glycoside hydrolases (GHs) present in the soil environment. A key component of this approach includes the use of activity-based probes (ABPs). An ABP includes a substrate analog designed to target the enzyme active site, a chemical specificity moiety that directs the probe toward a particular enzyme family, and a reporter tag for providing feedback on probe-labeled enzymes. Reporter tags may include biotin, or click chemistry handles such as azides or acetylenes. Bound enzymes can either be extracted with the complex proteome and visualized using SDS-PAGE, or enriched from the complex proteome and analyzed using high-resolution mass spectrometry. We have synthesized a suite of thirteen probes designed for GHs with an anticipated specificity for enzymes involved in cellulose deconstruction, i.e. beta-1,4-endoglucanases [EC 3.2.1.4], exoglucanases/cellobiohydrolase [EC 3.2.1.74(91)], and beta-glucosidase [EC 3.2.1.21]. Initial tests outside the soil environment using commercially available GHs, and model cellulose degrading microorganisms indicate that while each probe varies in its specificity (labeling of a single CAZy GH sub-class to multiple CAZy GH sub-classes) almost all exhibit an affinity for enzymes that cleave beta-glycosidic bonds. The labeling of GHs, spiked to different soils has been undertaken with success, and the demonstration of these ABPs for labeling native GHs in soils is currently being evaluated. Ultimately, the measurement of GH redundancy using this capability will be used to study the role of functional redundancy in the stability of a key process in the carbon cycle.



S11.02-P -6

**EARTHWORM AND COVER CROPS CONTRIBUTION TO ENHANCE SOIL ORGANIC MATTER
IN NOTILLAGE SOYBEAN PRODUCTION IN JAPAN**

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Cover crops and no-tillage farming may be effective tools for ensuring sustainable agriculture and eco-system service; because these soil management strategies increase soil organic matter and improve soil biological diversities and activities in intensively managed summer field cropping system. To investigate the abilities of earthworm and cover crops to improve soil organic matter and crop growth response in no-till condition, a three year field research was carried out in Ibaraki, Japan. The experimental was a split plot randomized complete block design with four replications consisting of cover crop species [winter fallow, hairy vetch (*Vicia villosa* Roth), and rye (*Secale cereale* L.)] and earthworm introduction in no-till upland rice and soybean production from 2007 until 2009. Cover crop biomass were significantly higher in rye (Ave.= 7.95 Mg ha⁻¹) compared with hairy vetch (Ave.= 3.56 Mg ha⁻¹), however, fallow showed lowest biomass (Ave. = 0.263 Mg ha⁻¹). Earthworm introduction was successful in both of rye and hairy vetch although the earthworm survival ratios were relatively low in all treatment. Soil bone nitrate was highest in earthworm introduction plots during April to August; however these differences were disappeared after September. Soybean yields were significantly higher in earthworm introduction plots although the year differences were observed. Soil organic matter contents significantly higher in cover crop with earthworm introduction compared with winter fallow plots. These results suggesting cover crop and earthworm introduction to crop land have high potential to improve soil organic matter and enhance nutrient cycle under the low input crop production system.



S11.02-P -7

EFFECT OF LARGE SCALE PRODUCTION OF ENERGY CROPS ON FUNGAL COMMUNITY IN TOPSOIL LAYER

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Soil microorganisms are very important group of soil biota in soil ecosystems. Especially some microscopic fungi in soil ecosystem are able to utilize indecomposable organic matter e. g. lignin, cellulose or chitin. This contribution explore effect of large scale production of some energetic crops on composition of cultivable fungal communities and PLFA –(phospholipid fatty acid) content and composition. We conducted two studies in first we compare (*Rumex acetosa*-2 years old plots and 10 years old plots), compared to *Brassica napus* and cultural meadow. In second study we focused on effect of large scale production of native (*Salix viminalis*, *Phalaris arundinacea*) and introduced (*Helianthus tuberosus*, *Reynoutria sachalinensis*, and *Silphium perfoliatum*) energy crops with comparison to cultural meadow. Study was performed in split plot field experiment of Crop Research Institute in town Chomutov (Czech Republic). In second study we studied also cellulose decomposition (using litter bags). We found statistical significant difference of soil microbial respiration among field sites planted by introduced (*Silphium perfoliatum*, *Helianthus tuberosus* and *Reynoutria sachalinensis*) energy crops with comparison to native (*Salix viminalis*, and *Phalaris arundinacea*) energy crops. Total organic Carbon did not showed any significant difference among field sites planted by used energy crops. PLFA assay did not showed statistical significant difference between used energy crops. Field sites planted by various energy crops were colonized different soil fungi, but all field were dominated by *Cladosporium* and *Penicillium* genera. *Rumex* fields contain more phytoparasitic fungi compared to the other plots.



S11.02-P -8

EFFECT OF RAINFALL-INDUCED SOIL GEOCHEMISTRY DYNAMICS ON GRASSLAND SOIL MICROBIAL COMMUNITIES

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In a Mediterranean grassland ecosystem, the timing of rainfall events controls biogeochemical cycles as well as phenology and productivity of plants and animals. Here, we monitor changes in soil chemical and nutritional conditions during a natural wetting-drying episode to identify changes in soil microbial community structure. Soil samples were collected from a meadow in Northern California at four time points after the first two rainfall events of the rainy season. We used the 16S rRNA microarrays (PhyloChip) to track changes in bacterial and archaeal community composition. Microbial communities at time points one and three were significantly different than communities at time points two and four. Based on ordination analysis, available carbon, soil moisture, temperature, ammonium and pH explained most of the variation in community structure. A complementary approach using linear regression (LR) and generalized logical networks (GLN) were used to identify linear and non-linear associations among environmental variables and the relative abundance of sub-families. Soil moisture, temperature and available carbon correlated with the relative abundance of many sub-families within the Actinobacteria, Acidobacteria, Proteobacteria, Bacteroidetes, Firmicutes, Cyanobacteria, Chloroflexi and Verrucomicrobia. Only the phylum Actinobacteria showed a lineage specific relationship to soil moisture but not carbon or nitrogen, suggesting that the use of high taxonomic rank as nutritional indicators might need further investigation.



S11.02-P -9

EFFECTS OF CONSERVATIVE PRACTICES ON BACTERIAL DIVERSITY AND DENITRIFYING GENES EXPRESSION IN INTENSIVE AGRICULTURE

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Conservative farming practices, such as no-tillage, crops rotation, and balanced fertilization are increasingly adopted for maintaining soil fertility, improving crops health, and reducing soil erosion. Shifting tillage practices from the traditional moldboard plow to no-tillage also contributes in mitigating climate changes by increasing carbon soil sink. However, in certain circumstances such as in poorly aerated soils, no tillage and N fertilization may increase N₂O emissions, with serious implications for loss of fertility and global warming. Bacteria are crucial drivers of agro-ecosystem functioning and may receive benefits from conservative practices because of a reduction in soil disturbance and a higher availability of organic substrates. In this study we have tested the hypothesis that the use of conservative practices might influence the composition and diversity of active soil bacterial community. The active bacterial community and those involved in denitrification process were analysed in a long-term field trial in which conservative and conventional agricultural systems were compared. Bacterial diversity was evaluated by PCR-denaturing gradient gel electrophoresis (DGGE) exploiting 16rRNA of bacteria and nirK, nirS and nosZ transcripts of denitrifiers. Moreover, a canonical correspondence analysis (CCA) was used to correlate DGGE analyses with edaphic variables. The highest values of bacterial richness and diversity were found in soil samples from no-tillage and N-fertilized thesis while the highest genetic diversity was found in the most conservative thesis with no tillage and without N fertilization. CCA analysis showed the soil parameters that may influence the composition and diversity of denitrifying bacterial community.



S11.02-P -10

EFFECTS OF OLIVE OIL PRODUCTION WASTEWATER ON SOIL ARTHROPODS IN TWO DIFFERENT CULTIVATION SCENARIOS IN ISRAEL AND PALESTINE

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During the three-phase olive oil extraction process, large quantities of olive oil production wastewater (OPWW) accrue and are often disposed into the environment. Wastewater treatment plants do not accept OPWW because it interferes with microbiological processes during water treatment. Deterioration of natural environmental conditions results due to the fact that OPWW is acidic, has an extremely high chemical and biological oxygen demand, high concentrations of fats, oil and greases and furthermore contains polyphenols. On the other hand, OPWW contains fertilizers and could represent a valuable soil amendment if a controlled application would take place. This study investigates the effects of a controlled OPWW application in two contrary managed olive orchards in Beit Rima (Palestine Authorities) and Be'er Sheva (Israel) on soil arthropods. In Beit Rima an extensive agriculture with no irrigation dominates whereas the olive orchard in Be'er Sheva is characterized through irrigation and high-density planting. In both scenarios soil arthropods are expected to serve as a proxy for soil performance and ecosystem structure. Effects of OPWW application on soil arthropod diversity were investigated via Berlese-Tullgren extraction. Additionally soil samples were analyzed for soil parameters such as organic carbon content and soil texture. The identification of the individuals and statistical analysis of the community composition will provide estimates of effects of different controlled OPWW application scenarios. The results will increase the knowledge for the design of optimized OPWW disposal techniques as well as the development of OPWW application to agriculture by using the benefits of OPWW without suffering the risks.



S11.02-P -11

EXPLORING THE CADMIUM “SYMPATHIZER” BACTERIA THROUGH A SOIL METAGENOME APPROACH.

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*With the advent of metagenomic studies and of next generation sequencing technologies, one of the most elusive, but ecologically highly relevant for biosphere functioning, topics of microbial ecology, the study of the relationships between taxonomic structure and functioning of a microbial community could be addressed at the single-gene detail. In particular in industrialised countries, contamination of soil with trace metals deriving from industrial and mining activities is posing serious concerns, related to human health and land use for agriculture and urbanisation. It is consequently urgent to apply metagenomic approaches to derive models of behaviour (at taxonomic and functioning level) of soil impacted by trace metals contamination, together with the identification of gene functions potentially involved, at the whole community level, in counteracting the toxic effect of trace metals, thus help maintaining soil functionality. Here, we describe the results obtained from a clear tube lysimeter experiment in which a noncontaminated native soil was spiked with Cd solution. The goal was to increase our understanding of taxonomic and single-gene response to this ecological challenge. The cadmium “sympathizer” bacterial population within the complex soil community is analyzed by a metagenomic approach, including 16S library analysis and whole environmental DNA sequencing by using Illumina technology. A complementation library in *E. coli* host for identifying genes related to Cd tolerance was also prepared.*



S11.02-P -12

GENOME SEQUENCING OF TWO EXOELECTROGENIC BACTERIA ISOLATED FROM SOIL AND ASSESSMENT OF THEIR METABOLIC PROFILE BY MEANS OF PHENOTYPE MICROARRAYS

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The increasing demand for clean, economic and sustainable energy has recently led the major industrialized countries to invest huge resources for alternative energies. Microbial Fuel Cells (MFCs), that generate electricity directly through the catalytic oxidation of organic matter, are having a lot of interest. The process is made possible by the presence of the so-called "exoelectrogenic" bacteria which are commonly spread within the soil. The objective of this work was the selection and characterization of exoelectrogenic bacteria from both soil (S) and an organic fertilizer (A) through the use of Microbial Fuel Cells (MFCs). At the end of incubation Denaturing Gradient Gel Electrophoresis (DGGE) analysis revealed a significant alteration of the total eubacterial community structure and the consumption of organic carbon (TOC) increased in MFCs with current. The genetic diversity of culturable bacterial communities was assessed by Random Amplified Polymorphic DNA analysis (RAPD) of 106 bacterial isolates obtained both under aerobic and anaerobic conditions, and the 16S rRNA gene sequencing of their representative groups has indicated that over 50.4% of isolates from MFCs fed with S were Proteobacteria, 25.1% Firmicutes and 24.5% Actinobacteria, whereas in the MFCs inoculated with A the dominant species belonged 100% to Proteobacteria. The most representative haplotypes were electrically assessed by using "test-tubes" and cyclic voltammetry (CV) and the entire genomes of two of the most efficient exoelectrogenic strains, Enterobacter sp. and Pseudomonas geniculata, were sequenced. Finally they were metabolically characterized by means of Phenotype Microarrays. The correlation between genomic and phenotypic profiles will be discussed.



S11.02-P -13

GENOMIC AND TRANSCRIPTOMIC TOOLS TO REVEAL THE IMPACT OF LAND USE ON BACTERIAL β -GLUCOSIDASE DIVERSITY AND EXPRESSION

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Contrasting management practices were evaluated in a 30-year trial with rainfed olive orchards in semiarid Mediterranean region. Genomic and transcriptomic approaches were used to gain insight into the relationship between soil management and bacterial β -glucosidase function. The potential transcription (DNA-based q PCR) did not reveal the real transcription (RNA-based qPCR) of β -glucosidase genes, pointing towards RNA-based method providing more constructive information. The study of bacterial β -glucosidase molecular diversity by Denaturing Gradient Gel Electrophoresis fingerprinting evidenced a clear effect of land use on the molecular diversity of β -glucosidase genes. Molecular diversity and expression of bacterial β -glucosidase genes have been found to be a function of soil management.



S11.02-P -14

GLOMALIN-RELATED SOIL PROTEIN AND ITS IMPORTANCE IN ALUMINIUM EXCLUSION MECHANISM OF PLANTS GROWING IN ACID SOILS

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Aluminium (Al) phytotoxicity in acid soils represents a major limitation to crop production. Glomalin-Related Soil Protein (GRSP), a glycoprotein produced by arbuscular mycorrhizal fungi (AMF) would have the capacity to immobilize important quantities of metals as such Al. The aim of this work is to discuss some results related with the role played by GRSP in the exclusion of aluminium (Al) phytotoxic by AMF colonized roots. A soil experiment (SE) was performed with Al- tolerant wheat (*Triticum aestivum* L.) and barley (*Hordeum vulgare* L.) cultivars under greenhouse conditions at two Al saturations levels. Moreover, AMF communities from four vegetative succession gradients, Bare, Edge, Sward and Tree, were isolated on an abandoned coalmine in West Virginia, USA, and a soil-less experiment (SLE) was carried out with *Andropogon virginicus* inoculated with these AMF communities at two Al levels. In SE, the GRSP production was higher in cultivars more Al tolerant that showed better development when they were exposed at high Al saturation. In SLE, the higher GRSP production was observed in Edge and Sward treatments where apparently AMF community is more Al tolerant. In both SE and SLE experiment Al bound to GRSP (Al-GRSP) was higher when it was produced in the soil with greater Al levels. Finally, the GRSP showed its ability to sequester Al in the molecule by means of confocal laser scanning microscopy (CLSM), suggesting that GRSP could form stable complexes with Al, representing a important external AMF mechanism to be taken into account for reducing the Al toxicity.



S11.02-P -15

GRASSLAND DIVERSITY RESTORATION ON EX-ARABLE LAND BY SOIL INOCULATIONS

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Ex-arable land can be used for the restoration of species-rich grasslands and can thereby help the conservation of biodiversity. Restoration is hampered by the absence of target plant seeds, high residual soil fertility and altered soil communities. Top soil removal and seed additions can solve some of these constraints, but restoring beneficial biotic soil conditions remains a challenge. In this study we tested whether inoculation of soil from secondary succession grasslands in arable receptor soil enhances performance of late successional plants and whether its impact depends on top soil removal or not. Mixtures of late successional plants were grown in arable top soil or in underlying mineral soil mixed with donor soil that was collected grasslands that had been under restoration for 5 to 41 years, or from semi-natural grassland. Donor soil addition increased plant community biomass especially when collected from older sites. In contrast, addition of soil from semi-natural grassland promoted plant community evenness, and hence its diversity, but reduced community biomass. Effects of donor soil additions were stronger in mineral than in top soil. Plant community composition related strongly to the abundances of nematodes, ergosterol concentration and soil pH. We found that inoculation of soil from late secondary succession grassland into ex-arable land can strongly promote target plant species, and that the role of soil biota in promoting target plant species is greatest when added after top soil is removed. Soil transplantations may thus be a tool for grassland restoration provided that biodiverse soil is applied.



S11.02-P -16

IMPACT OF DIFFERENT LAND USES ON SOIL BIOLOGICAL AND BIOCHEMICAL PROPERTIES: SALIX SHORT ROTATION COPPICE COMPARED WITH INTENSIVE AGRICULTURAL SYSTEM, GRASS STRIPS AND ALLUVIAL FOREST.

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The Short Rotation Coppice (SRC) of willows is a technique developed recently. References on its impacts on soil properties are scarce. The successive harvests every three years are likely to remove nutrient resources and modify soil functioning. This study aimed to evaluate biological and biochemical parameters which can be affected and can be used as indicators of soil quality. Soil samplings were done on homogeneous soil of the Aisne valley (France) where four land uses are performed: plots planted with SRC in 2006 and the neighbouring systems: intensive crop, grass strips and alluvial forest. Soil characteristics were measured (organic matter, cation exchange capacity, C/N, available phosphorus etc...) and biological variables: earthworms diversity, density and biomass, microbial community structures: 16S and 18S rRNA genes for bacterial and fungal communities; arbuscular mycorrhizal fungi, 18S/16S ratio, enzymatic activities and basal respiration. Results showed that C/N, laccase, phosphatase activities and 18S/16S gene copy number were positively correlated and were higher in SRC and alluvial forest systems suggesting an evolution of SRC towards forest systems. Earthworm biomass, cellulase and FDA activities were also positively correlated and have larger values in grass strips and forest where organic matter contents are higher. Multivariate analysis showed that Salix SRC, in short term, improved soil parameters compared with intensive wheat crop. It improve organic matter quality, phosphatase, laccase activities, fungal, earthworms diversity and finally essential soil parameters. Selection of indicators to better define impact and modeling can be developed. Key words: SRC, Biological indicators, Land use.



S11.02-P -17

ISOLATION, IDENTIFICATION AND SCREENING OF CELLULOLYTIC MICROORGANISMS FROM SOIL AND ORGANIC WASTE

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Cellulose degradation and its subsequent utilization is important for global carbon sources. The value of cellulose as a renewable energy source has made hydrolysis of this compound the subject of intense research and industrial interest. The aim of the study was evaluation of cellulolytic potential of microorganisms isolated from different environments. Microorganisms were isolated from soil, corn silage and fruit processing waste. The bacteria and fungi were cultured on agar medium with appropriate soil or waste extract and Martin medium, respectively. Screening of cellulose producers was done on minimal medium with 2% of cellulose addition. After plates inoculation, these were incubated at 26°C for 120 hours and flooded with Gram's iodine for every 24 hours and the zone of clearance around the colony were observed and measured. Microorganisms identification was done using sequencing analysis (MicroSEQ) with universal primers for bacteria (16S-rDNA) and fungi (D2-LSU). Metabolic characterization of microorganisms was done using BIOLOGTM system. The plates GEN-III and FF were used respectively for bacteria and fungi characterization. The metabolic pattern of particular guilds group (carbohydrates, amino acids, amines and amides, carboxylic acids, polymers and miscellaneous) was assessed for all microorganisms. Molecular identification indicated that investigated microorganisms belonged to the following bacteria and fungi genus: *Bacillus*, *Brevibacillus*, *Mucor*, *Fusarium*, *Aspergillus*, *Trichoderma* and *Penicillium*. Tested strains have potential in degradation of cellulolytic compounds, which could be useful in the first stage of methane fermentation process. Scientific work was funded from the budget for science by National Centre of Research and Development in Poland.



S11.02-P -18

LITHOLOGICAL CONTROL ON SOIL CHEMISTRY AND MICROBIAL DIVERSITY

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The geological diversity of Northern Ireland provides a unique opportunity to investigate the effects of differing lithologies on the geochemistry of overlying soils. This will increase our understanding of how lithology influences the microbial populations within the soil and their role in biochemical cycling. Whilst several factors contribute to the properties of developing soils, source rock is a major control in determining chemistry and formation rate. The array of geological ages and formations within Northern Ireland occurs over a relatively small area. When this is combined with the glacial history of the British-Irish ice sheet during the last glacial maximum, any soils present now will all be of the same age and have undergone the same climatic conditions. The Tellus project, an intense high resolution geochemical mapping study which analysed soil samples across Northern Ireland, has been utilised to select sites of potential interest where specific elements occur in high concentrations and evidence of anthropogenic activity is limited. There are several components to this interdisciplinary study; one of which is the chemical analysis, of inorganic and organic constituents throughout the depth profile. This has been undertaken upon soils from varying lithologies (Paleogene basalts, Devonian sandstones and Carboniferous limestones). The study also includes biological assessment in the form of DNA profiling techniques and lab based microcosm experiments using soils obtained from the field. This will enable a thorough investigation of the microbial communities present which will identify microbial diversity arising from differences in lithology through the soil profile.



S11.02-P -19

MICROARTHROPOD AND CILIATED PROTOZOA SOIL COMMUNITIES IN SIX CENTRAL ITALIAN BEECH FORESTS

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Edaphic fauna play a key role in many soil functions such as organic matter decomposition, humus formation and nutrient elements cycling; moreover, they affect the porosity, aeration, infiltration and distribution of organic matter in soil horizons, modifying soil structure and improving soil fertility. In this study, six beech forests located in three areas of the centre of the Italian Apennine were studied to evaluate the microarthropod and ciliate communities, in order to evaluate their potential as a soil biodiversity reservoir. Microarthropod abundances, Acari/Collembola ratio, biodiversity indices and QBS-ar index were calculated. Microarthropod communities were found to be rich and well diversified in all of the six beech forests, characterized by typical groups generally present in woods with good natural conditions. The number of taxa ranged between 10 and 14 in the six forests and in all sites important groups such as Symphyla, Chilopoda, Pauropoda and Protura were present. Pseudoscorpiones were found in four forests while Isopoda were present only in two forests. Ciliate communities were investigated by means of qualitative and quantitative methods. Abundance, dominance, species diversity and C/P quotient (ratio of r-selected colpodean and k-selected polyhymenophorean ciliates) were calculated. A total of 27 ciliate species belonging to 10 order, 14 families and 17 genera were recorded from three sites. Colpoda, Gonostomum and Spathidium were the dominant genus. Species richness ranged from 13 to 16 for all the sites. Biological quality and edaphic community composition highlighted the importance of beech forests in the protection policy of soil biodiversity.



S11.02-P -20

NEMATOFAUNA STUDY FOR SOIL MONITORING, RISK ASSESSMENT AND SOIL CHARACTERIZATION. RESULTS FROM THE FRENCH NATIONAL "BIOINDICATORS PROGRAMME."

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In this poster will be presented the main results concerning soil nematofauna analysis of the French "BioIndicator programme" in which many different biological parameters have been tested i.e. soil fauna: nematodes, collembola, mites, earthworms, total macrofauna but also microorganisms, micro-mammifers and flora. Nematode abundances (density of obligate plant-feeders, facultative plant-feeders, bacterial-feeders, fungal-feeders, omnivores and predators), nematological indices (MI, PPI, SI, EI, NCR) as well as nematode community structure were assessed on 13 sites leading in 47 plots which differ in terms of land use and agricultural practices (e.g. pasture rotation, tillage impact, management), soil type and contamination origin (PAH or metal) and pollution levels.



S11.02-P -21

PLFA EXTRACTION – PROBLEMS ASSOCIATED WITH THE PREPARATION OF SOIL SAMPLES WITH UNKNOWN WATER CONTENT AND THE EFFECT OF FREEZE DRYING

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In expensive ¹³C labeling experiments, the amount of soil for phospholipid fatty acid (PLFA) extraction is limited and in many cases no additional soil for the determination of the soil water content is available. When conducting ¹³C PLFA analysis under this situation, questions are raised concerning the effects of wrongly calculated Bligh & Dyer (B&D) extraction solution and freeze drying as an alternative preparation step on the extraction capacity. In a test experiment we incubated 3 different agricultural soils at a water holding capacity of 70% and took samples after 8 incubation days. These samples were frozen and extracted with a B&D solution corrected for the soil water content and an uncorrected B&D solution, and freeze dried and extracted by the original B&D solution. In one soil, fresh samples were also analyzed. In all three soils freeze drying increased extractable PLFAs, but only a few PLFAs were significantly elevated. In fresh soil generally less PLFAs were extracted than in frozen or freeze dried soil, but again only a few were significantly affected. Using uncorrected B&D solution did not alter extractability significantly. Interestingly, freeze drying affected the composition of PLFAs extracted, with significantly higher extraction capacities for 17:0, 15:0 and i15:0 in 2 soils. To avoid problems associated with sample preparation, we propose to use only one technique within one experiment. Freeze drying enables the determination of the water content and extraction of PLFAs within the same sample and might be the preferred preparation method for small sample amounts.



S11.02-P -22

**PRELIMINARY INVESTIGATION ON THE MICROBIAL AND GENETIC SOIL DIVERSITY:
EFFECT OF PEDOGENIC SUBSTRATE**

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The biological functions of soil, mainly guaranteed by the activity of microbial communities, are influenced by the interaction between the type of covering and the soil type. This study will focus on the influence of different soil substrate against the composition of ecosystem services and activities of the microbial community in natural forest ecosystems. Three systems have the same covering (Quercus cerris) and similar topographic conditions but with a different pedogenic substrate (Andosol, Entisol, Inceptisol). The sampling was carried out in 2009 in three different natural reservation of Central Italy (Selva di Meana, Rufeno Mountain, Lake of Vico) at a depth of 0-20cm horizon A. The functional diversity was determined by studying the physiological impression of microbial communities (CLPP) through the use of the MicroResp. Microbial molecular biodiversity represent the core of the activity planned in second part of this study: T-RFLP analysis is the molecular approach chosen in this study. The method quantifies sequence variability in small-subunit (16S) ribosomal DNA extracted from soil, producing a DNA “fingerprint” for each bacterial community based on the length and abundance of unique phylotypes from each soil sample. As a results a set o visible band is produced for a microbial community. Each visible band (i.e. peak corresponding to different fragments) represents a single operational taxonomic unit or ribotype. Comparison of bands permits the comparison of microbial communities. The possible presence of polymorphisms allows to further characterize microorganisms of interest in this background (or their background) and represent an innovative biotechnological application.



S11.02-P -23

**QUANTIFYING CARBON ROUTING FROM MAIZE INTO BACTERIAL AND FUNGAL BIOMASS
IN AN AGRO-ECOSYSTEM**

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Using the shift in carbon (C) stable isotope values associated with replacing C3 by C4 plants we followed root- vs. shoot litter-derived C resources into different soil C pools. We established the following treatments: Corn Maize (CM), Fodder Maize (FM), Wheat + maize Litter (WL) and Wheat (W) as reference. The Corn Maize treatment provided root- as well as shoot litter-derived C (without corn cobs) whereas Fodder Maize (FM) provided only root-derived C (aboveground shoot material was removed). Maize shoot litter was applied on the Wheat + maize Litter (WL) plots to trace the incorporation of C4 litter C into soil microorganisms. Maize-derived C signal was detectable after three to six months in the following pools: soil organic C (Corg), extractable organic C (EOC), microbial biomass (Cmic) and fungal biomass (ergosterol). Similar amounts were incorporated into each of the C pools in the FM and WL treatments, indicating greater importance of the root- than shoot-derived resources for the belowground food web. In the CM plots twice as much maize-derived C was incorporated into the pools. After two years, maize-derived C in the CM treatment contributed 14.1, 24.7, 46.6 and 76.2 % to Corg, EOC, Cmic and ergosterol pools, respectively. Fungi incorporated maize-derived C to a greater extent than did total soil microbial biomass, suggesting that the fungal based energy channel dominated over the bacterial one. Overall, our results suggest that C from both above- and belowground residues of maize is channelled predominantly via fungi into higher trophic levels.



S11.02-P -24

RESIDUAL EFFECT OF DE-OILED OLIVE MILL WASTE AMENDMENT ON ENZYME ACTIVITIES IN A DEGRADED MEDITERRANEAN SOIL UNDER FIELD CONDITIONS

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Alperujo is a by-product of the olive mill industry that is produced in large amounts in Mediterranean countries. After drying, it is generally subjected to a further process of chemical extraction leaving a solid residue, de-oiled olive mill waste (DW). Because DW has a high organic matter content, its recycling as an organic amendment or fertilizer is promising for farming practice. The aim of this study was to determine the residual effect of fresh DW amendment on enzyme activities (dehydrogenase, β -glucosidase, urease, phosphatase, and arylsulfatase) in a degraded Mediterranean soil under long-term field conditions. The soil was amended with DW at rates of 0, 27, and 54 Mg ha⁻¹, dry weight equivalent, for eight years, with residual effects being assessed two years after the last application. Although the results were quantitatively different from those obtained previously in evaluating the cumulative effect of DW amendment, none of the enzyme activities tested appeared to be negatively affected by the addition of this waste. On the contrary, they increased even with the higher DW application rates. Dehydrogenase activity in particular increased by about 19% and 44% at the 27 and 54 Mg ha⁻¹ DW rates, respectively, compared to the control, suggesting that fresh DW may not be toxic to soil microorganisms, at least at the application rates examined. The application of DW as an organic amendment hence would appear to effective as a farming practice to contribute to the maintenance of Mediterranean agricultural ecosystems by improving the soil's biochemical quality.



S11.02-P -25

SEARCHING FOR MICROBIAL INDICATORS OF SOIL STABILITY AGAINST REPEATED HEAVY METAL CONTAMINATION EVENTS

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Soil is a natural resource that provides multiple ecosystem services essential for the preservation of life on Earth; however, sources of environmental stress such as heavy metal contamination are jeopardizing the functioning of the soil ecosystem. This situation brings about the need of developing accurate methodologies for the assessment of soil health. The term of stability (which includes both resilience, the ability of the system to recover after a disturbance, and resistance, the system's ability to withstand shocks) refers to an emergent, most important attribute of the soil ecosystem. On the other hand, soil microbial communities are, to a great extent, responsible for the health of the soil ecosystem. In order to identify what microbial properties are more sensitive and informative regarding a specific soil's stability against repeated heavy metal contamination events, it was subjected to reiterated contamination with heavy metals: Cd, Pb, Cu, Zn and a combination of them. Over a period of several weeks, parameters of soil microbial activity (β -glucosidase, acid phosphatase and potentially mineralizable nitrogen), biomass (real-time PCR) and biodiversity (PCR-DGGE) were determined, as well as metal availability in soil. Although the first contamination event did not significantly affect the measured properties, subsequent metal applications surpassed the threshold of resistance of the soil ecosystem. The contamination-induced adverse consequences were greater in soils contaminated with a mixture of metals than when they were applied individually. It was concluded that soil microbial properties are valuable indicators of soil stability against repeated metal contamination events and, hence, of soil health.



S11.02-P -26

SHORT AND LONG TERM EFFECTS OF IRRIGATION WITH TREATED WASTEWATER ON SOIL MICROBIAL COMMUNITY STRUCTURE AND FUNCTION

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Irrigation with treated wastewater (TWW) is a common practice in many regions and will become even more important with the decline in available fresh water worldwide. TWW irrigation can be characterized by relatively high organic matter and various minerals concentration. The effects these characteristics have on soil properties and crops are well established. On the other hand, TWW effect on the soil microbial community has not yet been completely understood. We followed soil chemical parameters (pH, soil organic matter (SOM) and nitrogen), microbial activities and microbial community composition during several years of irrigation of two orchards with TWW vs. freshwater (FW) irrigation. Microbial activities assays include soil respiration rates (CO₂ emission), hydrolysis of macromolecules and potential nitrification. We used high throughput nucleic acid sequencing to determine bacterial community composition (using the 16s rRNA gene), the active bacterial community (using rRNA) and ammonia oxidizing bacteria (using the amoA gene). Seasonal shifts in microbial community structure and function were observed in both orchards and both water types. The results show that soil total bacterial community composition and ammonia oxidizing communities are affected by the irrigation with TWW only during irrigation season (summer). The community returned to steady state (similar to FW communities) during the rainy season (winter), in both experiments. On the other hand, total microbial community activity was affected by the irrigation type all year long in one experiment and not affected at all in the other. These changes were in correlation to seasonal changes in SOM in the soil.



S11.02-P -27

SIGNIFICANCE OF ABIOTIC AND BIOTIC PARAMETERS ACROSS MICRO- AND MACRO-NICHE GRADIENTS. THE SPECIAL CASE OF GYPSUM DOMINATED SOILS.

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Gypsiferous soils are soils that contain sufficient quantities of gypsum to interfere with plant growth. Pedogenic origin gypsum occurs under ustic, xeric and aridic moisture regimes. The White Sands region in Southern New Mexico, USA, at the northern edge of the Chihuahuan Desert is characterized by almost pure gypsum dunes interspersed with low laying inter-dune areas and playas. In these low laying areas superficial aquifers induce an udic regime. While overall plant density throughout the dunefields is sparse these low-lying areas allow vascular plants, algae, cyanobacteria, and microfauna to thrive. Microbial activity and diversity are believed to play key roles in the sustainability of the ecosystem. Seasonal, ephemeral precipitation and resulting low and variable nutrient inflow are followed by localized or generalized drought. This precipitation and nutrient flow regime, combined with the low water holding capacity of gypsiferous soils and rapid depletion of available nutrients, induces a succession of short, wet, likely copiotrophic periods followed by extended dry and oligotrophic stages. Superficial aquifers induce similarly variable gradients across depth. These extreme chemical and physical habitats require well-developed stress resistance mechanisms that usually impose significant energy costs and associated nutrient uptake and allocation kinetics that contribute to unique microbial diversity profiles and activity potentials. We present here a taxonomic, phylogenetic and functional diversity inventory of bacterial, fungal, nematode and microarthropod populations in the context of the spatially varied biotic and abiotic parameters including five to seven distinct microecological niches from these gypsiferous soils.



S11.02-P -28

SOIL AND CROP RESPONSES IN LEGUME/BARLEY INTERCROPPED SYSTEMS

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*In a modern agriculture, cropping systems are addressed to provide ecosystem services. Legume crops are known to contribute more to the farming system than simply the harvested part: they fix atmospheric nitrogen into chemical forms available for plant metabolism, they break the cycles of diseases that attack the major cereal crops, and they can replace other food, feed, fiber and fuel crop products that are imported from other countries. This work contributes to the European research programme "Legume Futures" (FP7, KBBE), aimed at delivering an improved understanding of the range of ecosystem services provided by legume-containing systems. The present study was focused on investigating the environmental effects (C and N cycling, soil bacterial diversity, weed control, N use efficiency) of farming systems based on legume/barley intercropping and grown in a Mediterranean environment. Six-row barley (*Hordeum vulgare* L.) cultivar was cultivated both in additive or replacement combination with pea (*Pisum sativum* L.) or faba bean (*Vicia faba* L.). Soil chemical (EC, TOC, TN, NH₄⁺-N, NO₃⁻-N, total soluble N, EON), biochemical (basal respiration, MBC and MBN, potentially mineralizable N, mineralization quotient), ecophysiological (qCO₂, MBC/TOC, qCO₂/TOC) variables and bacterial community molecular structure were monitored at three sampling times (tillering, flowering, harvest) over the growing cycle. The ecological services provided by intercropped legumes were also evaluated in terms of weed control and complementary use of soil nitrogen supply. Results show that even in the short-term legume/barley intercropping selectively affected biochemical variables linked to soil C cycling, and some related soil quality attributes.*



S11.02-P -29

SOIL COMPACTION IN TEMPERATE FOREST SOILS INDUCES METHANOGENIC ARCHAEA AND METHANE EMISSIONS

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Problems with soil compaction are widely distributed but tend to be most prevalent where heavy machinery is used in landfill sites, agriculture and forestry. Untimely trafficking with heavy machinery leads to irreversible damage of soil functions. Our goals were to investigate microbial community responses to compaction and to determine whether a relationship between soil physical and microbiological properties exists. To study the changes of the microbial community structures in a time course, trafficking experiments in forests were carried out to generate wheel tracks of different impact (low, moderate and severe). Soil samples obtained from compacted soil had a greater bulk density, decreased macropore space, a lower air porosity and water conductivity than uncompacted soil. These data were in accordance with changes in total bacterial community structures analysed by T-RFLP. Compacted soils also yielded higher denitrifying and methanogenic potentials than did uncompacted soils. Our results indicate that different morphologically classified wheel tracks can be characterized with bacterial community analysis and soil physical parameters. These basic data are important in respect to help regulators to define guidelines for impact of forest soils with heavy machinery from forest operations.



S11.02-P -30

SOIL ENZYMOMICS: WHAT CAN BE DONE NOWADAYS?

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Soil enzymomics is the “omics” that is necessary, together with genomics, transcriptomics, proteomics and metabolomics for a comprehensive understanding of soil biological processes. Only direct detection of enzyme confirms that the genetic information is effective in soil processes. Characterization of soil enzymes can be performed only if there is the possibility to extract them from soil and bring them in free solution in a simple, fast, selective (without interfering substances such as humic ones) and efficient way. Nowadays this is possible when a protein is used as a desorbant, which acts as a heteromolecular exchanger. To date this technique has demonstrated to be effective for several soil enzymes such as arylsulfatase, phosphomonoesterase, aminopeptidases, glucosidases and others. Enzymes in these soil extracts can be easily, quickly and cheaply quantified using microplates and fluorescent substrates with a throughput which is currently 10 times larger than traditional techniques. An even higher order of magnitude is possible when many enzymes are simultaneously detected using automated instrumentation. By contrast, determination of important properties, such as molecular weight and tertiary structure of enzymes directly extracted from soil, still remains a challenge.



S11.02-P -31

SOIL FAUNA AS A FOREST SOIL QUALITY INDEX

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Soil and processes occurring in it have essential significance for the conservation of productivity of the forest ecosystems. Animals inhabiting the soil and its surface play important role in these processes. In monitoring soil ecosystems, organisms are used more and more frequently because they show measurable morphological, anatomical and physiological changes occurring in the ecosystem in which they live. According to many authors a change in the number and diversity of organisms can be assumed as a biological indicator which will assess the functioning of the ecosystem. The aim of this study was the use of soil fauna in assessing the quality of forest soils, the influence of usage on soil properties. Test plots were located in central Poland and founded in different site conditions, the soils used in different ways (forest management stands and natural stands which are protected, the third part of the surface was devoid of trees as a result of blowdown). In soil samples the physical, physico-chemical and chemical properties were marked. In the samples with natural moisture the dehydrogenases and urease activity was marked. For determination of earthworms density manual sorting method was used supplemented with extraction in formalin. The density of earthworms was varied in the studied soil samples, similarly to enzymatic activity. The test parameters correlated with each other and the fundamental physical and chemical properties.



S11.02-P -32

SOIL FUNCTIONAL DIVERSITY: DO CLPP AND ENZYMES TARGET THE SAME MICROBIAL PROCESSES?

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Microbial functional diversity represents the sum of the ecological processes developed by the organisms of a community and it can be expressed through species or important groups to maintain several functions in the soil, while the genetic one represents gene and genotype variations. Distinct from the genetic diversity of the soil microbial biomass which assess potential diversity, functional diversity is related to the actual activities resulting from that potential so that "functional rather than taxonomic diversity may provide greater insight to microbial roles in ecosystems". In the current literature functional diversity of soil microbial communities is determined alternatively either through enzyme activities or by means of community level physiological profile (CLPP) techniques, such as Biolog™ and/or MicroResp™. In very few studies both approaches are used and thus it is discussed whether the same results were obtained. We measured microbial functional diversity, using both methodological approaches, in four case-studies differing in pedogenetic substrates, plant cover and land use. In all cases the diversity indexes calculated using enzyme activities and CLPP gave opposite results suggesting that we are probably pointing to different components of microbial functional diversity. We thus hypothesize that measuring microbial functional diversity by means of enzymes or CLPP methods provides information on sequential processes occurring in soil: firstly the exemplification of complex organic substrates obtained after enzymatic hydrolysis and secondly the direct utilization of simple substrates, derived from the previous step, by microorganisms (CLPPs).



S11.02-P -33

SOIL PROTEOMICS: INTERFERENCE OF SOIL SOLID PHASES ASSESSED BY MODEL STUDIES

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*Soil proteomics is a promising approach for a deep understanding of the ecological and biological functions expressed by the highly diverse soil microbial communities, responsible for the soil functionality. Previous soil studies demonstrate that a critical point for implementing soil proteomics is the determination of the location of the extracted proteins, as most of the soil constituents (e.g. sand, clay hydro-oxides, humic substances) can stabilize proteins, actively or passively released by the soil microorganisms, making difficult to distinguish between newly expressed and soil-stabilized proteins. To better understand the potentials of soil proteomics and specifically address the effects of various soil solid phases on protein extraction from soil, we performed model studies based on the use of the Gram-negative soil-borne bacterium *Cupriavidus metallidurans* CH34, with known genome and proteome, inoculated into either natural or microcosms artificial soils. The bacterial proteome was analyzed by 2-DE and mass spectrometry approach. Based on the previous results which showed that the presence of the high reactive clay montmorillonite gave the largest interference in the bacterial proteome analysis as compared to low reactive clay kaolinite, we also inoculated *C. metallidurans* CH34 in artificial soils with a different kaolinite:montmorillonite ratios. The results from this study showed that the presence of high reactive clays in soils may negatively influence the potential of recognize the proteomic signature of active microorganisms in soil microbial communities, likely due to proteins irreversible adsorption or denaturation. We conclude that model studies can contribute to improve the protein extraction and purification from soils.*



S11.02-P -34

SPATIO-TEMPORAL CHANGES OF SOIL ALGAE AND ITS REFLECTION BY VIS-NIR SPECTROSCOPY OF THE SOIL

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Soil algae play an important role within the agro-ecosystem. They enhance soil formation, stability and fertility and can therefore be used as bioindicators for soil quality. However, spatial and vertical distribution are recently investigated and especially for temperate environments, their contribution to soil organic matter (SOM) and soil function is still widely unknown. This study monitors the monthly algal development within three different agricultural land use types (maize, rapeseed, cereals) identifying seasonal changes of algal abundance. Specific goals are (i) to determine spatio-temporal changes of algal abundance and (ii) to identify its impact on of VIS-NIR spectra of the soil surface in relation to seasonal and vertical changes of SOM. Both, biomass and species composition are analysed separately for three soil depths of 0-1 cm, 1-5 cm and 5-10 cm at 20 sites elucidating vertical distribution. Biomass is determined by chlorophyll a extraction. To relate it to SOM and microbial community properties, total and organic C and total N (Ct, OC, Nt), microbial C and N (Cmic, Nmic) and phospholipid fatty acids (PLFA) are analysed. Further identification of species composition is done by cultivation and DNA extraction, focussing on internal transcribed spacer (ITS) algal sequences. The monthly sampling is accompanied by VIS-NIR spectroscopy of the soil at the three soil depths using a field spectrometer (ASD FieldSpec II-Pro-FR). Statistical analysis and Partial Least Squares Regression (PLSR) prediction models are used to determine the impact of algal abundance on VIS-NIR spectra. Results of the first 8 month are presented.



S11.02-P -35

STRESS TOLERANCE ASSAYS AND GENETIC DIVERSITY OF SINORHIZOBIUM MELILOTI FIELD POPULATION

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Studying of rhizobial biodiversity opens up the possibility to preserve and maybe to exploit some indigenous strains with hidden symbiotic or ecological potential. In order to improve the beneficial effect of alfalfa inoculation it is important to characterize the indigenous strains and to obtain information about actual composition of rhizobial field population. The main aim of the present study was to characterize indigenous rhizobia associated with alfalfa (Medicago sativa L.) in different regions of Croatia. Over 250 isolates were obtained from root nodules of alfalfa. To study their diversity and characterize them in relation to environmental conditions of their soils of origin, a polyphasic approach was used. Stress tolerance assays revealed significant variations in pH tolerance while almost all isolates showed similar tolerance to elevated salt concentrations and growth temperatures. PCR-RFLP of 16S rDNA revealed most of isolates to be closely related to S. meliloti. However, several isolates produced slightly different RFLP pattern from S. meliloti type strain and other isolates. Dendrogram derived from AFLP profiles revealed considerable genetic diversity among S. meliloti isolates. Only a few strains were identical or nearly identical to each other. The strains originated from the same region were mostly grouped within the same cluster. Better understanding of rhizobial ecology and selection of locally adapted and genetically defined strains as well as their targeted application is one among many approaches to improve the nitrogen fixation efficiency and crop productivity. Keywords nitrogen fixation; rhizobia; Sinorhizobium meliloti; indigenous strains; stress tolerance; genetic diversity



S11.02-P -36

THE EFFECT OF FERTILIZER ON THE ABUNDANCE AND DIVERSITY OF FUSARIUM SPP. IN SOYBEAN FIELD

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The effect of fertilization management on the abundance, diversity, pathogenic differentiation and phylogenetic analysis of *Fusarium* spp. community were investigated in soybean field at National Observation Station of Hailun Agroecology System, Northeast Institute of Geography and Agroecology, CAS. The fertilization treatments included no fertilizer (NF), chemical fertilizer (NP) and chemical fertilizer combined with manure (NPM). Dilution plate method was used to survey *Fusarium* spp. quantity. The population of *Fusarium* spp. was not significantly different in the three treatments during the soybean growth stage. The result of Real-Time PCR showed that the dynamic change trends of the *Fusarium* DNA are similar between NP and NF during the soybean growth stage. At VE stage, the mass of soil *Fusarium* DNA in NP and NPM were 44.61pg and 140.83pg, respectively, and which were significantly higher than in NF. Total of 101 *Fusarium* spp strains were isolated from NF, NP and NPM at VE stage. *Fusarium. oxysproum* were the dominant species in the three treatments. The pathogenicity of *F. oxysproum* was significantly lower in NPM than that in NF and NP. The value of Shannon-Wiener (H) of *Fusarium* in NPM was 1.8 and significantly higher than in NP and NF. The value of Simpson (C) in NF was 0.57 and significantly higher than in NP and NPM. Keywords: Fertilization, *Fusarium* spp., Diversity, Soybean



S11.02-P -37

THE FATE AND ECOLOGICAL RELEVANCE OF EXTRACELLULAR DNA IN SOIL

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The relevance to study the extracellular DNA (eDNA) fraction in soil is clear when we consider the plethora of ecological functions in which eDNA is involved. The eDNA represents the extracellular fraction of the mobile genetic information present in the soil environment, defined as mobiloma. The adhesive properties of the DNA molecule confer to eDNA at high concentrations the capacity to inhibit or kill pathogenic bacteria by cation limitation induction, and to facilitate the formation of biofilm and extracellular traps (ETs), that may protect microorganisms inhabiting biofilm and plant roots against pathogens and allelopathic substances. Moreover, eDNA at sub-inhibitory concentration could cause an inducible antibiotic resistance in biofilm inhabiting bacteria. Finally the cation limitation induction may also represent an eDNA self-defence from DNases degradation due to Mg²⁺ limitation, cation required as co-factor by DNases. The ecological relevance of ETs, actively extruded by root border cells when they are dispersed in the rhizosphere, consist in empower plants to extend an endogenous pathogen defensive system outside the organism. One of the most promising areas for future development is the manipulation of the rhizosphere to produce sustainable and efficient agriculture production systems. Using Omics approaches, to define the distinctive features of eDNA systems and structures, will facilitate progress in rhizo-enforcement and biocontrol studies. Finally the relevance of eDNA from soil bacteria could also be extended to human health applications in terms of immunotherapy, particularly against cancer, and for creating strategies to control biofilm formation and eradicate persistent infections



S11.02-P -38

UNRAVELLING SOIL FUNGAL COMMUNITIES FROM DIFFERENT MEDITERRANEAN LAND-USE BACKGROUNDS

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Fungi strongly influence ecosystem structure and functioning, playing a key role as decomposers, mutualists and pathogens. The Mediterranean area is a biodiversity hotspot that is increasingly threatened by intense land use. To achieve a balance between conservation and human development a better understanding of land use impact of on the underlying fungal communities is needed. We used massively parallel pyrosequencing of the nuclear ribosomal ITS regions to characterize the fungal communities in five soils subjected to different anthropogenic impact in a typical Mediterranean landscape: from natural Quercus forest through managed meadows to vineyards. We examined fungal diversity at the genus level and we found marked differences in the distribution of taxon assemblages among the different sites and communities. Each soil featured typical fungal taxa: ectomycorrhizal species were numerous in the natural sites but were nearly completely missing from the more anthropogenic sites; similarly, coprophilous fungi were common in anthropogenic sites but missing from the others. In addition, we observed that the fungal community composition is mainly influenced by organic matter abundance. The importance of soil fungi in complex carbon degradation was investigated in one of the five soils by examining gene expression profiles of the fungal cellobiohydrolase I gene (cbhl). Total number of fungal species was higher in natural soils than in soils subjected to land use. Dataset provided in this study may contribute to future searches of fungal bio-indicators of the land-use degree of the site. Preliminary results document the complexity of cellulolytic fungal communities in the Mediterranean ecosystems.



S11.03-P - ECOSYSTEM SERVICES AND FUNCTIONS DRIVEN BY THE DIVERSITY OF SOIL BIOTA

Friday 06 July 2012 from 17:00 to 18:30. Room Poster Areas

S11.03-P -1

A 25 YEARS BIOLOGICAL STUDY OF VINEYARD SOILS – THE VITIECOBIOSOL PROGRAM IN CHAMPAGNE

Raphaël Marichal, Paimpont - France

S11.03-P -2

ARE TOPSOIL PARAMETERS RELEVANT INDICATORS OF ALLUVIAL SOIL EVOLUTION?

Hallaire Vincent, Rennes - France

S11.03-P -3

ASSESSMENT OF SOIL BIOLOGICAL QUALITY INDEX IN BURNED FOREST ECOSYSTEMS

Chiara Lisa, Firenze - Italy

S11.03-P -4

CAN MODIFICATION OF CULTURAL PRACTICES INFLUENCE SOIL MICROBIAL COMMUNITY RESPONSE DURING A DROUGHT EVENT?

Aurore Kaisermann, Paris - France

S11.03-P -5

CILIATE COMMUNITIES AS A TOOL TO ASSESS SOIL QUALITY IN AGROECOSYSTEM: INVESTIGATION ON AGRICULTURAL SOILS UNDER ORGANIC FARMING

Daizy Bharti, Camerino - Italy

S11.03-P -6

CONSERVATIVE VS TRADITIONAL AGRICULTURE: HOW DO THEY AFFECT SOIL FAUNA AND ECOSYSTEM SERVICES?

Federica D. Conti, Parma - Italy

S11.03-P -7

DETECTION OF PRION PROTEIN ASSOCIATED WITH CERVID CHRONIC WASTING DISEASE IN ENVIRONMENTAL SAMPLES

Chad Johnson, Madison - United States



S11.03-P -8

DO MULTITROPHIC INTERACTIONS MATTER FOR TREE NUTRITION? A LABORATORY STUDY INVOLVING BACTERIA, BACTERIAL-FEEDING NEMATODES AND ECTOMYCORRHIZAL FUNGI

Claude Plassard, Montpellier - France

S11.03-P -9

DOES REPLACING FALLOW BY A COVER CROP AFFECT BIOGEOCHEMICAL PROPERTIES?

Chiquinquirá Hontoria , Madrid - Spain

S11.03-P -10

EARTHWORM COMMUNITIES UNDER PASTURES: EFFECTS OF PLANT DIVERSITY MANIPULATION AND GRAZING MANAGEMENT

Martin Potthoff, Göttingen - Germany

S11.03-P -11

EFFECT OF PHYSICAL AND BIOLOGICAL FACTORS ON METHANOTROPHIC ACTIVITY OF SOIL AND OTHER POROUS MATERIALS

Witold Stepniewski, Lublin - Poland

S11.03-P -12

EFFECT OF REDUCED SOIL DISTURBANCE ON SOIL PHYSICAL QUALITY RELATED TO EARTHWORM PARAMETERS

Stephen Crittenden, Wageningen - Netherlands

S11.03-P -13

EFFECTS OF LONG-TERM ORGANIC AND MINERAL FERTILISATION ON MICROBIAL PROPERTIES IN A SANDY SUBSOIL

André Sradnick, Witzenhausen - Germany

S11.03-P -14

HOME-FIELD ADVANTAGE EFFECT UNDER CONTROL OF DIFFERENT DECOMPOSER GROUP BETWEEN THREE SUCCESSIONAL STAGES

Gabriel Perez, Mont Saint Aignan - France

S11.03-P -15

IMPACT OF SOIL MANAGEMENT ON EARTHWORM DIVERSITY ACCORDING TO DIFFERENTIAL PLOWING AND PLANT RESIDUE INCORPORATION

Aboulkacem Lemtiri, Gembloux - Belgium



S11.03-P -16

INTERACTIVE EFFECTS OF EARTHWORMS AND VEGETATION ON C AND N GAS FLUXES FROM RIPARIAN AREAS IN SOUTHERN QUEBEC

Maria Kernecker, Montreal - Canada

S11.03-P -17

IS FUNCTIONAL BIODIVERSITY RELATED TO PROFILE DEVELOPMENT?

Sara Marinari, Viterbo - Italy

S11.03-P -18

MICROBIAL ABUNDANCE AND ACTIVITY AS A RESPONSE TO SOIL COVERING AND MINERAL NITROGEN FERTILIZATION

Ivana Rajnovic, Zagreb - Croatia

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PHYTASES AND ITS APPLICATION IN AGGRICULTURE

Mohammad Reza Sarikhani, Tabriz - Iran, Islamic Republic of

S11.03-P -20

SCARABAEID GRUBS; POTENTIAL SOURCE OF ATMOSPHERIC NITROUS OXIDE IN TROPICAL SOILS

Muhammad Zeeshan Majeed, Montpellier - France

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SEED GERMINATION DEPENDS ON EARTHWORM SPECIES AND SOIL TYPES

Julia Mchergui Chockri, Mont Saint Aignan - France

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SHORT-TERM CHANGES IN METABOLIC DIVERSITY OF SOIL BACTERIAL COMMUNITY AS INFLUENCED BY ORGANIC AMENDMENTS AND FERTILIZERS APPLICATION

Ivana Cavoski, Valenzano - Italy

S11.03-P -23

SOIL BIODIVERSITY CHARACTERIZATION ALONG A GLACIAL CHRONOSEQUENCE (PRÉ DE BAR GLACIER, NW ITALY).

Ciro Gardi, Ispra (VA) - Italy



S11.03-P -24

SOIL ORGANIC MATTER QUALITY INFLUENCES FUNCTIONAL AND STRUCTURAL MICROBIAL DIVERSITY OF A LONG-TERM FERTILIZATION EXPERIMENT

Caterina Giacometti, Bologna - Italy

S11.03-P -25

SOIL QUALITY IN LONG-TERM ORGANICALLY MANAGED VINEYARDS: ANALYSIS OF CILIATED PROTOZOA AND MICROARTHROPOD COMMUNITY STRUCTURES

Antonietta La Terza, Camerino - Italy

S11.03-P -26

THE SOFIA PROJECT: INCLUDING SOIL BIODIVERSITY SERVICES IN AGROECOSYSTEMS' MANAGEMENT SCHEMES

Sylvie Recous, Reims - France



S11.03-P -1

A 25 YEARS BIOLOGICAL STUDY OF VINEYARD SOILS – THE VITIECOBIOSOL PROGRAM IN CHAMPAGNE

Cluzeau Daniel^[1], Marichal Raphaël^{*[1]}, Chaussod Rémi^[2], Nouaïm Rachida^[3], Descotes Arnaud^[4], Georget Cédric^[4], Montcomble Dominique^[4], Perrault André^[4], Peres Guénola^[1]

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Conventional vineyard practices have lead in many environmental disturbances as erosion, soil compaction, loss of organic matter and soil biodiversity, water contamination... Therefore, there is an increasing interest to develop sustainable viticulture in the famous Champagne vineyard since 20 years: a huge program called "VITI 2000" has been developed since 1986 by CIVC (Inter-professional Committee of Champagne Wine) in collaboration with researchers. The aims are i) to assess the impact of vineyard practices on soil functioning environmental properties and wine quality, ii) to advice progressively sustainable practices to winegrowers. One strength of this program is to allow a long term field experiment: earthworm communities, microbial biomass, soil and vine parameters were followed during 25 years in 19 plots representing 66 treatments which tested the impact of pesticides applications (nematicides, fungicides, herbicides), or organic matter inputs, or vine management (organic vs conventional vs integrated). This program ended in a huge data collection e.g. the data table of earthworm communities (species, body mass, sexual stage) presents more than 39 000 lines. A database, compatible to others soil fauna databases developed by the laboratory EcoBio, has been developed. First results indicate that i) grass strip between the vine rows and compost, quickly stimulate biological soil processes, while dried organic matter inputs have a slow positive impact, ii) fungicides containing copper alter in the same pattern, earthworms and microorganisms, iii) integrated management could be as positive as organic practices. Statistical treatments are still going on and further results will be discussed.



S11.03-P -2

ARE TOPSOIL PARAMETERS RELEVANT INDICATORS OF ALLUVIAL SOIL EVOLUTION?

Salomé Clémence^[1], Claire Guenat^[2], Géraldine Bullinger-Weber^[3], Vincent Hallaire^{*[4]}, Jean-Michel Gobat^[1], Claire Le Bayon^[1]

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Floodplains are known to be areas of extraordinary biodiversity with a mosaic of shifting habitats with high interdependency. More specifically, a wide pattern of all stages of soil evolution could be observed, which are relevant for the study of initial steps of soil structuring. In this context, our aim was to verify if these topsoil structures may be relevant indicators of soil evolution, testing out the relative importance of mineral inherited deposits due to fluvial dynamics, and the in situ pedogenesis due to earthworms. Our study was conducted in carbonate-rich and calcium saturated environments that are still influenced by fluvial dynamics, taking into account two spatial variables: 1) an altitudinal gradient from subalpine to hill levels, and, 2) a gradient perpendicular to the river, stratified by vegetation. We hypothesise that: i) thickness of the most structured soil layer, ii) soil porosity and iii) soil aggregates stability would increase along these two spatial gradients. A total of 45 samples were collected at the field scale and analysed concerning: 1) physicochemical parameters, 2) earthworm communities, 3) soil structure and porosity. We found that clays, iron forms and active CaCO₃ were related to soil structuring processes. At each altitudinal level, proportions of earthworm anecic species, and to a lesser extent endogeic species, explained soil aggregate diameter. Structural stability was highly correlated with earthworm biomass, especially those of endogeic and anecic species. At the hill level, earthworms increased complexity of both the size and the shape of soil pores independently of vegetation units.



S11.03-P -3

ASSESSMENT OF SOIL BIOLOGICAL QUALITY INDEX IN BURNED FOREST ECOSYSTEMS

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*In the Mediterranean environment fires are one of the main risks for conservation of forest ecosystems. Forest fires can affect biotic and abiotic soil components reducing edaphic biodiversity. The objective of this study is the assessment of soil biological quality index in burned forest ecosystems. The study area is located in central Italy (Tuscany) within the Montefalcone National Nature Reserve. Pine forests (*Pinus pinaster* Aiton) and mixed oak forests (*Quercus cerris* L. and *Quercus petraea* Liebl.) are the prevailing forest types. In the study area forest fires occurred in 2001 and 2009. Soil samples were collected both in pine and oaks forests for a comparison of forest stands affected by fire in 2001, in 2009, and both in 2001 and 2009, and forest stands untouched by fire in the last 40 years. Temperature, pH and moisture were measured for each sample. We assessed organic matter and we computed the biological soil quality index (QBS-ar). QBS-ar uses edaphic microarthropods as bioindicators of the soil matrix. In addition, microarthropod density and biological diversity indexes have been calculated to analyse edaphic community evolution over time. Results show that the QBS-ar index is an effective tool for characterizing edaphic biological diversity in burned forest ecosystems, as well as for assessing fire effect on soil quality and the edaphic community's ability of restoring their balance over time.*



S11.03-P -4

CAN MODIFICATION OF CULTURAL PRACTICES INFLUENCE SOIL MICROBIAL COMMUNITY RESPONSE DURING A DROUGHT EVENT?

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Soils play an important role in the global carbon (C) cycling, in particular by storing organic C or releasing CO₂ to the atmosphere. Agricultural practices are known to modify soil C content and several studies suggest that microbial communities could also be modified. Because stability is related to the ecological insurance and because drought might be more frequent, this study aims to evaluate the influence of soil C content (as integrative parameter of cultural change) on microbial community stability during drought event. We used 3 soils from the same experimental plot, cultivated according to 3 different practices for 14 years. We incubated them in microcosms, and applied water stress (drought then rewetting). Microbial biomass, genetic structure of bacterial communities, released CO₂ and physicochemical parameters have been followed for 28 days. It appears that C content has an influence on bacterial community composition and that it can be positively related to basal respiration and microbial biomass. Regardless of soil, water-stress seems to alter the dynamic trajectories of bacterial communities and mineralization, but the resilience is total at 28 days. However, the C-rich soil seems to have a higher resistance and slower resilience. Finally, cumulative mineralization is more important for C-rich soil but as cultural practice (cover crops) has enriched this soil in C, the turnover could be more important and the net C balance positive over years. Moreover, cumulative mineralization tends to decrease with drought event but it remains to be seen in other water-stress contexts.



S11.03-P -5

**CILIATE COMMUNITIES AS A TOOL TO ASSESS SOIL QUALITY IN AGROECOSYSTEM:
INVESTIGATION ON AGRICULTURAL SOILS UNDER ORGANIC FARMING**

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Ciliated protozoa are ubiquitous eukaryotic microorganisms, which constitutes an essential component of aquatic and soil ecosystems. Ciliates are very sensitive to any change in their habitat and fluctuations in their communities can affect the food web and energy transfer within the ecosystem. Thus, the monitoring of the structure of ciliate communities can represent a valuable tool to assess ecosystem quality and functioning. Currently, few studies have been addressed to the analysis of soil ciliate communities and in particular, in agricultural soils under organic management. In our study, the first one to be performed in Italy, the ciliate communities in three fields under organic management located in a hill area (300-550 m asl) of the province of Macerata (Marche), were investigated by means of qualitative and quantitative methods. Soil samples were taken twice in autumn and spring. Furthermore, six more sites representative of natural and semi-natural soils were sampled for comparison. Our surveys showed a total of 79 species belonging to 3 classes, 19 orders, 42 genera from all sites under study with the dominance of the ciliates genus: Colpoda, Gonostomum, Oxytricha, and Halteria. The species richness ranged from 37 to 15 and it is higher in agricultural fields as compared with the natural habitats. These results highlight the high bio-indicative potential of ciliate species number. This research aims to develop molecular profiling assay of ciliate communities and finally to merge taxonomic and molecular data to evaluate, more rigorously, soil ciliate biodiversity.



S11.03-P -6

CONSERVATIVE VS TRADITIONAL AGRICULTURE: HOW DO THEY AFFECT SOIL FAUNA AND ECOSYSTEM SERVICES?

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Agriculture production relies on several functions provided by the soil fauna, including organic matter decomposition, nutrient cycling and dispersal, maintenance of soil structure and fertility. Traditional agriculture management practices have affected soil biodiversity in negative ways mainly due to tillage. Preserving environmental and soil "health" has become a priority in conservation programs in the last years. In order to realize the benefits of ecosystem services and to maintain and enhance crop productivity, conservation agriculture may represent an alternative to traditional techniques, seeing that it optimize the use of resources during the production cycle and it tend to reduce soil degradation. The targets of this study are to characterize and compare soil microarthropod communities in traditional and conservative agriculture fields cultivated principally with maize. Three sites in Lombardia Region (Northern Italy) were investigated in late 2010 and 2011: in provinces of Pavia, Lodi and Mantova. Soil fauna sampling consisted in three top soil cores (10x10x10 cm); microarthropods were extracted by using Berlese-Tüllgren funnels, identified to order level and counted, then biodiversity index and soil biological index (QBS-ar and QBS-c) were calculated. The results seemed to confirm that conservative agricultural practices allow to protect soil ecosystems. Soil cover and the highest amount of organic matter in conservative management fields consent to increase soil stability. Furthermore the low mechanical disturbance, in particular tillage absence, promote the presence of groups with morphologic characters strictly associated to edaphic life. Acknowledgements: Research supported by ERSAF Lombardia



S11.03-P -7

DETECTION OF PRION PROTEIN ASSOCIATED WITH CERVID CHRONIC WASTING DISEASE IN ENVIRONMENTAL SAMPLES

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Chronic wasting disease (CWD) is a transmissible spongiform encephalopathy (TSE) or prion disease affecting North American members of the deer family (cervids). The known range of the disease has expanded dramatically since 2000, with cases in captive and free-ranging cervids reported in 16 U.S. states, two Canadian provinces and South Korea. Like other TSEs, a central event in the pathogenesis of CWD is the conformational conversion of normal cellular prion protein (PrPC) to a partially protease-resistant, β -sheet-rich pathological form (PrPTSE). The disease agent may enter the environment through decomposition of carcasses and shedding in feces, saliva, and urine. Once in the environment PrPTSE can bind to soil components and remain bioavailable for extended time periods. Because the disease agent lacks nucleic acid, polymerase chain reaction cannot be used to detect small amounts of disease agent in environmental samples. Here, we report that a combination of detergent extraction and protein misfolding cyclic amplification with beads (PMCAb) substantially improves the sensitivity of PrPTSE detection in environmental samples. PMCAb uses periodic sonication to disrupt PrPTSE aggregates allowing them greater access to supplemented PrPC which is then converted to PrPTSE. This conversion accumulates PrPTSE to biochemically detectable levels after repeated cycles of sonication and incubation. Using this technique we are able to achieve detection limits substantially lower than animal bioassay and characterize the effect humic acids exert on the conversion of PrPC to PrPTSE. This technique holds promise for helping to clarify the relative importance of direct and indirect transmission of CWD.



S11.03-P -8

DO MULTITROPHIC INTERACTIONS MATTER FOR TREE NUTRITION? A LABORATORY STUDY INVOLVING BACTERIA, BACTERIAL-FEEDING NEMATODES AND ECTOMYCORRHIZAL FUNGI

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Soil microorganisms act as a sink and a source of available N and P by mediating key processes in the biogeochemical N and P cycling. The microbial loop, based upon the grazing of bacteria is thought to play a major role in the mineralization of nutrients such as nitrogen (N) and phosphorus (P) in terrestrial ecosystems. However, little is known about the impact of grazing by nematodes on mineral nutrition of ectomycorrhizal woody plants. We addressed this question in young seedlings of *Pinus pinaster*, whether or not associated with the ectomycorrhizal basidiomycete *Hebeloma cylindrosporum*. Plants, whether inoculated or not with *Bacillus subtilis* and bacterial-feeding nematodes, isolated from the same *P. pinaster* plantation in ectomycorrhizae and soil respectively, were grown in sterile agar gel. N was supplied equally as nitrate and bacterial N, and P as mineral P, bacterial P or phytate. Phytate is a well-known poorly available P source to plants but is used by *B. subtilis* able to release phytase in the medium. Nematode grazing upon ¹⁵N labeled bacteria increased plant growth and induced a low accumulation of ¹⁵N in shoots compared to medium N. This effect disappeared with bacterial P as the sole source of P. In contrast, nematode grazing considerably enhanced plant P access from phytate, and ectomycorrhizae increased plant P accumulation. These results underline the importance of multitrophic interactions to increase mineral nutrition of a woody species from nutrients locked up in bacteria and the prominent role of P availability for microbial loop efficiency.



S11.03-P -9

DOES REPLACING FALLOW BY A COVER CROP AFFECT BIOGEOCHEMICAL PROPERTIES?

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*Replacing fallow with cover crops seems to be a good practice to enhance soil quality, and biochemical properties might be a good indicator of the improvement. The aim of this study was to analyse the effect of replacing fallow by different winter cover crops (CC) on the biochemical properties of an Haplic Calcisol. A 4-year field trial was conducted using Barley (*Hordeum vulgare* L.) and Vetch (*Vicia sativa* L.) as CC on an irrigated cropping systems in Central Spain. Soil respiration was measured in situ and samples at 0-5 and 5-20 cm depth were taken in 2010 and analyzed for soil organic carbon (SOC), particulate organic carbon (POC), total nitrogen (Nt), enzyme activities (β -glucosidase, β -glucosaminidase, urease), C microbial biomass estimated by substrate-induced respiration, easily and total Bradford-reactive soil proteins (EE-BRSP and BRSP). Barley increased SOC, β -glucosaminidase activity, soil respiration and EE-BRSP at 0-5 cm depth while Vetch significantly increased POC and Nt. C microbial biomass and β -glucosidase activity showed a tendency towards higher values under CC but differences were not significant. Urease activity did not show any response at all to treatments. Except urease, most variables showed very strong lineal relationships between them when whole data were considered.. Our preliminary results suggest that Barley was more effective than Vetch enhancing soil quality, and biochemical properties related to soil protein content were good indicators of microbial activity enhancement in the short-medium term under study conditions.*



S11.03-P -10

**EARTHWORM COMMUNITIES UNDER PASTURES: EFFECTS OF PLANT DIVERSITY
MANIPULATION AND GRAZING MANAGEMENT**

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*Earthworms are known to be quite abundant in temperate grassland systems. Earthworm communities interact with plant communities and are affected by farming inputs. In a field experiment on pastures, we investigated the earthworm community response to different grazing treatments and herbicide use. Two plant diversity treatments were established: (1) untreated, representing the full plant diversity of the area and (2) application of Starane and Duplosan KV to reduce the cover of dicotylous plants in the community. Within both plant community treatments, three different grazing practises were carried out: (1) cattle, (2) sheep, and (3) co-grazing with both. The whole setting was repeated 3 times in independent blocks. Earthworms were extracted from the soil using mustard extraction in October 2011 (6 per plots). In total, 6 different species (*Lumbricus castaneus*, *Lumbricus terrestris*, *Aporrectodea caliginosa*, *Aporrectodea rosea*, *Octolasion lacteum*, *Octolasion cyaneum*) were found covering all 3 ecological groups. *A. caliginosa* and *L. terrestris* were most abundant. Plant species diversity did not affect earthworm numbers. Earthworm communities were supported from sheep grazing compared to cattle and cattle+sheep treatments.*



S11.03-P -11

EFFECT OF PHYSICAL AND BIOLOGICAL FACTORS ON METHANOTROPHIC ACTIVITY OF SOIL AND OTHER POROUS MATERIALS

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Soil can be a source (under anoxic conditions, e.g. natural wetlands or rice fields) or a sink (in case of well aerated soils) of methane. The capacity of soil methanotrophic microorganisms to oxidize methane is a very important factor influencing global carbon cycle and mitigating atmospheric methane concentration. It also substantially reduces methane emission from such anthropogenic sources as landfills of municipal solid wastes and from waste water treatment plants. The methanotrophic activity in soils, and others porous materials, depends on numerous physical, chemical and biological factors. The paper presents the effect of physical parameters of soil such as particles size distribution, water content, temperature, gas diffusion coefficient, as well as concentration of substrates (CH₄ and O₂) and products (CO₂) of the methane oxidation reaction. The combined effects of gas diffusion coefficient and kinetic parameters of Michaelis – Menten equation (V_{max} and K_M) are analyzed by means of numerical simulation by finite element method. The knowledge of the limitations of methanotrophic activity can be used in practice for maximizing the methane-oxidizing capacity in soil and other porous materials likely to be used in landfill covers, bio- windows and biofilters to mitigate methane emission to the atmosphere.



S11.03-P -12

EFFECT OF REDUCED SOIL DISTURBANCE ON SOIL PHYSICAL QUALITY RELATED TO EARTHWORM PARAMETERS

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Soil water regulating ecosystem functions are an important topic among Dutch farmers given that climate change scenarios for The Netherlands predict exacerbated extreme rainfall events and drought periods (MNP, 2005; KNMI, 2006). Conservation tillage practices, such as non-inversion tillage, are being implemented to reduce compaction, improve the infiltration and water storage capacity of soils, and stimulate biological activity. It was hypothesized that reduced tillage systems and controlled traffic will promote earthworm density and diversity and therefore encourage an improvement in soil physical quality (soil water retention and infiltration). Two replicated field experiments in randomized complete block designs were performed on organic farms in Flevoland, The Netherlands. The non-inversion tillage systems showed significantly higher penetration resistance and lower infiltration capacity. Seasonal controlled traffic had significantly lower water holding capacity, presumably because of greater macropores created by earthworms, roots or cracks through which water can quickly escape. The non-inversion tillage systems, after only 3 seasons, did not improve soil physical quality. Seasonal controlled traffic however, does appear to increase infiltration capacity but decrease soil water retention. References KNMI, 2006. *Klimaat in de 21e eeuw, vier scenario's voor Nederland*. In: De Bilt. MNP, 2005. *Effecten van klimaatverandering in Nederland*. In: Milieu- en Natuurplanbureau, Bilthoven



S11.03-P -13

EFFECTS OF LONG-TERM ORGANIC AND MINERAL FERTILISATION ON MICROBIAL PROPERTIES IN A SANDY SUBSOIL

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Recent and past investigations about the effect of long –term organic and mineral fertilisation was mainly focused in topsoil, but little is known about the fertilisation effects on subsoil. In 2009 soil samples were taken between 0 and 100 cm soil depth from a long-term field trail in Darmstadt (Hessian). The application of cattle manure, cattle manure + biodynamic preparations and mineral fertilisation was investigated. The field is characterised by heterogeneous conditions caused by lime bands in field, consequently the effects of soil pH were also investigated. The contents of organic carbon, total nitrogen and microbial biomass in subsoil were not affected by fertilisation. However the amounts of microbial residues (amino sugars) were significantly reduced in the subsoil under mineral fertilisation in comparison with organic fertilisation. The contribution of microbial residual carbon to organic carbon is approximately 30% higher under organic fertilisation. In addition, the distribution of microbial residues in the soil profile was dependent on fertilisation and independent of heterogeneous pH conditions. The results suggest that long-term application of organic fertiliser supports the accumulation of microbial residues and that potentially influence the quality of organic carbon in the subsoil. We also investigated the possibility to estimate the amino sugars by near infrared spectroscopy in soil the profile.



S11.03-P -14

HOME-FIELD ADVANTAGE EFFECT UNDER CONTROL OF DIFFERENT DECOMPOSER GROUP BETWEEN THREE SUCCESSIONAL STAGES

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Decomposition is the second most important ecosystem function maintaining life on Earth, after primary production. Several studies clearly indicated the role of plant species diversity and identity in controlling decomposer assemblages. Furthermore, there is some evidence that some plant species can preferentially select for decomposer taxa that enhance the decomposition of their own litter. From these observations, researchers draw the hypothesis of the Home-Field Advantage (HFA) stating that litter tends to decompose more rapidly in the habitat from which it was derived (home) than in other habitats (away). So far, HFA effect was mainly studied under a typical plant assemblage (e.g. grassland or forest) and focusing on one group of decomposer. To test this hypothesis we performed a litter transplant experiment in three typical successional stages: short grassland, encroached grassland and forest. Litter derived from the short grassland has been transplanted in encroached grassland and forest, and all combinations were realized. We used two types of litterbags: micromesh (0.175 mm) and mesomesh (2 mm). After 6 months, litter derived from short grassland presents a significantly higher percent of mass remaining in forest and encroached grassland for micromesh treatment (HFA effect). In opposite, litter derived from forest presents a significantly lower percent of mass remaining in short grassland and encroached grassland. Nevertheless, percent of mass remaining after litter translocation was buffered for all litter types for litterbags with mesomesh size. Thus, we observed that the home field advantage effect is dependent to both the successional stage and the decomposers involved.



S11.03-P -15

IMPACT OF SOIL MANAGEMENT ON EARTHWORM DIVERSITY ACCORDING TO DIFFERENTIAL PLOWING AND PLANT RESIDUE INCORPORATION

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Earthworms are largely distributed in terrestrial ecosystems and their abundance and diversity in soils are significantly affected by biotic (macro- and micro-organisms) and abiotic factors: soil properties (pH, texture, structure...); agricultural management system and climate change. Here, tillage effect of earthworm population combined with crops residual management was investigated and correlated with soils properties. From wheat experimental field plots, the diversity of earthworm according to the field crop management was assessed. Application of particular crop production practices such as the integration of different levels of crop residues, diverse parts of wheat straws, at the field level regulate earthworm diversity and population abundance. Indeed, tillage reduced earthworm population with a 35% rate also corresponding to changes in soil properties. Agricultural practices had to be adapted to include consideration on macro-invertebrate abundance and diversity to maintain efficient soil fertility and allow sustainable crop production. Key words: Soil management, soil fertility, crop residues, earthworm.



S11.03-P -16

INTERACTIVE EFFECTS OF EARTHWORMS AND VEGETATION ON C AND N GAS FLUXES FROM RIPARIAN AREAS IN SOUTHERN QUEBEC

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Riparian areas are subject to periodic flooding events. In these areas, tolerance of temporary inundation is a characteristic of the plant communities and soil fauna. Fluctuations between aerobic and anaerobic conditions can shift the gaseous products of soil microbial respiration from CO₂ to N₂O and CH₄. Earthworms are abundant in riparian soils; their feeding on plant litter accelerates decomposition and mineralization of plant-available nutrients, increasing CO₂ fluxes. Soluble C and plant-available N generated from earthworm feeding activities serve as substrates for microbially-mediated anaerobic reactions, potentially increasing N₂O and CH₄ fluxes. However, earthworms are selective feeders, preferring plant litter with a low C:N ratio. Our objective was to investigate how the interactive relationship between earthworms and vegetation influences CO₂, CH₄ and N₂O from riparian areas. We hypothesized that this interactive effect would be greatest where earthworm populations were highest and plant litter had the lowest C:N ratio. Three study sites along the Rivière-aux-Brochets in southern Quebec were selected. At each site, there were three transects (3 m x 90 m): one in the agricultural riparian buffer and one in the forest remnant patch, each approximately 5m from the river, and one transect in the forest remnant patch, approximately 30m from the river. In each transect, earthworm populations were evaluated and vegetation was surveyed. In each transect, there were three chambers that measured gas production with ambient earthworm populations while the other three measured gas produced by artificially elevated earthworm populations from July to November 2011. Results will be presented.



S11.03-P -17

IS FUNCTIONAL BIODIVERSITY RELATED TO PROFILE DEVELOPMENT?

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Well developed soils are largely stratified habitats, with distinct horizons; each of them may be regarded as a separate entity in that it differs in physical and chemical properties. Soil classification systems take horizon differentiation into account at several levels and, in well drained humid environments, an increase in profile stratification links Entisols to Inceptisols to Spodosols. Niche separation is an important mechanism to increase soil biodiversity, and because of horizonation, we expect a link between functional diversity and soil development. In this work we propose a new methodological approach that relates functional biodiversity and soil development. We selected a Lithic Cryorthent, a Lithic Dystrudept, a Mollic Haplocryept and a Typic Haplocryod, and analysed microbial functional diversity testing eight enzyme activities at different scales, from soil horizons to soil profiles. From the values of enzyme activities Gini coefficient was calculated for each horizon (alfa-diversity). The final value for each profile was obtained calculating the average, weighed for each horizon thickness, along soil profile (beta-diversity). Gini coefficient allowed a clear discrimination among the four soils. In particular, an inverse relationship between profile development and beta-diversity was observed. Moreover, the lowest the diversity of the profile the highest the variability of the values obtained in the horizons (alfa-diversity). This large range alfa-diversity could be related to the differentiation of soil horizons. The diversity index calculated at different scale may represent a new approach to establish the interrelationship between pedogenic processes, soil development, as depicted by soil classification, and soil microbial functions.



S11.03-P -18

MICROBIAL ABUNDANCE AND ACTIVITY AS A RESPONSE TO SOIL COVERING AND MINERAL NITROGEN FERTILIZATION

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Microorganisms play a key role in the soil ecosystem functioning and their role is essential in numerous soil processes. The aim of the present study was to determine the effect of soil covering with different materials and three nitrogen fertilizer rates on total number of bacteria, abundance of microorganisms involved in nitrogen cycling, abundance of cellulolytic microorganisms and dehydrogenase activity. Stationary field trial was set up on hydromeliorated terra rossa soil in Istria. Nine trial plots were formed, with three replications, which differed from one another in the amounts of nitrogen fertilizers applied as well as in soil surface covering. Sampling was carried out four times during the growing season. Effect of sampling season on total number of bacteria as well as on the abundance of nitrifiers and denitrifiers was determined. In both years, statistically significant effect of soil covering upon the cellulolytic bacteria was found. Nitrifiers were the least abundant of all examined groups of microorganisms in both years, and in 2010 significantly highest number of nitrifiers was obtained with 120 kg of nitrogen applied (in May). In June and October significantly highest number of denitrifiers was recorded in plots covered with polyethylene film. Dehydrogenase activity was highest in uncovered plots in three sampling seasons in 2010. This study revealed that soil covering and different nitrogen fertilizer rates had very different impact on total number of microorganisms and on microbiological processes involved in the nitrogen cycle. Keywords: soil microbial properties, nitrogen cycle, dehydrogenase activity, nitrogen fertilization, soil covering



S11.03-P -19

PHYTASES AND ITS APPLICATION IN AGGRICULTURE

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Hydrolytic enzymes have major role in catabolism especially in C, N and P cycles. Most industrial enzymes belong to the hydrolysis class of enzyme. Phytases are a special class of phosphatases that catalyze the step-wise release of phosphate from phytate, the principle storage form of phosphate in plant seeds. These enzymes have a wide distribution in plants, microorganisms and in some animal tissues; however, microbial sources are more promising for the production. They are added to animal feedstuff to reduce phosphate pollution in the environment, since monogastric animals such as pigs, poultry and fish are unable to metabolize phytate. The first commercial phytase product became available on the market around 20 years ago. Based on biochemical properties and amino acid sequence alignment, phytases can be categorized into four major classes, HAP, BPP, CP and PAPs. In general, phytases behave like a monomeric enzyme with molecular masses between 40 and 100 kDa. Up to now two main types of phytases have been identified based on optimal pH for activity; acid phytases with a pH optimum around 5 and alkaline phytases with a pH optimum around 8. Most of identified phytases depending upon the source of origin they have generally pH and temperature optima around 4.5-6 and 45-60 °C. Some of phytases show broad substrate specificity and hydrolyzes metal-free phytate, in contrast some of them exhibit strict substrate specificity for the calcium-phytate. This article reviews enzymology, application and biochemical and catalytic characteristic of four different classes of HAP, BPP, CP and PAPs.



S11.03-P -20

SCARABAEID GRUBS; POTENTIAL SOURCE OF ATMOSPHERIC NITROUS OXIDE IN TROPICAL SOILS

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This study constitutes the first attempt to gain insight into the biotic origin of nitrous oxide (N₂O) by the coleopterous white grubs dwelling in the tropical and subtropical soils with a substantial biomass. The scarabaeid grubs are among the main macroinvertebrates in terrestrial ecosystems having a considerable influence on soil physico-chemical properties and organic matter mineralization by their diversified biological activities. Despite of their ecological importance, their role in N₂O flux is yet unexplored even though their alkaline digestive tracts resemble to a soil-feeding termite's gut containing all the conditions favorable for the process of denitrification and subsequent production of nitrogenous oxides. So the main objective of this work was to determine if these edaphic white grubs play an important role in soil-atmospheric N₂O flux and what are the potential microbial communities involved in this flux? N₂O emission was determined by gas chromatography on five different species of scarabaeid grubs collected from Madagascar and Mexico rainforests. The microcosm experiments revealed that a significantly higher amount of N₂O is emitted by the scarabaeid grubs than their surrounding parent soil. Quantification of microbial communities showed that denitrifiers' gene abundance is significantly higher in parent soil than white grub's gut albeit these microbes are more functional inside the gut's environment. Moreover, the N₂O emission is found significantly correlated to the nitrite reductase (nirS and nirK) gene abundances of their guts which demonstrates that denitrification is the most probable process responsible for N₂O emissions from grubs. These findings are consistent with our working hypothesis.



S11.03-P -21

SEED GERMINATION DEPENDS ON EARTHWORM SPECIES AND SOIL TYPES

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*It has been largely shown that the modification of soil properties through earthworm action has indirect consequences on plant growth. Some studies also suggest that earthworms could have a direct impact on seed germination and plant seedling growths through their ingestion and rejection of seeds within their nutrient-rich casts. The relationship between physical, chemical and biological properties of casts and a modification of seed germination is yet still to be studied. The objective of this study is to link seed/seedling performances with physical properties (pH, aggregate stability and water content), chemical properties (CEC, C, N, cations, OM) and biological properties (fungal and microbial populations) of earthworm casts. Casts of three earthworm species (*Allolobophora chlorotica*, *Aporrectodea rosea* and *Lumbricus terrestris*) were collected over a six-month period and seeds of six species were studied (*Festuca lemanii*, *Holcus lanatus*, *Origanum vulgare*, *Trifolium campestre*, *Trifolium repens*, *Urtica dioica*). Casts were produced on three different grassland soils that followed a humidity gradient. The twelve treatments (3 EW species x 3 soils + 3 soil controls) were repeated five times in mesocosms. Our results show both the influence of species and of soils on physical (pH and water content), chemical (N) and biological properties of aggregates. Some analyses are still under process and laboratory results are expected soon. All results will be discussed to analyze the impact of earthworm casts composition on the dynamics of plant communities. These results can potentially lead to applications in restoration ecology and the use of earthworms to restore vegetation.*



S11.03-P -22

SHORT-TERM CHANGES IN METABOLIC DIVERSITY OF SOIL BACTERIAL COMMUNITY AS INFLUENCED BY ORGANIC AMENDMENTS AND FERTILIZERS APPLICATION

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Soil microorganisms are responsible for many important processes supporting soil functioning. They play an important role in maintaining, enhancing, and reconstituting soil quality and plant health. Community level physiological profile (CLPP) has been successfully used to detect short-term changes in the microbial functional diversity. A field experiment was designed to examine the short term response of bacterial communities to organic amendments and fertilizers applications. Seven treatments in a randomized block design with four replications were set up: unamended soil as control (CON); biochar (BCH); organic fertilizers (OF); combined application of biochar and organic fertilizers (BCH+OF); cattle manure and vineyard wood compost (MVC); dairy wastes industry and vineyard wood compost (DVC) and solid poultry slaughterhouse wastes and vineyard wood compost (SVC). After 80 days, the soil was sampled in order to evaluate the Community Level Physiological Profile (CLPP) variations, as a function of the different soil treatments. The bacterial CLPP was evaluated using the Biolog technique. A new approach in CLPP assessment was used by applying samples serial dilutions. Our goal was to identify the most conservative treatment among sample dilutions of key metabolic traits of the microbial biomass. Results showed that MVC and DVC turned out to be the best performing treatments, as they were able to keep functional capacity of soil microorganisms at different dilutions. New approach of Biolog use could open an interesting research field aimed at exploring the long-term effect of soil treatments.



S11.03-P -23

SOIL BIODIVERSITY CHARACTERIZATION ALONG A GLACIAL CHRONOSEQUENCE (PRÉ DE BAR GLACIER, NW ITALY).

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After the maximum expansion phase of the Little Ice Age, soils located in proglacial areas of the Alps evolved over a time span of about 190 years. These young soils represents excellent case studies for investigation of soil biota community succession in evolving soils. A series of soil samples for the characterization of soil biota (microbial and microarthropods communities), was collected along a glacial retreat soil chronosequence, during the Autumn of 2010. The sampling sites range in elevation from 1880 to 2100 m a.s.l., and the age of soils from 7 to 190 years. The microbial communities were studied using the MicroResp methodology, based on the measure of soil respiration in response to a range of carbon substrates, while the microarthropods have been characterized using the QBS approach. Community level physiological profiles of the microbial communities showed statistically significant differences in the oldest soils, which were different from all other soils, but no significant differences between community level physiological profiles of the microbial communities of the other three soil ages investigated.



S11.03-P -24

SOIL ORGANIC MATTER QUALITY INFLUENCES FUNCTIONAL AND STRUCTURAL MICROBIAL DIVERSITY OF A LONG-TERM FERTILIZATION EXPERIMENT

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Functional and structural diversity of soil microorganisms and their relationships with soil organic matter quality were investigated under long-term organic (manure and crop residues) and mineral (0 and 200 kg N ha⁻¹ year⁻¹) fertilization treatments. The activity of enzymes involved in the biochemical cycles of C, N, S and P were assayed to assess soil functional diversity. Phospholipids fatty acid profiles (PLFA) were used to estimate the viable microbial biomass and to investigate changes in the microbial community structure. Diffuse reflectance Fourier transformed infrared spectroscopy (DRIFTS) was applied to characterize soil organic matter composition. C-related enzyme activities were stimulated by manure and mineral nitrogen, while the activity of leucine-aminopeptidase increased under manure but was suppressed by nitrogen addition. P and S-related enzymes were not affected by the different treatments. Total PLFA content and the ratio between gram-positive and gram-negative bioindicators were higher under manure, indicating an increase in the viable microbial community and a change in its composition. Mineral nitrogen fertilization did not influence total PLFA content but induced a shift of the community toward gram-negative bacteria. The relative enrichment in aliphatic C and the marked reduction of the ratio between aromatic and aliphatic groups observed in the DRIFT spectra of soil amended with manure suggested a shift of soil organic matter quality under this treatment. This shift was reflected by a change in the amount, activity and composition of the soil microbial community, indicating the existence of a strong relationship between these abiotic and biotic properties.



S11.03-P -25

SOIL QUALITY IN LONG-TERM ORGANICALLY MANAGED VINEYARDS: ANALYSIS OF CILIATED PROTOZOA AND MICROARTHROPOD COMMUNITY STRUCTURES

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Organic wine represents an emerging market that is showing potential for growth. There is, in fact, a growing worldwide interest and attention for environmental friendly products and sustainable agricultural practices. Organic farming employs a set of farming practices that contribute in preserving soil quality. The aim of this study was to assess the soil quality of organically managed vineyards by means of two bioindicators: protozoan ciliates and microarthropods. The study was conducted in a farm in the district of "Verdicchio" of Matelica (Marche, Italy), on three vineyards with different years of implant (1992, 1998, 2009). Soil samples were taken monthly in the period from March to October 2011. A total of 252 samples including those sampled from an adjacent permanent pasture as reference site, were collected. Ciliate analysis showed a total of 20 species belonging to 6 classes, 11 orders, 15 genera. The species richness ranged from 12 to 6. Interestingly, the ciliate species (6) in V92 belongs to Spirotrichea. This situation seems to indicate a possible species coexistence due to a mature, stable soil. Microarthropod communities with the presence of biological forms well adapted to soil as Diplura, Pauropoda, Chilopoda and Protura and QBS-ar values up to 247 (V92), showed great biological value in all vineyards. Moreover and exclusively in V92, Palpigrada a rare and highly euedaphic form considered as a good indicator of soil quality, were repeatedly observed. Collectively, data indicate that the long-term organic management of the soil contribute to global soil quality in vineyards.



S11.03-P -26

THE SOFIA PROJECT: INCLUDING SOIL BIODIVERSITY SERVICES IN AGROECOSYSTEMS' MANAGEMENT SCHEMES

Recous Sylvie*^[1], Michel Bertrand^[2], Hubert Boizard^[11], Nicolas Brunet^[11], Daniel Cluzeau^[10], Annie Duparque^[5], Mickael Hedde^[6], Pierre-Alain Maron^[7], Chauvat Matthieu^[8], Stephane Saj^[9]

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The "Soil Functional diversity as an Indicator of sustainable management of Agroecosystems " (SOFIA) project focuses on the assessment of the effects of agricultural practices on the taxonomic and functional diversity of soil biotic assemblages and on several services they support: regulation (GHG emission, C storage), supply (nutrients for crop) and maintenance of soil fauna and flora biodiversity. The project is held on the SOERE experimental platform of Estrées-Mons (Northern France) dedicated to the study of long-term anthropogenic disturbance on biogeochemical cycles and biodiversity. This experiment, started in 2010, is characterized by a series of treatments comprising different crop rotations (annual, perennial and energy-based crop rotations), rate of N fertilization, deep and reduced soil tillage. These practices are known to affect soil organisms by modulating the amount, chemical nature and location of their food resources and by modifying their habitat. During four years, the induced-differentiation of the agro-system is being characterized for plant biomass production and soil physical and chemical properties. Concomitantly, earthworms, macro-invertebrates, microfauna, bacterial and fungal communities are characterized by their density, taxonomic and functional diversities and their dynamics. Plant residue decomposition, soil N mineralization, CO₂ and N₂O emissions are also determined at different periods. The results will contribute to testing and improving soil indicators that could better guide farmers' choice, especially during the transition phases generated by changes in cropping practices. The project is ongoing. The poster will present experimental design, preliminary results and the adopted conceptual scheme linking agricultural practices, soil communities and soil functions.



S11.04-P - ORGANIC MATTER DECOMPOSITION: DOES SOIL DIVERSITY MATTER?

Monday 02 July 2012 from 17:00 to 18:30. Room Poster Areas

S11.04-P -1

ASSESSMENT OF LONG-TERM TILLAGE SYSTEM INFLUENCES ON CATABOLIC POTENTIAL OF THE SOIL MICRO-DECOMPOSERS COMMUNITY

Mehdi Sharifi, Truro - Canada

S11.04-P -2

CHANGES IN LEAF LITTER QUALITY ALONG PURE BEECH FOREST AGEING AFFECT SOIL MICROBIAL COMMUNITY AND ORGANIC MATTER DECOMPOSITION

Jean Trap, Mont Saint Aignan - France

S11.04-P -3

CHITINOLYTIC AND PECTINOLYTIC COMMUNITY OF THE TERRESTRIAL AND SOIL ECOSYSTEMS IN CHERNOZEM ZONE

Evgenya Lukacheva, Moscow - Russian Federation

S11.04-P -4

DOES MICROBIAL COMMUNITY STRUCTURE CHANGE IN PYC TREATED FOREST TOPSOIL WITHIN THE FIRST YEAR?

Nimisha Singh, Zurich - Switzerland

S11.04-P -5

DYNAMIC RESPONSE OF MICROBIAL RESPIRATION TO MASS LOSS, CHEMICAL PROPERTIES, AND MORPHOLOGY OF DEAD FINE ROOTS IN A BROAD-LEAVED TEMPERATE FOREST, JAPAN

Ayumi Kawamura, Kyoto - Japan

S11.04-P -6

EVIDENCE THAT SOIL ORGANIC MATTER MINERALISATION IS NOT CONTROLLED BY THE SIZE, ACTIVITY OR BIODIVERSITY OF THE SOIL MICROBIAL BIOMASS – A NEW HYPOTHESIS.

Philip Brookes, Harpenden - United Kingdom



S11.04-P -7

IMPACT OF N AVAILABILITY ON HETEROTROPHIC MICROBIAL DYNAMIC DURING DECOMPOSITION OF MISCANTHUS X GIGANTEUS LEAVES IN A SOIL.

Isabelle Bertrand, Reims - France

S11.04-P -8

IMPACTS OF ORGANIC RESIDUE MANAGEMENT IN EUCALYPTUS FOREST ON MICROBIAL COMMUNITIES.

Agnès Robin, Montpellier - France

S11.04-P -9

IMPLICATIONS OF EXTRACELLULAR ENZYMES ACTIVITIES ON C AND N DYNAMICS DURING LITTER DECOMPOSITION: EXPANDING A THEORETICAL MODEL

Gwenaëlle Lashermes, Reims - France

S11.04-P -10

INFLUENCE OF PLANT RESIDUE QUALITY ON ENZYMES DYNAMICS: IMPORTANCE OF ENZYME DISTRIBUTION BETWEEN SOIL AND RESIDUE.

Isabelle Bertrand, Reims - France

S11.04-P -11

INVESTIGATING THE IMPACT OF PLANT COMPOSTING ON THE MICROBIAL DEGRADER COMMUNITY DYNAMICS IN SOIL USING PLFA-SIP APPROACH

Thomas Lerch, Paris - France

S11.04-P -12

MAY SOIL PARENT MATERIAL INFLUENCE NITROGEN TRANSFORMATION IN FOREST FLOOR?

Marina Nadporozhskaya, Saint-Petersburg - Russian Federation

S11.04-P -13

MICROBIAL HABITAT CONDITIONS OR MICROBIAL COMMUNITIES AS DRIVERS OF SOIL ORGANIC MATTER DECOMPOSITION?

Sabrina Juarez, Thiverval Grignon - France

S11.04-P -14

MODELING EARTHWORM POPULATION DYNAMICS IN SEVERAL ORGANIC MATTERS

Taofic Alabi, Gembloux - Belgium



S11.04-P -15

MODIFICATION OF A COMMERCIAL DNA EXTRACTION KIT TO SIMULTANEOUSLY RECOVER RNA, SAFELY AND RAPIDLY, AND TO ASSESS MOLECULAR BIOMASS OF THE TOTAL AND THE ACTIVE PART OF MICROBIAL COMMUNITIES, FROM SOILS WITH DIVERSE MINERALOGY AND CARBON CONTENT.

Agnès Robin, Montpellier - France

S11.04-P -16

MODIFICATION OF A COMMERCIAL DNA EXTRACTION KIT TO SIMULTANEOUSLY RECOVER RNA, SAFELY AND RAPIDLY, AND TO ASSESS MOLECULAR BIOMASS OF THE TOTAL AND THE ACTIVE PART OF MICROBIAL COMMUNITIES, FROM SOILS WITH DIVERSE MINERALOGY AND CARBON CONTENT.

Robin Agnès, Montpellier - France

S11.04-P -17

POTENTIAL INFLUENCE OF TERPENES ON SOIL ENZYMATIC ACTIVITY

Sylwia Adamczyk, Vantaa - Finland

S11.04-P -18

SPATIAL ECOLOGY OF BACTERIA IN SOIL: WHY DIVERSITY MAY NOT MATTER THAT MUCH

Xavier Raynaud, Paris - France

S11.04-P -19

SUBSTRATE INDUCED RESPIRATION METHODS: ARTEFACTS DEPEND ON SOIL, ADDED SUBSTRATE AND CO₂ ACCUMULATION

Renault Pierre, Avignon - France

S11.04-P -20

TANNINS AS NITROGEN-RETAINING AGENTS IN BOREAL FOREST SOILS

Bartosz Adamczyk, Vantaa - Finland



S11.04-P -1

ASSESSMENT OF LONG-TERM TILLAGE SYSTEM INFLUENCES ON CATABOLIC POTENTIAL OF THE SOIL MICRO-DECOMPOSERS COMMUNITY

Sharifi Mehdi^[1], Zebarth Bernie^[2], Burton David^[1], Drury Craig^[3], Grant Cynthia^[4]

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This study investigated long-term tillage system influences on catabolic capacity of the soil microbial community. Intact core samples from 0-5 cm soil depth under conventional tillage (CT) and 0-5 cm and 10-15 cm soil depth under no-tillage (NT) were collected after 14 years of winter wheat–corn–soybean rotation. Soil cores received a common substrate (14C-labelled wheat residues) either surface-applied or incorporated into the soil to measure catabolic capacity. Decomposition of the 14C-labelled residues, soil mineral N concentration and soil microbial biomass 14C (MB14C) were monitored over 86 d at 25°C. Cumulative respired CO₂-C and potentially mineralizable C (C₀) at 0-5 cm were 41% greater in NT compared with CT, and 40% greater at 0-5 cm than 10-15 cm depth under NT. The MBC at 0-5 cm depth at 16 and 30 d after residue addition was 64 and 43%, greater in NT compared with CT, respectively. Metabolic quotient (qCO₂-C) averaged 34% higher in surface-applied than incorporated residues 16 and 86 d after residue addition. Greater cumulative respired CO₂-14C (10%) and potentially mineralizable 14C (14C₀) (20%) at 0-5 cm was measured in CT compared with NT. The MB14C was 39% greater for residue incorporation compared with surface application. Overall, the microbial community under CT had a more catabolic potential than under NT, however, the differences in respiration and size of the microbial biomass appear to be primarily a function of quality and quantity of the soil organic matter rather than differences in catabolic capacity.



S11.04-P -2

CHANGES IN LEAF LITTER QUALITY ALONG PURE BEECH FOREST AGEING AFFECT SOIL MICROBIAL COMMUNITY AND ORGANIC MATTER DECOMPOSITION

Trap Jean*^[1], Marthe Akpa-Vinceslas^[2], Fabrice Bureau^[2], Karine Laval^[1], Christophe Gangneux^[1], Isabelle Gattin^[1], Michael Aubert^[2]

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We tested the hypothesis that litter quality of beech stand varies along an age gradient with consequences for decomposition and soil microbial community. We took advantage of fully replicated pure beech stands in France differing in age (15-, 65-, 95- and 130-yr-old stands). Litter fibres and nutrients (Ca, Na, Mg, Mn, K) were quantified. Using litterbags, stand-specific litter was exposed in the field during one year to assess litter decomposition and nutrient dynamics. Microbial biomass (ergosterol, fungal and bacterial DNA) and functional diversity of bacteria were assessed within the unmodified litter (OL), the fragmented and humified (FH) layers and the organo-mineral (A) layer. We observed great changes in litter quality and soil microbial community. Litter Mg and K contents decreased with increasing stand age. Manganese was the only nutrient analyzed that was highest in the oldest stands. Polysaccharides were lowest and lignin was highest in stands of intermediate age (65- and 95-yr-old stands). The ergosterol content in FH and A layers and the fungal / bacterial biomass ratio increased in the FH layer with increasing forest age. The functional diversity of heterotrophic bacteria was greater within OL and FH layers of 130-yr-old stands. Multivariate analyses showed intrinsic relationships between litter variability, microbial community and organic matter decomposition and suggested that litter quality was the driving factors of soil functioning along chronosequence. We conclude that forest age is an important driver of intraspecific variability in litter quality which needs to be accounted for a better understanding of key ecosystem processes.



S11.04-P -3

CHITINOLYTIC AND PECTINOLYTIC COMMUNITY OF THE TERRESTRIAL AND SOIL ECOSYSTEMS IN CHERNOZEM ZONE

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Chitin is a long-chain polymer of a N-acetylglucosamine and is found in many places throughout the natural world. Pectin is a structural heteropolysaccharide contained in the primary cell walls of terrestrial plants. Roots of the plants and root crops contain pectin. The breakdown of chitin and pectin within chernozem zone was studied. The aim was to provide a characterization of microorganisms involved in chitin and pectin degradation in the soils, litter and phylloplane. Quantity of eukaryote and procaryote organisms increased in the test samples with chitin and pectin. Increasing of eukaryote in samples with pectin was more then in samples with chitin. Also should be noted the significant increasing of actinomycet's quantity in the samples with chitin in comparison with samples with pectin. Further prokaryote community was investigated by method FISH (fluorescence in situ hybridization). Quantity of Actinomycets and Firmicures was the largest among identified cells with metabolic activity in soil samples. Should be noted significant increasing of the quantity of Acidobacteria and Bacteroidetes in pectinolytic community and Alphaproteobacteria in chitinolytic community. In considering of the phylogenetic structure investigated communities in samples of the litter should be noted increase in the segment of Proteobacteria. Increasing of this group of microorganisms was also detected in samples of the phylloplane. Also should be noted increasing of Baceroidetes in these samples. Further inoculation from investigated samples was provided. The dominant species of microorganisms were isolated on dense nutrient media. These microorganisms were detected by sequence analysis.



S11.04-P -4

DOES MICROBIAL COMMUNITY STRUCTURE CHANGE IN PYC TREATED FOREST TOPSOIL WITHIN THE FIRST YEAR?

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In several recent studies, pyrogenic carbon (PyC, the product of incomplete combustion of vegetation and fossil fuels) addition to soil has been shown to increase soil organic matter (SOM) decomposition (priming effect). The observed priming effect could be attributed to changes in microbial community induced by PyC. However, PyC effect on microbial community structure remains unclear. To understand the observed priming effect of SOM, we take advantage of our long-term field experiment in a temperate mixed forest (Wettingen, Switzerland) where we installed cylindrical mesocosms (20 cm long and 10 cm diameter) and added 2.8 g-C kg⁻¹ of soil equivalent of PyC at 2 cm depth from the surface. The PyC added is highly labelled (13C 842‰) and produced by charring Pinus ponderosa at 450°C under N₂ atmosphere. We observed +43 % of priming effect on SOM respiration induced by PyC addition within the first 10 months. We extracted the mesocosms and sampled soils at different column depths (0–5, 5–10, 10–15 cm). We analysed the soil sub-samples for microbial biomass using fumigation–extraction and 13C incorporation into different microbial communities using 13C-phospholipid fatty acid (PLFA) analyses. Further, to analyse changes in total microbial community we did pyrosequencing, a high-throughput tools for microbial identification and characterization. The changes (if any) in microbial diversity or functionalities will be linked to the observed priming effect.



S11.04-P -5

DYNAMIC RESPONSE OF MICROBIAL RESPIRATION TO MASS LOSS, CHEMICAL PROPERTIES, AND MORPHOLOGY OF DEAD FINE ROOTS IN A BROAD-LEAVED TEMPERATE FOREST, JAPAN

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*Fine root decomposition has mostly been characterized by microbial activity and dead root properties such as mass loss and chemical compounds, while less is known about the direct quantitative relationship between microorganisms and dead root properties. To clarify responses of microbial activities to changes in dead root properties with decay time, we examined specific microbial respiration normalized at 20 °C and its relationships to mass loss, chemical composition (C and N), and morphological traits of fine roots across two diameter classes (<0.5 mm, 0.5-2 mm) of *Quercus serrate* and *Ilex pedunculosa* in a broad-leaved temperate forest in Japan. Microbial respiration rate at 20 °C of all the roots increased with decay time in both species in the first year. For both species, microbial respiration, mass loss, and chemical and morphological properties of dead fine roots differed between diameter classes: the <0.5mm root showed higher respiration rate, slower mass loss, constant C/N dynamics, and faster loss of root length than the 0.5-2mm root. The respiration rate was correlated positively with mass loss and negatively with C/N across diameters and species. These results indicate that microbial respiration was determined by mass loss and chemical properties of dead fine root beyond species. The relationship between microbial respiration and root properties enables us to explain the mechanisms in the decomposition of dead roots with consequences of accurate and consistent estimates of belowground C and N dynamics.*



S11.04-P -6

EVIDENCE THAT SOIL ORGANIC MATTER MINERALISATION IS NOT CONTROLLED BY THE SIZE, ACTIVITY OR BIODIVERSITY OF THE SOIL MICROBIAL BIOMASS – A NEW HYPOTHESIS.

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BROOKES P. C., aKEMMITT S. Rothamsted Research, AL5 2JQ.. aCurrent address: FSA, London, E14 5HS. The amount of carbon sequestered in soil is three times that in vegetation. Understanding factors regulating mineralisation of soil organic matter (SOM) is essential to understand functioning of the soil-microbial-plant ecosystem. SOM probably has no definable structure, existing in structureless forms. It is this lack of polymeric structure which gives SOM resistance to microbial degradation, coupled with physical protection, e.g. sorption to surfaces of soil minerals or held within aggregates. Nevertheless, SOM is slowly mineralised by the microbial biomass. Here we introduce a new hypothesis to account for the observation that the rate of mineralisation of non-biomass SOM is independent of the size, biodiversity or activity of the biomass. This stems from work of Jenkinson Jenkinson and Powlson (1976) who showed that, following 24 h fumigation with CHCl_3 then fumigant removal, the fumigated soil respired at the same rate as a non-fumigated control soil, despite the biomass in the fumigated soil being only about 5 to 10 % of that in the non-fumigated soil and also of different diversity and activity. To account for this phenomenon we suggest that the rate-limiting step in SOM mineralisation is controlled by abiotic rather than microbial processes. These may include diffusion, desorption from soil surfaces, oxidation or (less likely) stabilised extracellular enzymes. This work has important implications for increasing our understanding of the role of the soil microbial community in regulating SOM dynamics.



S11.04-P -7

IMPACT OF N AVAILABILITY ON HETEROTROPHIC MICROBIAL DYNAMIC DURING DECOMPOSITION OF MISCANTHUS X GIGANTEUS LEAVES IN A SOIL.

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Carbon and N cycles are intimately associated during the residue decomposition process in soils. The overall N availability (residue + soil N) controls the rate of residue decomposition under N limiting conditions. Therefore studies have demonstrated low N availability reduced C mineralization rate on short term by reducing opportunist microbial biomass growth. However the effect of N availability on C mineralization and microbial biomass growth and composition on longer term, are still poorly understood. In the context of biofuel perennial plant production with Miscanthus, in which N amendments are limited, we investigated the effects of N availability on C and N dynamics, microbial dynamics and enzymatic functions on the short and long terms. Miscanthus leaves were incubated in an agricultural soil for > 500 days at two levels of soil N availability by adding inorganic N or not. C and N mineralization, microbial biomass C, ergosterol, xylanase and laccase activities and 18S-rRNA and 16S-rRNA were determined at several dates during the experiment. Results showed that a high N availability increased the rate of residue C mineralized in the short term (< 1 year) together with an increase in microbial C, fungal ergosterol, and enzymatic activities related to C degradation (xylanase). However, the high N availability suppressed laccase activity while it has no significant effect on 18S- and 16S r-RNA microbial communities. On longer term (> 1 year), high N availability slightly decreased C mineralization compared to low N treatment demonstrating the antagonist effect of N on residue decomposition.



S11.04-P -8

IMPACTS OF ORGANIC RESIDUE MANAGEMENT IN EUCALYPTUS FOREST ON MICROBIAL COMMUNITIES.

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Harvest residue management during inter-rotation period greatly influences the availability of nutrients in the soils and the sustainability of future rotations in fast growing plantations established on highly weathered tropical forest. Impact of forest management treatment on productivity was shown, particularly in plantations where organic matter (OM) content is extremely low like in Congo. Consequences of OM management on microbial communities were rarely taken in account. However, changes in microbial biodiversity can impact decomposition processes indicating that understanding the significance of biodiversity is essential to assess the consequences of forestry practices for carbon and nutrient cycles. Experiment was conducted in Eucalyptus plantations in Congo. Three treatments were studied (all aboveground organic residues removed from the plot; only stemwood harvested which correspond to Congolese commercial plantation; or double supply of residues). DNA and RNA were co-extracted from leaf-litter and upper soil layers (0-10 cm). Density and structure of bacterial and fungal communities were assessed by the quantitative PCR (qPCR) and fingerprinting technique (DGGE), respectively based on 16S and 18S rRNA. We also investigated functional microbial communities potentially involved in C cycling: the phylum of the Actinobacteria, known for their saprophytic activities; the BphDox bacterial community involved in the degradation of aromatic compounds and Laccase fungal community implicated in the degradation of phenolic compounds. Altogether, these data allowed to progress in the establishment of links between nutrients flux measured in field and microbial analyses which is a challenge to a better understanding of the functioning of forest ecosystems.



S11.04-P -9

IMPLICATIONS OF EXTRACELLULAR ENZYMES ACTIVITIES ON C AND N DYNAMICS DURING LITTER DECOMPOSITION: EXPANDING A THEORETICAL MODEL

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Understanding the decomposition process of organic matter in soil is essential to the stewardship of many ecosystems services that depend on the quantity and quality of soil organic matter. Decomposition is largely a microbial process and a growing literature view patterns in activities of extracellular enzymes as a functional indicator of microbial metabolism or resource availability, both in decomposition studies and at ecosystem scales. However, most traditional mathematical models do not describe the activities of extracellular enzymes as drivers of decomposition. Schimel and Weintraub (2003) were among the few authors to explicitly couple microbial, extracellular enzyme and soil organic matter dynamics while balancing microbial energy and nutrient requirements. Their conceptual model defines a single microbial pool that produces a single pool of extracellular enzymes that hydrolyzes a single pool of substrate containing C and N, but in a manner that permits comparing enzyme pool size, dynamics and activity to energy and nutrients fluxes. We expanded this conceptual model in developing the EEZY model (ExoEnzyme model) which includes three pools of extracellular enzymes hydrolyzing or oxidizing three pools of substrate: one containing C and N (e.g. proteins), another containing only C (e.g. cellulose and hemicelluloses) and the last containing both recalcitrant C (e.g. lignin-like) and N. This model describes the allocation schemes of microorganism resources to enzyme production to balance C- and N-acquisition, integrating the general relationships in ecological stoichiometry and metabolic theories reported in the literature (e.g. Manzoni et al. 2010, Sinsabaugh and Follstad Shah 2011).



S11.04-P -10

INFLUENCE OF PLANT RESIDUE QUALITY ON ENZYMES DYNAMICS: IMPORTANCE OF ENZYME DISTRIBUTION BETWEEN SOIL AND RESIDUE.

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The intrinsic characteristics of plant, which is the substrate for microbial growth and enzyme activities, is a key factor driving residues decomposition in soils. The objective of this work was to compare the pattern of microbial enzyme activities and C mineralization kinetics in order to obtain functional information about the influence of residue quality during their decomposition. Incubations of plant residues of contrasted quality i.e. maize leaves and roots were performed at 15°C under non N limiting conditions. A dynamic evaluation of plant residue quality, of several enzymes activity, of microbial biomass C and of the residue C mineralized was performed at different dates of the 43-day incubation. Enzymes activities were determined in soil and plant extracts. Results showed that at the end of the incubation period, significantly higher amounts of C was mineralized in case of maize leaves than roots. Enzymes activities of leaves were systematically higher in leaves than in roots. High xylanase and cellulase activities measured at the start of incubation revealed that xylan and cellulose are among the first compounds to decompose. Overall laccase activity was much lower than CBH-1 activities. This suggests that specialized lignolytic fungi producing laccase gradually took over when opportunist microorganisms decreased. Further, more enzymes were quantified in soil than on plant residue while enzyme concentrations were higher in plant residue. These results indicates that nature of C source/plant residue quality has a strong influence on microbial biomass production and enzyme activities.



S11.04-P -11

INVESTIGATING THE IMPACT OF PLANT COMPOSTING ON THE MICROBIAL DEGRADER COMMUNITY DYNAMICS IN SOIL USING PLFA-SIP APPROACH

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Composts are applied on cultivated soils to sustain the content in soil organic matter (SOM). The mechanisms leading to an increase of SOM content are still poorly understood. The changes of OM during the thermophilic phase of composting might be different from the changes naturally occurring in soils, which might influence the decomposition of composted OM compared to non composted OM in soils. Our objectives were to better understand the effect of composting on the structure of the soil microbial degrader communities and to identify potential relationships with the rate of mineralisation and OM chemical composition. Composted (during 12 weeks) or non composted ¹³C enriched plant residues were incubated with arable soils during 3 years under controlled condition (20°C, 80%WHC). The evolution of chemical composition of plant residues, CO₂ evolved and the dynamics of the microbial degraders throughout the experiment were determined by ¹³C-NMR, GC-IRMS and PLFA-SIP method, respectively. The structure of the whole soil microbial community (total PLFA) was only slightly affected by the addition of OM, whatever their nature, compared to non amended soil (control). During the first 3 months of incubation, the structure of the microbial degrader communities (¹³C labelled PLFA) differed when composted or not composted plant residues were added but converged thereafter. These population changes were closely related to the evolution of the rate of mineralisation and the composition of the OM added.



S11.04-P -12

MAY SOIL PARENT MATERIAL INFLUENCE NITROGEN TRANSFORMATION IN FOREST FLOOR?

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Forests floor contains 20-30% of total soil organic matter and up to 80% of active roots. Forest productivity is largely ensured of forest floor quality. The litter fall transformation hypothesis is the more humified materials the more nitrogen stabilized as the humic substances. We have collected some literary and our own data fixing increasing C/N from L (litter) to H (humified) of forest floors as on sand as on clay and loam. In our two years study we marked C/N increasing and C/N decreasing from L to F sub-horizons in forests floor of the pine forests soils on the sands with predominant of SiO₂ and R₂O₃ respectively. In our long terms laboratory experiments we had found the nitrogen decreasing along the decay continuum of biochemically different litters in the contact with quarts sand and moraine loam. It seems that contact caused predominance mineralization above humification and nitrogen loss. The compost overwetting reduced and it aeration and mixing increased the nitrogen loss. Without performing a complete analogy between laboratory experiments and natural processes, it is likely to assume that the mineral substrates have a significant impact on the transformation of litter, especially during early stages of overgrowing of disturbed areas, and during the forest floor formation on the parent materials poor of R₂O₃. This phenomenon may play in nature important role prolonging the oligotrophic stage of boreal forests and affecting their productivity and stability. The authors acknowledge SPbU for the research grant 1.0.142.2010 and the RFBR grant 10-04-00481a.



S11.04-P -13

MICROBIAL HABITAT CONDITIONS OR MICROBIAL COMMUNITIES AS DRIVERS OF SOIL ORGANIC MATTER DECOMPOSITION?

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Soil microbial communities live in a complex three-dimensional framework in which a variety of ecological niches exist. These niches correspond to the microbial habitat. Unlike higher organisms, microorganisms are directly exposed to the conditions of their habitat and they adjust their metabolism and activity to meet the challenges imposed by their local environmental conditions. Microbial habitat properties are therefore likely to profoundly affect microbial activity in general and microbial decomposition of soil organic matter in particular. The importance of habitat properties relative to biological properties such as microbial biomass or diversity is not known, however. In order to test the hypothesis that microbial habitat properties are more important determinants of organic carbon decomposition than are biotic properties, such as microbial biomass or diversity, we have established an experiment in which microbial communities from different soils were cross-inoculated into a range of soils with different properties (texture, pH, organic matter status) that had been sterilised by gamma radiations and measured soil respiration for a period of 4 months. In this way, we can compare the decomposition activity of the (initially) same microbial communities in different habitats and partition the effect of biotic and abiotic properties. Preliminary results suggest that habitat properties play a key role but the differences in microbial community structure, although significant, were not that great. We are now repeating the experiment with a larger range of microbial communities.



S11.04-P -14

MODELING EARTHWORM POPULATION DYNAMICS IN SEVERAL ORGANIC MATTERS

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Feeding and burrowing behaviors regulate the ecological groups of earthworms so that Epigeic Eisenia species with their natural ability to colonize organic matter expressed high rates of consumption, growth and reproduction. With a tolerance to a wide range of abiotic factors and short life cycles, Eisenia species displayed most of the characters required in vermicomposting process. Using several organic matters, we investigated the behavior and traits in terms of how organic matters regulate Eisenia fetida growth and population. Mathcad 15 software led to perform a growth model of Eisenia species with 5 variables in 5 organic matters. Population growth rates of earthworms were significantly different ($P < 0.05$) according to the tested organic matters. Methanogenesis digestate from chicory plants and roots increased Eisenia species biomass by 3.43 after 3 months. This model appears as a simulation approach of organic matter efficiency to increase earthworm population with an interest for vermicomposting process. Keywords: Earthworm, Eisenia, population, growth, organic matter



S11.04-P -15

MODIFICATION OF A COMMERCIAL DNA EXTRACTION KIT TO SIMULTANEOUSLY RECOVER RNA, SAFELY AND RAPIDLY, AND TO ASSESS MOLECULAR BIOMASS OF THE TOTAL AND THE ACTIVE PART OF MICROBIAL COMMUNITIES, FROM SOILS WITH DIVERSE MINERALOGY AND CARBON CONTENT.

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*We have modified a commercial DNA extraction kit for soil to simultaneously co-extract RNA. In this new procedure RNA and DNA are separated by two selective purifications in cascade without the need of DNAase or RNAse digestion. Consequently DNA and RNA are respectively purified from the whole co-extraction solution. Nucleic acids extraction is based on the action of SDS coupled with an efficient bead-beating step, but it does not require any solvent. Avoiding the use of solvents, which are damaging for human health and environmental quality, was one of our most important motivations to develop this protocol. In a second time, we have optimized this protocol to improve the DNA and RNA yield, but keeping those yields below the saturation limit of the kit to assess and quantify the variations of molecular biomass of the total (DNA) and the active (RNA) part of microbial communities in natural samples. We have also introduced a first step of homogenization of soil sample in liquid nitrogen to improve the reliability of the fungal 18S gene sequence quantification. Finally, we have shown that this protocol can be applied to a wide diversity of soils whatever their mineralogy and metal content (2 Ferralsols, 1 Vertisol, 2 Andosols from Madagascar), texture or biomass content (1 poor sandy soil from Congo and one carbon rich temperate soil sample submitted or not to a 1 month cold stress). * E Tournier, L. Amenc and AL. Pablo contributed equally to this study.*



S11.04-P -16

MODIFICATION OF A COMMERCIAL DNA EXTRACTION KIT TO SIMULTANEOUSLY RECOVER RNA, SAFELY AND RAPIDLY, AND TO ASSESS MOLECULAR BIOMASS OF THE TOTAL AND THE ACTIVE PART OF MICROBIAL COMMUNITIES, FROM SOILS WITH DIVERSE MINERALOGY AND CARBON CONTENT.

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S11.04-P -17

POTENTIAL INFLUENCE OF TERPENES ON SOIL ENZYMATIC ACTIVITY

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Terpenes are plant secondary compounds that may influence on microbial processes related to C and N cycling in forest soils. Chemically terpenes are hydrocarbons derived from isoprene units. Terpenes have a potential to influence on nitrification and microbial growth. In comparison with monoterpenes, the role of higher terpenes in soil decomposition process is far less-known. The aim was to study effects of monoterpenes (alfa-pinene, myrcene, carene), diterpenes (abietic acid, colophony) and triterpenes (beta-sitosterol) on activity of enzymes involved in C and N cycling (beta - glucosaminidase, beta-glucosidase, protease). We studied such effect of terpenes on enzymes in two ways: i) in vitro - a buffered solution of commercial enzyme was pre-incubated with terpenes, and later enzymatic activity was measured, ii) in vivo - terpenes were incubated with two different forest soils in controlled conditions (17°C, 60% water-holding capacity). Moreover, for soil incubation experiment CO₂-production was measured on gas chromatograph to get a picture of intensity of soil microbial activity. Terpenes used in our studies showed some ability to decrease enzyme activity in studies in vitro; in studies in vivo (in soil incubation experiment) this effect was weaker. In conclusion, terpenes may have an influence on soil processes by influencing on enzyme activities.



S11.04-P -18

SPATIAL ECOLOGY OF BACTERIA IN SOIL: WHY DIVERSITY MAY NOT MATTER THAT MUCH

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The development of molecular techniques during the past two decades has uncovered a phenomenal bacterial diversity in soils. For example, a single gram of soil can harbour up to 10^{10} bacterial cells and an estimated species diversity of between $4 \cdot 10^3$ (Torsvik et al, 1990) to $5 \cdot 10^4$ (Roesch et al, 2007). Recent studies have identified major environmental influences on soil bacterial diversity (pH) and biomass (soil organic carbon) between geographical regions and across biomes (Dequiedt et al, 2009 ; Lauber et al, 2008). It is intriguing however, that no link between diversity and many important microbial-driven processes, such as soil carbon mineralization, nitrite oxidation or denitrification, has been identified. Here, we analyse distributions of individual bacterial cells in soil measured in 760 microscopic observations of 90 different soil thin slices and build a 3D statistical model of bacterial distribution in soil. The analysis of model properties suggest that, despite the huge number of cells and the astronomic diversity present in soil, bacterial communities (defined as a group of individuals among which there are interactions) are not in fact that diverse and that our conception of soil bacterial communities is out of kilter with reality.



S11.04-P -19

SUBSTRATE INDUCED RESPIRATION METHODS: ARTEFACTS DEPEND ON SOIL, ADDED SUBSTRATE AND CO₂ ACCUMULATION

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The measurements of substrate induced respiration may be subjected to artifacts in the MicroRespTM method. When dealing with, the total CO₂ comes from the microbial respiration, the dissolution of calcareous materials and the sodium bicarbonate initially present in the gel with cresol red. Its partitioning between the gaseous headspace, the gel and the soil solution could affect these measurements. We develop and use a geochemical model that describe the main acid-base reactions occurring in the gel and in the soil in order to simulate the distribution of CO₂ as gaseous and aqueous CO₂, carbonyl acid, bicarbonate and carbonate in the 'soil-air-gel' closed system in order to assess the bias in the microbial CO₂ production estimate and propose correction factors. Although microbial respiration may be overestimated for calcareous soils initially amended with acid substrates, it is more generally underestimated. For defined volumes of gel, gaseous headspace and soil solution, the correcting factor not only depend on the soil pH(water), but also on the presence of calcareous compounds, the amount and pK_a or pK_b of the supplied compounds, and the CO₂ partial pressure at the end of the incubation, since it greatly affects the pH of the gel and the pH of the soil solution. This approach has been checked for a calcareous soil incubated over various periods, after supplying some substrates either acid, neural or alkaline.



S11.04-P -20

TANNINS AS NITROGEN-RETAINING AGENTS IN BOREAL FOREST SOILS

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Tannins are complex group of phenolic plant secondary compounds, which are especially abundant in certain unfertile environments having low soil pH like boreal forest ecosystems. Tannins are able to create recalcitrant complexes with proteins, therefore they may conserve litter N within the ecosystem. Tannins can potentially influence N mineralization, induce toxicity to microbes and affect enzyme activity. The influence of tannins seems to depend both on the chemical structure and molecular mass of tannins. The exact role and the function of different tannins in soil decomposition processes is not fully recognized. We studied differences between tannins in plant and soil samples, tannins ability to precipitate proteins, and moreover, degradation of protein-tannin complexes. We found differences between tannin concentrations between three main common trees in Finland (Picea abies, Scots pine, Pinus sylvestris), but also between ground vegetation species and between soil organic horizon under these trees. Also protein-precipitating capacity differed, pointing to differences in tannin astringency. In laboratory short-term studies, in which tannin-protein complexes were subjected to enzymatic attack, hardly any proteins were released from the complex. Our recent study showed, that tannins can also precipitate some other N-containing organic compounds (of all proteinaceous amino acids only arginine, polyamines, nitrogen bases, chitin and chitosan). While little is known about degradation of tannin-protein complexes, there is no information about tannin complexes containing other organic N-compounds than proteins.



S11.05-P - NITROGEN TURNOVER AND GLOBAL CHANGE - INFLUENCE OF ECOSYSTEM DEVELOPMENT, CLIMATE, LAND USE AND XENOBIOTICS ON ABUNDANCE, DIVERSITY AND ACTIVITY OF SOIL MICROBIAL KEY PLAYERS

Wednesday 04 July 2012 from 17:00 to 18:30. Room Poster Areas

S11.05-P -1

ACTIVE ACETYLENE REDUCTION FROM MEADOW TUNDRA SOIL MICROBIOTA BUT NOT IN THOSE OF HEATH TUNDRA IN ABISKO, SWEDEN

Yasuyuki Hashidoko, Sapporo - Japan

S11.05-P -2

AMMONIA OXIDATION IN SOILS OF DESERT ECOSYSTEMS: EFFECT OF ARIDITY LEVEL

Yonatan Sher, Sde Boqer campus - Israel

S11.05-P -3

BASELINE OF BIOGEOCHEMICAL CYCLES IN TEMPERATE OLD GROWTH FORESTS IN CHILE

Roberto Godoy, Valdivia - Chile

S11.05-P -4

BIOGEOCHEMICAL PROCESSES BEHIND HIGHLY VARIABLE N₂O EMISSIONS IN FORESTED AND AGRICULTURAL PEATLANDS

Maarit Liimatainen, Kuopio - Finland

S11.05-P -5

EFFECT OF COBALT, AND NITROGEN FORMS ON NITRATE ACCUMULATION IN JEW'S MALLOW PLANT AS AFFECTED BY A NITRIFICATION INHIBITOR

Safaa Abdalla, Giza - Egypt

S11.05-P -6

GRASS-ENDOPHYTE (NEOTYPHODIUM COENOPHIALUM) SYMBIOSIS INFLUENCES INORGANIC N AND AMINO ACID DYNAMICS IN SOIL

Somayeh Ghasemi, Isfahan - Iran, Islamic Republic of



S11.05-P -7

GROSS NITROGEN FLUXES IN INTACT BEECH-SOIL MICROCOSMS UNDER SIMULATED CLIMATE CHANGE

Michael Dannenmann, Freiburg - Germany

S11.05-P -8

NEW PRIMERS FOR PCR-DGGE ANALYSIS OF NITRATE REDUCING BACTERIAL COMMUNITY: APPLICATION TO SOIL ENVIRONMENT

Roberta Pastorelli, Bologna - Italy

S11.05-P -9

QUANTIFYING THE UNCERTAINTIES IN SOIL DENITRIFICATION POTENTIAL AS DETERMINED BY ACETYLENE INHIBITION METHOD

Shuping Qin, Shijiazhuang - China



S11.05-P -1

ACTIVE ACETYLENE REDUCTION FROM MEADOW TUNDRA SOIL MICROBIOTA BUT NOT IN THOSE OF HEATH TUNDRA IN ABISKO, SWEDEN

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Nitrogen fixation potential of soils under four different vegetative states in Scandinavian boreal forest limit in Abisko, Sweden, was examined. In the sampling site (N 68° 21' 16", E 18° 48' 58"), soils under heath tundra (altitude 640 m, *Empetrum nigrum* ssp. *hermaphroditum* as major vegetative composition) and meadow tundra (altitude 647 m, *Betula nana*, *Carex bigelowii*, and *C. lachenalii* as major vegetative composition) and bed soils under the birch-heath forest (altitude 454 m, *Betula pubescens* and *Vaccinium myrtillus*) and birch-meadow forest (altitude 509 m, *Betula pubescens* and *Vaccinium myrtillus*) were collected. All suspensions of each meadow soil (1 mg soil per mL medium) cultured for 7 days in 10 mL Winogradsky's mineral base medium supplemented with 0.3% gellan gum and 0.5% sucrose showed active C₂H₄ production at the rate of 100-150 nmol h⁻¹. In contrast, both heath soils from tundra and birch forest did not show any significant C₂H₄ reduction. These results suggested that wet soils in the meadow sites accelerated nitrogen fixation while nitrogen supply in soils covered with heath carpet seemed to be repressed. It is therefore necessary to investigate bacterial composition of soil microbiota under the meadow sites and the heath sites. Since the major nitrogenfixing bacteria in heath tundra in Kilpisjärvi, Finland, have been characterized by 16S rRNA gene-DGGE and *nifH* gene- DGGE analyses to be *Clostridium* spp., *Mesorhizobium* spp. and *Geobacter* spp., detection of those nitrogen-fixers under heath as covering vegetation would be important information and elucidated by means of DGGE analyses.



S11.05-P -2

AMMONIA OXIDATION IN SOILS OF DESERT ECOSYSTEMS: EFFECT OF ARIDITY LEVEL

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Arid regions are expected to be extremely vulnerable to global climatic changes. Balanced interrelations between the above-ground biological activities (plants) and below-ground biological activities (microbes) are key factors for sustainable desert ecosystems under changing climatic parameters. Perennial shrubs in desert ecosystems create hot-spots of microbial activities by concentrating nutrients (minerals and organic matter) in the soil beneath their canopies. We hypothesized that comparing the performance of these components in ecosystems of different aridity levels can help in predicting the responses of desert ecosystems to increased aridity. Ammonia oxidation is a central process of the nitrogen cycle, while nitrogen is considered to be the second most limiting factor, after water, for arid ecosystem productivity. In this study we compared the activity and diversity of ammonia-oxidizing microbes in semi-arid and arid landscapes. Abundances of ammonia oxidizers, varied between shrub and inter-shrub patches within examined ecosystems, correlating with varying environmental factors. A similar community structure of ammonia-oxidizing bacteria was found in the arid and semi-arid ecosystems, while ammonia-oxidizing archaea showed a different community structure between the two ecosystems. Ammonia-oxidizing communities remained stable after one year of reciprocal soil exchange experiments, indicating their resilience to short-term changes in aridity level. However, a long drought period that struck the semi-arid region and caused massive shrub mortality, promoted a temporary increase in soil levels of ammonia and nitrate together with reduced ammonia oxidation activity. The environmental implications of nitrate accumulation in desert soils will be discussed further.



S11.05-P -3

BASELINE OF BIOGEOCHEMICAL CYCLES IN TEMPERATE OLD GROWTH FORESTS IN CHILE

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Old-growth forests in Chile are an important part of the global temperate forest reserve. They are characterized by a comparably high efficiency in nutrient cycling, particularly under extreme climatic conditions like high rainfall (> 7000 mm yr⁻¹). In addition, they are considered relatively unpolluted compared with forest ecosystems of the Northern Hemisphere, so they can act as blueprints for preindustrial deposition regimes in biogeochemical research. Therefore, we characterized gas emissions, biological activity in soil, and water and nutrient fluxes in all strata in a Nothofagus forest, located in the Puyehue National Park (41°S, 800-900 m a.s.l.) and monitored the changes after deforestation. The low availability of nitrogen along with low atmospheric input both produce a strong dependence on symbiotic (e.g. mycorrhizal) and non-symbiotic N-fixation at stand level, further supporting already highly efficient nutrient cycling mechanisms. Deforestation causes N losses and will increasingly occur as DIN instead of DON, since DON production decreases and DIN release by microorganisms increases, as do emissions of greenhouse gases (CO₂, CH₄, and N₂O) due to changing microorganism communities and enzymatic activities in the soil. These emissions are substantially higher as to be expected by the decomposition of remaining dead biomass after deforestation. (Fondecyt 1110331)



S11.05-P -4

BIOGEOCHEMICAL PROCESSES BEHIND HIGHLY VARIABLE N₂O EMISSIONS IN FORESTED AND AGRICULTURAL PEATLANDS

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Natural peat soils are minor sources for N₂O but after drainage of nutrient rich peat soils for agriculture or forestry N₂O emissions may increase substantially. The factors affecting N₂O production are complex causing high variation in the N₂O emissions. We are studying the biogeochemical processes in peat to explain the high spatial and temporal variation in N₂O emissions from drained peat soils and to find the proper land-use options to minimize the N₂O emissions. The N₂O emissions have been measured 1 to 3 times per month during a study period of two years from three peatland forests with different nitrogen availability. Laboratory experiments have been done with these three peatland forest soils but soils are sampled also from peatlands under different land-use from six other sites in Finland, Iceland and Sweden. The annual N₂O emissions from all these sites are known. Production rates for N₂O and CO₂ have been studied in laboratory experiments, as well as the role of denitrification and nitrification in the N₂O production (acetylene inhibition technique), microbial biomass in soils (substrate induced respiration method) and gross and net nitrogen mineralization (15N isotope labeling techniques). In addition, soil physical and chemical characteristics were determined inclusively from different depths of peat profiles.



S11.05-P -5

EFFECT OF COBALT, AND NITROGEN FORMS ON NITRATE ACCUMULATION IN JEW'S MALLOW PLANT AS AFFECTED BY A NITRIFICATION INHIBITOR

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A pot experiment was established in the green house of National Research Centre to evaluate the effect addition of cobalt element at a rate 10 ppm, different rates of nitrogen (100 and 200) ppm N and forms of nitrogen as a Sodium Nitrate Na NO₃, Ammonium Sulphate (NH₄)₂ SO₄ and Urea (NH₂)₂ CO as others two treatments with and / or without a nitrification inhibitor (N-serve) on mineral composition and nitrate accumulation in Jew's mallow plant in alluvial soil of type clay loam. The results revealed that a positive contact was found between nitrogen rates and each of fresh, dry weight and plant contents of Cobalt, Nitrogen, Phosphorus, Potassium, Nitrate and residual effect of inorganic Nitrogen. While, a negative relation with trace elements contents (Fe, Mn, Zn and Cu) was observed. Treatments of Ammonium sulphate and Urea with Cobalt and (N-serve) as a nitrification inhibitor registered the highest value of all the determinations studied, except a nitrate accumulation in plant which recorded the highest values with (Sodium Nitrate, Ammonium Sulphate and Urea) with cobalt and without inhibitor respectively. Residual effect of inorganic nitrogen registered the highest values with (ammonium sulphate and urea) treatments with cobalt and (N-serve) inhibitor respectively.



S11.05-P -6

GRASS-ENDOPHYTE (*NEOTYPHODIUM COENOPHIALUM*) SYMBIOSIS INFLUENCES INORGANIC N AND AMINO ACID DYNAMICS IN SOIL

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Tall fescue (*Festuca arundinacea*) is often infected by the fungal endophyte *Neotyphodium coenophialum*. The adaptations of endophyte infected plants to biotic and abiotic stresses have already been investigated. However, there is a scarcity of information regarding the fate of N in soils received endophyte infected versus non-infected grass residues. Therefore, we conducted a laboratory experiment to study the effect of endophyte symbiosis on inorganic N and amino acids dynamics in soils treated with tall fescue residues. Result indicated that the patterns of net N mineralization or immobilization (Nm/i) in soils amended with tall fescue residues were influenced by the status of the endophyte. Residues of endophyte-infected (E+) caused strong N immobilization (41.4 mg N kg⁻¹ soil) during 22 weeks of incubation. The rate of N immobilization in the endophyte-free (E-) residue treated soil was less than that of E+ residues. In contrast, the concentration of amino acid remaining in soil was greater when exposed to E+ residues than E- residues. Our results suggest that the presence of endophyte may alter bioavailability of tall fescue residues and could consequently describe the influence of endophyte infection on the N storage of soil.



S11.05-P -7

GROSS NITROGEN FLUXES IN INTACT BEECH-SOIL MICROCOSMS UNDER SIMULATED CLIMATE CHANGE

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The simultaneous determination of gross turnover rates of amino acids and inorganic N in soil involving the players roots/plants, free living soil microorganisms and symbiotic mycorrhizal fungi still is a methodological challenge. Moreover, climate change effects on such gross nitrogen transformations as well as long-term N partitioning in intact plant-soil-microbe systems are unclear, but required to judge whether an adaption of present day beech forest ecosystems to expected future climatic conditions is possible. In an interdisciplinary climate change experiment, mini lysimeters containing intact beech-soil systems were transferred from cool-moist microclimate (NW exposure of the slope, model climate for present day conditions) to a nearby warm-dry microclimate (SW exposure of the slope, model climate for future conditions). After an equilibration period of one year, the intact beech-soil systems were homogeneously labeled with either ¹⁵N/¹³C-glutamine, ¹⁵N-ammonium or ¹⁵N-nitrate. Subsequently the short-term ¹⁵N recovery in pools ranging from plant to mycorrhiza as well as free soil microorganisms to inorganic and organic soil N pools was investigated via in situ incubations, leaving the plant-soil system intact. After repeated harvesting of the mini lysimeters, ¹⁵N excess data in the investigated pools was then used to derive gross N fluxes in the plant-soil-microbe system as influenced by climate change conditions. Here, the methodology of simultaneous determination of gross N fluxes in the intact beech-microbe-soil system will be outlined. Furthermore, first results on gross N turnover as well as long-term partitioning and storage of nitrogen as affected by climate change will be presented.



S11.05-P -8

NEW PRIMERS FOR PCR-DGGE ANALYSIS OF NITRATE REDUCING BACTERIAL COMMUNITY: APPLICATION TO SOIL ENVIRONMENT

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Nitrate is the most abundant form of oxidized nitrogen in biosphere, but it often constitutes a pollutant that strongly influenced soil and water conservation. In soil, nitrate levels are affected by the bacterial driven process of nitrate reduction, trough the denitrification, in which nitrate is reduced into gaseous compounds, or trough the dissimilatory reduction of nitrate to ammonium. Denitrification leads to loss of nitrogen from arable land and due to the atmospheric release of N₂O, it contributes to global warming and destruction of ozone layer. The narG gene, as it codes for the catalytic subunit of the nitrate reductase common to both dissimilatory nitrate reducers and denitrifiers, is frequently used as molecular marker for bacterial community-level analysis. In this study a new set of primers targeting the narG gene were designed and used to develop a semi nested PCR-DGGE (Denaturing Gradient Gel Electrophoresis) assay. The potential of new primers was verified on DNA directly extracted from soil considering five different experimental area distributed in Central and South Italy. Subsequently, we employed cloning and sequencing of DGGE fragments in order to validate the specificity of primers. The obtained DGGE results provided evidence on abundance and diversity of soil bacteria involved in nitrate reduction. The new primers have proved to highlight a number of bacterial species and/or gene species correlated mainly with narG sequences retrieved from gamma and beta-proteobacterial divisions. These new primers could expand the existing molecular tools for studying the size and diversity of nitrate-reducing community in soil.



S11.05-P -9

QUANTIFYING THE UNCERTAINTIES IN SOIL DENITRIFICATION POTENTIAL AS DETERMINED BY ACETYLENE INHIBITION METHOD

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Acetylene inhibition is still the mainstream method for soil denitrification potential (SDP) determination. However, this method has intrinsic uncertainties. The study aimed at quantifying such uncertainties. A fluvo-aquic soil was incubated under standard conditions of acetylene inhibition method for SDP measurement. The dynamics of N₂O and N₂ contents were monitored by a robotized sampling and analyzing system during the incubation. Our results showed that the acetylene inhibition method was not able to completely inhibit the reduction of N₂O to N₂. As high as 11.68% of the produced N₂O was reduced into N₂ in the presence of acetylene. It was necessary to correct the underestimation in SDP as determined by the acetylene inhibition method.



S11.06-P - BIOGEOGRAPHY OF SOIL MICROORGANISMS - Sponsored by IUSS

Wednesday 04 July 2012 from 17:00 to 18:30. Room Poster Areas

S11.06-P -1

BIOGEOGRAPHICAL EVALUATION OF ARID ZONE SOILS' MICROBIAL FUNCTIONAL AND GENETIC DIVERSITIES; ROLE OF CLIMATE, VASCULAR PLANT SPECIES, AND DISTURBANCE INDUCED VARIABILITY.

Adrian Unc, Las Cruces, New Mexico - United States

S11.06-P -2

BIOLOGICAL INDICES – AN OBLIGATORY COMPONENT IN THE CREATION OF THE INFORMATIONAL SOIL-GEOGRAPHICAL DATABASE

Maharram Babayev, Baku - Azerbaijan

S11.06-P -3

COMPOSITION OF SOIL BACTERIAL COMMUNITIES IN THE RHIZOSPHERE OF SOILS DERIVED FROM DIFFERENT LAND-USE TYPES

Sarah Herzog, Goettingen - Germany

S11.06-P -4

DISTRIBUTION AND DIVERSITY OF PROTISTS IN GRASSLANDS

Antonis Chatzinotas, Leipzig - Germany

S11.06-P -5

EFFECT OF SPATIAL CONNECTION VS DISCONNECTION BETWEEN SOIL MICROORGANISMS AND 2,4-D ON THE 2,4-D BIODEGRADATION.

Marc Pinheiro, Thiverval Grignon - France

S11.06-P -6

HOT SPOTS OF MICROBIAL BIOMASS AND EXTRACELLULAR ENZYME ACTIVITY ON THE MILLIMETRE SCALE IN ISRAELI SOILS IRRIGATED WITH TREATED WASTEWATER

Stefanie Heinze, Bochum - Germany

S11.06-P -7

IMPORTANCE OF SOIL ORGANIC CARBON AND MINERAL PARTICLE SIZE FRACTIONS FOR MICROBIAL DIVERSITY

Michael Hemkemeyer, Braunschweig - Germany



S11.06-P -8

INVESTIGATING SOIL RISK FACTORS FOR PARATUBERCULOSIS IN SCOTTISH CATTLE FARMING

Rupert Hough, Aberdeen - United Kingdom

S11.06-P -9

IS THERE A MICROBIAL SUB ALPHA-DIVERSITY AT SOIL MICROSCALE?

Florentin Constancias, Dijon - France

S11.06-P -10

LANDSCAPE-SCALE HETEROGENEITY OF SOIL MICROBIAL INDICES AND ENZYME-LABILE SOIL PHOSPHORUS DISTRIBUTION IN TYPIC AND AQUIC HAPLUDULTS.

Thanh H. Dao, Beltsville, Maryland - United States

S11.06-P -11

PROKARYOTIC DIVERSITY PATTERNS IN GERMAN SOIL SAMPLES

Christiane Fischer, Goettingen - Germany

S11.06-P -12

SOIL MICROBIAL COMMUNITIES IN GRASSLANDS – SPATIAL AND TEMPORAL PATTERNS AT THE LOCAL SCALE

Kathleen Regan, Stuttgart - Germany

S11.06-P -13

SPATIAL AND SEASONAL VARIABILITY OF ENZYME ACTIVITIES IN THE TOP- AND SUBSOIL OF A FORESTED CAMBISOL

Bernd Marschner, Bochum - Germany

S11.06-P -14

SPATIAL VARIATIONS OF MICROBIAL COMMUNITY STRUCTURE AND SOIL C TURNOVER ALONG A TRANSITION FROM A FORESTED TO A CLEAR CUT SITE

Carolyn Churchland, Vancouver - Canada

S11.06-P -15

THE ROLE OF ARCHAEA IN THE TURNOVER OF ROOT AND MYCORRHIZAL EXUDATES IN SOIL

Anna Karlsson, Lund - Sweden



S11.06-P -1

BIOGEOGRAPHICAL EVALUATION OF ARID ZONE SOILS' MICROBIAL FUNCTIONAL AND GENETIC DIVERSITIES; ROLE OF CLIMATE, VASCULAR PLANT SPECIES, AND DISTURBANCE INDUCED VARIABILITY.

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*Microbial genetic and physiological diversities are governed by complex abiotic and biotically induced parameters, most of which are insufficiently explored at community level. Soil moisture and substrate availability critically drive microbial physiology in manners that influence microbial community. These factors are dependent and mitigated by climatic variables, type and density of vascular plant cover, and management. To explore interactions between abiotic and biotic factors governing microbial community composition and function, we evaluated microbial communities at distinct sites in the Chihuahuan desert and the Colorado Plateau, in New Mexico USA, and in the Badia region of Jordan. We examined community composition using 454-pyrosequencing of 16S rDNA. Community function was assessed via community level physiological profiling (CLPP). CLPP assays quantify utilization of organic substrates, including diverse sugars, amino acids, and fatty acids, to explore differences in microbial community function associated with various sample matrices. To evaluate the role of abiotic factors similar plant species, namely woody shrubs of the *Atriplex* genus, were targeted at each site. Undisturbed, grazed and surface mine remediated sites were evaluated. At all sites we evaluated the significance of plants and soils as sinks for microbial diversity by direct comparison of soil, rhizosphere and plant endophytic communities. Multivariate, exploratory analyses, followed by multiple regression evaluation of the statistically relevant interactions, allowed integrative evaluation of genetic and physiologic profile datasets in the context of the measured abiotic parameters. This allowed simultaneous assessment of the role of biotic and abiotic factors on microbial diversity.*



S11.06-P -2

BIOLOGICAL INDICES – AN OBLIGATORY COMPONENT IN THE CREATION OF THE INFORMATIONAL SOIL-GEOGRAPHICAL DATABASE

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One of the tasks of primary importance facing Azerbaijan soil scientists is the creation of the informational soil-geographical database (ISGD), which can be helpful to regulate the use and the preservation of Azerbaijan soil resources and to join in the integrated soil-informational space of the European Union and Russia. One of the obligatory components in the creation of the informational soil-geographical database along with morphogenetic diagnostic soil indices is the integral index of the ecological biological state of soil (IIEBSS) determined on basis of most informative indices of soil biological activity (soil respiration, cellulose-decomposing capacity, total number of microorganisms, enzymatic activity). While examining the IIEBSS of Azerbaijan dry subtropics it was found out that the index of virgin and irrigated Qleyic Kastanozems soils (49-90%) is higher than that of irrigated Gleyic Calsisols soils (37-70%) and irrigated Gypsisols soils (25-62%). It can be explained by the physical chemical properties and the fertility rate of the soils. The indices of the IIEBSS decrease according to the following line: grey-cinnamon > meadow grey-brownish > grey-brown soils. The IIEBSS was practically used in the creation of the ISGD of the Azerbaijan irrigated Qleyic Kastanozems soils. In perspective, the ISGD has to be completed and created for the other zones and kinds of soils of the Azerbaijan Republic.



S11.06-P -3

COMPOSITION OF SOIL BACTERIAL COMMUNITIES IN THE RHIZOSPHERE OF SOILS DERIVED FROM DIFFERENT LAND-USE TYPES

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The composition of active (RNA-based) and entire (DNA-based) soil bacteria communities in the rhizosphere is rarely studied. In this study, we analyzed the influence of different land-use gradients (managed/unmanaged) on soil bacterial community compositions from a grassland experiment in the Solling, which is located in central Germany. Additionally, we investigated the influence of seasonal effects on soil bacterial community composition and activity. We collected the samples during spring, summer and autumn. We directly isolated DNA and RNA from 54 soil samples (18 soil samples per season, each with 3 replicates per land-use type). The total RNA was converted to cDNA. Both, the DNA and cDNA were used as template for phylogenetic analyses. The V2-V3 region of the 16S rRNA gene was amplified and the products were sequenced (454-pyrosequencing). The number of sequences was approximately 10,000 sequences per sample and season. The datasets were classified using the RDP pyrosequencing pipeline. Our sequence analysis showed differences between the entire (DNA-based analysis) and the active (RNA-based analysis) bacterial community in the soil rhizosphere. Furthermore, differences between the bacterial composition in spring, summer and autumn were encountered.



S11.06-P -4

DISTRIBUTION AND DIVERSITY OF PROTISTS IN GRASSLANDS

Chatzinotas Antonis^[1], Glaser Karin^[1], Berthold Tom^[1], Keil Daniel^[2], Marhan Sven^[2], Hai Brigitte^[3], Engel Marion^[3], Schlöter Michael^[3], Kandeler Ellen^[2], Harms Hauke^[1]

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^[2]University of Hohenheim ~ Institute of Soil Science and Land Evaluation, Soil Biology Section ~ Stuttgart-Hohenheim ~ Germany ^[3]Helmholtz Centre Munich ~ Environmental Genomics ~ Neuherberg ~ Germany

The goal of our project is to examine molecular diversity patterns of active and abundant single-cell eukaryotic predators of bacteria, the protists, over space and time along a land use gradient in grasslands. Bacterivorous protists as a key functional group within the soil microbiota represent an integral component of the terrestrial microbial loop and are involved e.g. in the release and cycling of nutrients immobilized in microbial biomass. Using molecular biological tools such as T-RFLP, qPCR and pyrosequencing, we obtained an overview of the active and overall protist community composition and abundances in soil. A geostatistical approach was applied to investigate the influence of grassland management representing different land-use intensities on the spatial distributions of selected protistan taxa. We hypothesized that the diversity and distribution of the protistan “seed bank” (total diversity including inactive dormant cells) and that of the established active population (“realized” diversity) will differ in response to biotic and abiotic factors. We further expected that habitat properties governing protistan distribution and activity patterns differ at plot- and at regional-scales and thus determine soil protistan biogeography. By comparing community patterns of the “realized” and the total community we could show a strong relevance of dormancy for soil protistan communities; thus, taking into account the trophic level of bacterivorous protists requires a distinction between the active and inactive pools in soil. Results further show that a generalization for all protists is not possible, since distinct phyla react differently to soil, habitat and general environmental factors.



S11.06-P -5

EFFECT OF SPATIAL CONNECTION VS DISCONNECTION BETWEEN SOIL MICROORGANISMS AND 2,4-D ON THE 2,4-D BIODEGRADATION.

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Distributions of pesticides used in agriculture and microorganisms are heterogeneous in soil, and so biodegradation is partly controlled by the respective localisations of pesticides and microorganisms and if they are not co-localised, by transfer processes which determine accessibility and availability of the substrate for degraders. Biodegradation is also controlled by local environmental conditions that can be more or less favourable to microbial activities. The relative importance of the regulatory factors and mechanisms is still poorly understood rendering difficult the prediction of pesticides dynamic in soils. We built soil cores with sterile and "natural" aggregates. We controlled the initial distributions of a pesticide, 2,4-D, and degraders that were co-localized or not in mm soil cubes. Two sets of experiments were performed: one with ¹⁴C-2,4-D to study the fate of 2,4-D and one with ¹²C-2,4-D to follow the development of degraders. At three dates (latency, exponential and final phase of 2,4-D mineralization), soil cores were cut out in slices and then in mm soil cubes that were then independently analyzed for extractable and non-extractable ¹⁴C-residues and for degraders by quantitative PCR (tfd A genes). Knowing the initial position of soil cubes allowed us to establish 3D maps of 2,4-D residues and degraders in soil. We also followed 2,4-D mineralization (¹⁴CO₂) at the core scale. Result showed a significant impact of the initial distribution of microorganism and 2,4-D on 2,4-D biodegradation. The experimental results will be used to test a 3D model called MOSAIC, a spatially explicit model of soil microbial substrate decomposition.



S11.06-P -6

HOT SPOTS OF MICROBIAL BIOMASS AND EXTRACELLULAR ENZYME ACTIVITY ON THE MILLIMETRE SCALE IN ISRAELI SOILS IRRIGATED WITH TREATED WASTEWATER

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In Israel nearly 70% of the agricultural irrigation water is treated wastewater (TWW) which has been shown to frequently result in the development of hydrophobic soil surfaces. Although not proven, it is assumed that this is caused by TWW-borne amphiphilic or hydrophobic organic compounds that cover the surfaces of mineral soil particles. Since physical surface properties are affected, we suggest that the activity and functionality of microorganisms in the first millimetres of soil surface differ from deeper soil. For this study, soils were collected from a multifactorial field experiment with three soils and four water qualities and from two field sites with long-term freshwater and TWW irrigation in Israel and Gaza. There, the first millimetres and the bordering soil (0-5 and 5-20 mm) were sampled and microbial biomass (C_{mic}), its respiratory activity and the activities of 10 extracellular enzymes involved in the C-, N-, S- and P-cycle were analysed. The results confirmed the expected higher microbial biomass and activity in the first millimetres of soil surface. C_{mic} is 35-60% higher in 0-5 mm than in the following depth. Microbial respiration was up to 65% higher than in the underlying soil over all sites. The influence of water quality is less important for microorganism distribution in the first millimetres of soil. The enzyme activities are also expected to be higher in the first millimetres of soil surface. These analyses are still not completed but for the conference, results from the 2011 spring and fall sampling campaign will be available and presented.



S11.06-P -7

IMPORTANCE OF SOIL ORGANIC CARBON AND MINERAL PARTICLE SIZE FRACTIONS FOR MICROBIAL DIVERSITY

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Soil microorganisms live in close contact with soil surfaces which are not homogenous but may provide different ecological niches within microscale distances. Our previous studies have revealed that soil fractionation can give rise to particle size fractions (PSF) which carry characteristic amounts of soil organic carbon, and which are associated with specifically selected microbial communities. Thus differently shaped microbial communities may interact with different amounts and qualities of organic carbon within a single gram of soil. In this study, we report on new results obtained from analyses of field soils from the long-term field study in Askov (Denmark) which were obtained by applying a wet-sieving technique and analyses of PSF by genetic profiling with T-RFLP and qPCR. The field variants from Askov should allow to elucidating the importance of soil organic carbon distribution among the PSF for the microbial communities.



S11.06-P -8

INVESTIGATING SOIL RISK FACTORS FOR PARATUBERCULOSIS IN SCOTTISH CATTLE FARMING

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Paratuberculosis (Mycobacterium avium ss. Paratuberculosis; MAP) is one of the biggest challenges facing cattle farmers in Scotland. Control programmes in Scotland have shown differential success rates suggesting that there are other, unrecognised factor(s) associated with disease prevalence. There is a growing body of evidence indicating that soil characteristics play a role. Much of this evidence relates to studies in the USA, Canada and Australia with little information available for Scotland. Our project aims to improve the understanding of the role that environmental factors play in the incidence of paratuberculosis in Scotland. A meta-analysis was conducted of 21 epidemiological studies that specifically targeted environmental risk factors with respect to paratuberculosis. The results of these analyses were used to identify the key potential environmental risk factors; namely soil pH (low), available iron content of soil (high), soil organic matter content (high), soil wetness (high), land capability (poor), manure management (access to manure), climate (cool, wet), and altitude (high). These data were used to design environmental sampling and analysis of 8 study farms (6 beef herds, 2 dairy), with a wider questionnaire-based survey, administered via face-to-face interviews. At each farm, sampling locations were selected on the basis of our meta-analysis. Quantitative-PCR was performed on samples along with traditional culture-based analyses to assess prevalence of MAP. Additional soil microcosm work was also performed to assess the persistence of MAP under a range of soil conditions. These results will be discussed and are the first attempt to identify soil risk factors for paratuberculosis in Scotland.



S11.06-P -9

IS THERE A MICROBIAL SUB ALPHA-DIVERSITY AT SOIL MICROSCALE?

Constancias Florentin^[1], Nicolas Chemidlin Prevost-Boure^[1], Samuel Dequiedt^[1], Virginie Nowak^[1], Jean-Philippe Guillemin^[2], Luc Biju-Duval^[2], Lionel Ranjard^[1]

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The distribution of the soil microbial diversity depends on a broad range of environmental filters nested in spatial scales from continent to millimeter. Although microbial biogeography studies have recently shown the influence of environmental factors (texture/pH/plant cover and land-use) on soil microbial abundance and diversity, little is still known about spatial heterogeneity at a micro-scale within soil. Our study aims at describing and understanding the distribution of abundance and diversity of soil microbial communities between different soil microenvironments. Four soils were selected on the basis of differences in physico-chemical properties and historical land-management practices. Soil microenvironments were obtained by applying a non-destructive soil fractionation procedure based on size separation of particles and water-stable aggregates (2000-250/250-63/63-20/20-2µm and <2µm classes). Total Soil and microenvironments physico-chemical characteristics were described (pH/C/N/texture). Microbial communities were described using: molecular microbial biomass (soil-DNA yield), bacterial and fungal density (real-time qPCR), genetic structure of bacterial and fungal communities (ARISA analysis) and, bacterial and fungal taxonomic inventory (pyrosequencing-based analysis of 16S & 18S rRNA gene regions). Our study allowed (i) the description of the spatial distribution of microbial communities at a microscale in different soil types and of the contribution of microenvironments' diversity to the overall biodiversity of soil, (ii) to evaluate, for the first time, the taxa-area relationship for soil microorganisms at a microscale and, (iii) to rank the environmental filters structuring sub alpha-diversity of soil microbial communities in comparison with filters highlighted in biogeographical studies and therefore to answer the question "which filter for which scale".



S11.06-P -10

LANDSCAPE-SCALE HETEROGENEITY OF SOIL MICROBIAL INDICES AND ENZYME-LABILE SOIL PHOSPHORUS DISTRIBUTION IN TYPIC AND AQUIC HAPLUDULTS.

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Long-term soil and nutrient management practices can have lasting effects on the geographic distribution of soil microorganisms, function, and those of non-mobile nutrients such as phosphorus (P). The non-random redistribution may influence nutrient turnover rate and use efficiency of crops, in comparison to mobile nutrients such as NO₃⁻. Spatial heterogeneity is also introduced during land applications of organic by-products such as animal manure and composts. We determined the distribution of soil microbial biomass and those of selected enzymes in a 10-ha field site based on a geo-referenced grid. The spatial structures of soil microbial indices and extractable P fractions were characterized based on their semi-variance distributions. A high biogeographic variability existed, and high microbial biomass and enzyme activities in specific locations reflected a localized high rate of nutrient turnover, and site-specific mechanistic differences for the accumulation of enzyme-hydrolyzable organic P. There existed a propensity for microbial and plant root systems to sequester phosphate in the biosynthesis of phosphomono- and diesters and for the induction and synthesis of hydrolytic enzymes to dephosphorylate organic substrates. Yet, conventional soil testing procedures do not adequately reflect the net accumulation or biogeochemistry of these organic P forms. In addition, biogeographic heterogeneity highlighted the need to improve current soil testing methods for estimating biochemical or microbial parameters, and nutrient requirements based on measurements of representative samples that were derived from compositing a large number of samples obtained from various locations on the field of interest.



S11.06-P -11

PROKARYOTIC DIVERSITY PATTERNS IN GERMAN SOIL SAMPLES

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Metagenomics has proven to be a powerful tool for the analysis of microbial communities present in different environments. By analyzing the abundance, diversity, and distribution of bacterial groups it is possible to gain insight into microbial structures of complex habitats. Although many surveys have been carried out that provided insight into microbial community compositions at various sampling sites, explaining differences between communities is still a challenge. Several habitat properties like soil characteristics and topographical factors are known to influence bacterial diversities in soils. However, the survey size was often too small for comprehensive comparisons, and correspondingly, the deduction of general theories was limited. To circumvent these limitations we performed large-scale analysis of soil bacterial community composition by surveying 300 sampling sites across Germany covering various forest and grassland plots, with different land-use types. Phylogenetic analyses on such a large scale contribute to the identification of general patterns with respect to composition and structure of soil bacterial communities. Moreover, the influence of the land-use type on the interplay of microbial community members can be detected by analyzing the metatranscriptome. In this approach, whole genomic RNA is isolated from the soil samples, rRNA is depleted, and the remaining mRNA is converted to cDNA, followed by next generation sequencing. The effect of fertilization on the active microbial community can be detected by this sensitive approach. In addition, metagenomic libraries have been constructed from the soil DNA, which have been screened on lipolytic and (hemi-)cellulolytic activity. Subsequently, the resulting gene products are characterized biochemically.



S11.06-P -12

SOIL MICROBIAL COMMUNITIES IN GRASSLANDS – SPATIAL AND TEMPORAL PATTERNS AT THE LOCAL SCALE

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Land-use intensity and seasonal plant-growth changes can modify the spatial distribution and nitrogen-cycling functions of soil microorganisms. To date, however, the extent to which spatial patterns are stable over the season has not been elucidated. Little is also known about how substrate availability derived from growing and decomposing plants changes the biogeography of soil microorganisms. We characterized the extent to which changes in the distribution of plant communities and substrate quality throughout a growing season changed the biogeography of nitrogen cycling soil microorganisms at the plot scale (10×10 m) to better understand the controls on their spatial distribution and function. One low land-use intensity grassland plot in the Swabian Alp region of southwest Germany was selected for its high plant diversity and previously determined high spatial dependence of microbiological properties. We sampled six times over one growing season, following the stages of plant exudate release at five plant growth stages and after frost-induced plant dormancy. This made it possible for us to 1) characterize whether the biogeography of soil organisms is constant within a season, and 2) determine how substrate availability from growing and decomposing plants influences their biogeography, using geostatistical mapping techniques. We also applied methods used in metabolomics for the first time in soils to profile the organic matter fraction and to better characterize functional relationships between plant and soil chemistry and ecosystem processes.



S11.06-P -13

SPATIAL AND SEASONAL VARIABILITY OF ENZYME ACTIVITIES IN THE TOP- AND SUBSOIL OF A FORESTED CAMBISOL

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The soil habitat is characterized by high spatio-temporal variability of regulating environmental factors like moisture, temperature or substrate availability at numerous scales. As SOC content and microbial densities decrease with soil depth, patchiness increases, with biological hot spots being associated with preferential flow paths or the rhizosphere. The study of enzyme activities and diversity provides an effective approach for examining functional diversity and heterogeneity in soils. The objective of this study was to determine enzyme activities at a very high spatial resolution in the top- and subsoil repeatedly in order to analyse spatial patterns and correlations with other soil parameters. Samples were taken in a loess-derived acidic Cambisol under forest in March, August and October 2010 at spatial resolutions ranging from 1 to 50 cm, using regular grids from the face of a profile and a nested sampling technique from the surface of the soil horizons. Sampling was performed in the Ah horizon in a depth of 5-11 cm and in the C horizon at 60-66 cm depth. In all 60-100 samples per depth, the activities of 10 hydrolytic enzymes were determined with a fluorimetric microplate assay. As expected, enzyme activities were generally higher in the topsoil samples and often below detection limits in the subsoil samples. However, some activity hot spots were found in both depths. The activities of most enzymes showed more temporal variability in the topsoil than in the subsoil. Geostatistical analyses showed distinctly different spatial patterns for the different enzymes in both depths.



S11.06-P -14

**SPATIAL VARIATIONS OF MICROBIAL COMMUNITY STRUCTURE AND SOIL C TURNOVER
ALONG A TRANSITION FROM A FORESTED TO A CLEAR CUT SITE**

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Spatial heterogeneity in climate, topography, bedrock geology, and hydrology are reflected in the abundance and species composition of plant communities. The plants themselves also create and maintain a mosaic of environmental conditions due to differences in nutrient demands, transpiration, and above- and belowground carbon inputs. Little is known about how this translates into corresponding variations in the activity and abundance of different groups of microorganisms. We therefore designed a study with the objective to determine to what degree trees influence the relative abundance and activity of mycorrhizal fungi, saprotrophic fungi and bacteria. This was achieved by using a geostatistical approach where the spatial variation in microbial community composition and C turnover was studied in a 27 by 18 meter square, extending from a forested area into a two year old clear cut. Variations in the microbial community composition were determined by PLFA analysis. We also measured respiration rates and used the isotopic composition of PLFAs, respired C, and different SOC pools to determine the influence of trees on the activity and abundance of different microbial groups. The results demonstrated that trees influenced the composition of the microbial community up to ten meters into the clear cut. The variations were reflected in the soil organic carbon turnover and suggest that trees influence not only the composition of microbial communities, but also their activity.



S11.06-P -15

THE ROLE OF ARCHAEA IN THE TURNOVER OF ROOT AND MYCORRHIZAL EXUDATES IN SOIL

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Archaea play an important role in the turnover of small organic compounds in marine environments. It is reasonable to assume that archaea also are involved in the turnover of these compounds in soil, represented by e.g. plant and fungal exudates. To test this hypothesis we designed a microcosm experiment in which we grew ponderosa pine, sitka spruce and western hemlock in forest soil. The root and mycorrhizal exudation rates were estimated in a ¹³C pulse-chase experiment and the number of archaeal and bacterial 16S rRNA genes was determined by qPCR. The archaeal abundance differed significantly among plant species, and the number of archaeal 16S rRNA genes was generally highest in soil with low concentration of exudates. The ratio between archaeal and bacterial abundance followed the same pattern, suggesting that archaeal abundance was negatively related to the rate of root and mycorrhizal exudation. The low abundance of archaea in the proximity of roots and mycorrhiza may be a result of slow growth rates and poor competitive ability of archaea versus bacteria and does not necessarily reflect a lack of heterotrophic abilities of the archaeal community.



S11.07-P - BIOTIC AND ABIOTIC DRIVERS OF PRIMING EFFECTS

Wednesday 04 July 2012 from 17:00 to 18:30. Room Poster Areas

S11.07-P -1

AGRICULTURAL PRACTICES SHAPE MICROBIAL COMMUNITIES AND CHANGE FRESH AND SOIL ORGANIC MATTER MINERALIZATION IN A TROPICAL SOIL.

Agnès Robin, Montpellier - France

S11.07-P -2

BIOCHAR PRIMING EFFECTS DURING COMPOSTING

Bruno Glaser, Halle (Saale) - Germany

S11.07-P -3

CARBON MINERALIZATION POTENTIAL AND PRIMING IN DEEP VOLCANIC RAINFOREST SOILS COMPARED TO THOSE OPERATING IN TOPSOIL

Rodrigo Neculman, Temuco - Chile

S11.07-P -4

EFFECTS OF ELEVATED ATMOSPHERIC CO₂ CONCENTRATIONS AND NITROGEN FERTILIZATION ON PRIMING EFFECTS, ENZYME ACTIVITIES AND PLFA IN AN AGRICULTURAL SOIL

Heike Ohm, Bochum - Germany

S11.07-P -5

EFFECTS OF PLANT-DERIVED DOM ON MINERALIZATION PROCESSES AND MICROBIAL COMMUNITY STRUCTURE IN MANAGED AND ABANDONED PASTURE SOILS IN SOUTHERN ECUADOR

Alexander Tischer, Tharandt - Germany

S11.07-P -6

IMPORTANCE OF PRIMING EFFECTS (PES) FOR PASTURE MANAGEMENT IN SOUTHERN ECUADOR

Karin Potthast, Dresden - Germany



S11.07-P -7

INTERACTIVE EFFECTS OF C AND N AVAILABILITY ON DECOMPOSITION OF SOIL ORGANIC MATTER

Ruirui Chen, Nanjing - China

S11.07-P -8

LIGHT INTENSITY AND MINERAL N INFLUENCE RHIZOSPHERE PRIMING EFFECTS

Ruirui Chen, Nanjing - China

S11.07-P -9

MANGROVE DECOMPOSITION DYNAMICS IN RESPONSE NUTRIENT ENRICHMENT

Joost Keuskamp, Utrecht - Netherlands

S11.07-P -10

MODELLING THE CHANGES IN DISSOLVED ORGANIC MATTER AROMATICITY CAUSED BY PRIMING EFFECT IN A METAL-CONTAMINATED SOIL

Jean-Yves Cornu, Bordeaux - France

S11.07-P -11

NITROGEN CONTROL OVER MICROBIAL ACTIVITY AND REAL PRIMING EFFECT

Sergey Blagodatsky, Aberdeen - United Kingdom

S11.07-P -12

ORGANIC MATTER ACCUMULATION IN THE SOIL CAN BE DETERMINED BY THE NET NUTRIENT BALANCE OF THE ECOSYSTEM: A MODEL TO EXPLAIN THE COMPLEX NETWORK OF INTERACTIONS BETWEEN MICROBIAL DIVERSITY AND PLANT

Nazia Perveen, Clermont Ferrand - France

S11.07-P -13

PRIMING EFFECT IN TOP AND SUB-SOILS IN THE CONTEXT OF MICROLANDSCAPE.

Alexey Zhuravlev , Pushchino - Russian Federation

S11.07-P -14

PRIMING EFFECT FOLLOWING NITROGEN ADDITION INTO BULK AND GLUCOSE-AMENDED SOILS

Eva Kastovska, Ceske Budejovice - Czech Republic



S11.07-P -15

THE AFFECT OF PLANT-PLANT INTERACTIONS ON THE RHIZOSPHERE PRIMING EFFECT (RPE)

Johanna Pausch, Bayreuth - Germany

S11.07-P -16

THE IMPACT OF TEMPERATURE AND SUBSTRATE QUALITY ON SOM PRIMING: EVIDENCE FROM LONG TERM INCUBATIONS AND C3-C4 TRANSITION EXPERIMENTS

Ilya Yevdokimov, Pushchino - Russian Federation

S11.07-P -17

THE ROLE OF PRIMING EFFECT IN DECOMPOSITION OF ORGANIC MATTER IN MODERN AND PALEO- SOILS.

Anna Zhuravleva , Pushchino - Russian Federation

S11.07-P -18

UNDERSTANDING MICROBIAL REGULATION OF PRIMING EFFECTS: NEW INSIGHT FROM SMALL-SCALE INVESTIGATIONS AT THE SOIL-LITTER INTERFACE

Christian Poll, Stuttgart - Germany



S11.07-P -1

AGRICULTURAL PRACTICES SHAPE MICROBIAL COMMUNITIES AND CHANGE FRESH AND SOIL ORGANIC MATTER MINERALIZATION IN A TROPICAL SOIL.

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Priming effect (PE) is defined as a stimulation of the mineralization of soil organic matter (SOM) due to fresh organic matter (FOM) supply. This process leads simultaneously to a loss of carbon to the atmosphere and to a remobilization of nutrients. PE should thus be considered in the management of residues or amendments in agricultural soils, especially where soil fertility is essentially based on organic supply. In Madagascar, the Direct-seeding Mulch based cropping (DMC) systems appeared to be an opportunity for the development of a sustainable upland rice culture. In DMC systems soil is not tilled and protected from physical erosion by dead or alive cover plants and/or mulches of crop residues. DMC systems are also known to increase soil organic matter stocks in the first centimetres below the mulch layer. As the quality of FOM is a determinant of the priming effect process, we were interested to evaluate whether the quality of mulches could shape the belowground microbial community and impact its capacity to mineralize SOM. In 2010, we sampled soil samples from a field experimentation set up in 2003 in the centre of Madagascar. The 10 first centimetres under three crop mulches (two grasses and one legume) and two different fertilizations (organic and organic + mineral), were sampled during the rice growing season. Soils were incubated in the presence of ¹³C-enriched wheat straw residue to measure their FOM and SOM mineralization capacity. Bacteria involved in both fluxes were identified by the coupling between DNA-SIP and pyrosequencing techniques.



S11.07-P -2

BIOCHAR PRIMING EFFECTS DURING COMPOSTING

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Biochar has received enormous attention recently due to its potential for long-term C sequestration and soil improvement known from the terra preta phenomenon. For producing terra preta-like substrates, it is imperative to combine biochar with nutrient-rich organic materials. We tested whether i) biochar is substantially more recalcitrant than fresh organic matter during the composting process, ii) biochar addition reduces the losses in labile organic matter occurring during the rotting process (negative priming) iii) anaerobic fermentation with 'effective microorganisms' exerts a stabilizing effect on organic feedstock, and iv) biochar addition amplifies fermentation-induced effects on organic matter. For this purpose, increasing amounts of biochar were composted with organic wastes under aerobic conditions in two experiments. Another series was treated with anaerobic fermentation prior to composting. Mass balance was established and contents of total organic carbon (TOC) and black carbon (BC) were measured prior to and after the process. Our results confirm that biochar is more resistant to degradation than fresh organic material during composting. Biochar was also shown to induce both positive and negative priming of fresh organic matter during composting. Apparently, properties of biochar and compost feedstock as well as process conditions have important influence on intensity and direction of priming. Fermentation reduced mineralization losses from fresh organic matter only as long as oxygen supply was limited. Subsequent aerobic composting caused losses, which largely compensated prior stabilization. Thus, there was no overall difference of organic matter losses between fermentation and composting. Biochar amplified this stabilizing effect only under anaerobic conditions.



S11.07-P -3

CARBON MINERALIZATION POTENTIAL AND PRIMING IN DEEP VOLCANIC RAINFOREST SOILS COMPARED TO THOSE OPERATING IN TOPSOIL

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C storage potential in Andisols is higher than in any other soil type, due to their high content of short-range order minerals such as allophane, with considerable potential to form stable complexes with organic molecules. Andisols present also a high amount of Aluminum and Iron with a great capacity to stabilize soil organic matter (SOM). The aim of this study was to evaluate the potential C mineralization of two Andisols under pristine temperate rainforests and to investigate the possibility of priming using ¹³C labeled cellulose addition. We hypothesized that disturbance of soil structure would have little effect on C mineralization potential of SOM. The study area is located in the Andean mountain range more specifically in San Pablo de Tregüa (SPT), Panguipulli and Puyehue National Park (PNP), Antillanca. Soil samples were collected at three different depths (0-20, 20-60 and 60-80 cm) and were incubated at 20°C with and without addition of cellulose for 80 days. The results showed that C mineralization occurred in all soil horizons from both sites. The addition of substrate to incubated soils stimulated significantly microbial respiration in all soil depths. However, the cellulose addition to the subsoil samples did not stimulate C mineralization to the same extent as in the topsoil. The interpretation of the results suggests a lower potential for C destabilization in the subsoil compared to the surface. Therefore, we suggest that the subsoil of Andisols may be regarded as C sinks, due to the strong protection of SOM by soil minerals.



S11.07-P -4

EFFECTS OF ELEVATED ATMOSPHERIC CO₂ CONCENTRATIONS AND NITROGEN FERTILIZATION ON PRIMING EFFECTS, ENZYME ACTIVITIES AND PLFA IN AN AGRICULTURAL SOIL

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The observed increase in plant biomass under elevated atmospheric CO₂ may enlarge the soil C pool, but it remains unclear whether this will lead to a long-term increased carbon pool, since little is known about the stability of the additional carbon inputs. The addition of such organic substances can lead to a shift in microbial activity, enzyme activity and composition of the microbial community and thus to priming effects. Topsoil samples were collected from a multifactorial FACE-experiment on an agricultural field in Northern Germany with two CO₂ concentration levels (550 $\mu\text{mol mol}^{-1}$ or 370 $\mu\text{mol mol}^{-1}$) and two N fertilizer levels (50 and 100% of the crop requirements). A 21-day incubation experiment was conducted to analyze the effects of the substrates fructose, alanine and ammonium nitrate on priming effects, enzyme activities and PLFA profiles at different times during the incubation. The results showed that the N-availability has to be taken into account if the influence of CO₂ fumigation is considered. The reduced N-fertilization had stronger effects on priming effects in the elevated samples where the CO₂ fertilization effect on plant growth is reduced by N-limitation. After all substrate additions, enzyme activities increased similarly throughout the incubation. At the end of the incubation similar distribution of the enzyme activities in soil samples with similar N-fertilization were observed, independent of the CO₂ fumigation. The PLFA analyzes showed that the microbial response to alanine was strongly controlled by the level of N-fertilization.



S11.07-P -5

EFFECTS OF PLANT-DERIVED DOM ON MINERALIZATION PROCESSES AND MICROBIAL COMMUNITY STRUCTURE IN MANAGED AND ABANDONED PASTURE SOILS IN SOUTHERN ECUADOR

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*Plants interact with soil in different ways and these impacts can lead to marked alterations of soil functionality. In the study area 2/3 of the pastures are degraded after the displacement of the pasture grass (*Setaria sphacelata*, C4-plant) by bracken-fern (*Pteridium arachnoideum*, C3-plant). Litter of bracken is known to be less decomposable than grass litter due to a wider C:N ratio and a higher lignin content. The aim of this study was to investigate the impacts of dissolved organic matter (DOM) derived from plant litter of different quality on soil microorganisms (activity, biomass, community structure). Since P-availability is low in the soils, in addition effects of P-fertilization were assessed within a microcosm experiment. Bracken-DOM was added to a pasture soil and grass-DOM was added to an abandoned pasture soil in excess (DOC/MBC=4.6-7.9) with or without P-addition and incubated for 28 days. During incubation the amount of CO₂ and its δ¹³C-signature was determined. The δ¹³C-signature of mineralised C indicated a preferential degradation of DOM-derived C irrespective of DOM source and significant negative priming effects. They were closely related to an increase in the relative abundance of Gram(-)-bacteria by 12-18%. At the end of incubation all amended microcosms showed an increase in microbial biomass-C and -P by a factor of 1.2-1.3 and 1.2-2.0, respectively. An additional effect was only observed after P-addition to abandoned pasture soil. It has to be discussed if this short-term negative priming effect might convert to positive priming in the longer term, due to increased nutritional demand of the soil microbes.*



S11.07-P -6

IMPORTANCE OF PRIMING EFFECTS (PES) FOR PASTURE MANAGEMENT IN SOUTHERN ECUADOR

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In Southern-Ecuador vast areas of pasture land are abandoned due to bracken-invasion. For a sustainable land-use it is important 1. to re-establish pastures on abandoned areas by bracken-control and subsequent Setaria-grass planting, and 2. to prevent degradation of active pastures by fertilization. To elucidate the implications of changing litter input (grass-C4 vs. bracken-C3) and of pasture-fertilization (urea, 50kg Nha-1a-1) on the structure and function of soil microorganisms, lab- (28-days) and in-situ (2-years) experiments were conducted. In total, after 28 days the addition of grass-litter to both pasture soils induced negative PEs of the same magnitude whereas the bracken-litter did not affect SOC mineralization due to its low litter quality. However, at the end of incubation a positive PE was observed after bracken-addition to the abandoned pasture soil supporting field-observations of CO₂-C effluxes that remained as high as at the active pasture soils. Urea fertilization induced a short-lived positive PE in both soils leading to a net loss of OC, as seen in the laboratory with ¹⁴C-labelled urea. In parallel, the relative abundance of Gram(-) bacteria and fungi increased. Short-term increases in CO₂-C effluxes have also been detected in-situ at urea-fertilized treatments for the first days after fertilization. 0.84t CO₂-C ha⁻¹a⁻¹ higher effluxes were measured. This is a further hint towards the occurrence of PEs under field conditions. However, the contribution of root respiration to the elevated CO₂-C effluxes is unknown. Positive PEs triggered by urea-fertilization or bracken-invasion can have negative impacts on the soil C balance in the long-term.



S11.07-P -7

INTERACTIVE EFFECTS OF C AND N AVAILABILITY ON DECOMPOSITION OF SOIL ORGANIC MATTER

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Exogenous organic C and mineral N play key roles in influencing whether native soil organic matter (SOM) is preserved or decomposed; however, turnover of SOM is difficult to study as turnover rate is low compared with its pool. Therefore, a natural ¹³C-labelling approach was used to investigate the interactive effects of C and N availability on the turnover of endogenous and exogenous soil organic C, and the resulting priming effects. The experiment included six treatments: non-amended C3-soil (Control); soil with mineral N (MIN); soil with C4-sucrose (SUC); soil with sucrose+mineral N (SUC+MIN); soil with C4-maize straw (MS); soil with maize straw+mineral N (MS+MIN). Sugar and straw significantly increased SOM-derived CO₂ emission, causing positive priming effects. Mineral N alone caused a negligible negative priming effect. With added organic C and mineral N, priming effects were 92.3 and 74.0 µg C g⁻¹ in SUC+MIN and MS+MIN. Furthermore, SOM-derived CO₂ emission in SUC+MIN was significantly higher than SUC, while sugar-derived CO₂ emission was not significantly different. In contrast, SOM-derived CO₂ emission was not significantly different in MS+MIN and MS, while MS+MIN significantly increased the decomposition of the added straw. We concluded that exogenous organic C acted as primer of SOM decomposition, but mineral N alone was incapable of promoting SOM decomposition. Mineral N in conjunction with organic C caused higher priming effects than pure organic C. Interactive effects of C and N on the turnover of SOM and exogenous substrate, were different depending on the C source.



S11.07-P -8

LIGHT INTENSITY AND MINERAL N INFLUENCE RHIZOSPHERE PRIMING EFFECTS

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*Linking rhizosphere processes and native soil organic matter (SOM) decomposition is crucial in soil biology and biochemistry. A natural ^{13}C -labelling approach was used to investigate the rhizosphere priming effects in response to different light intensities and added mineral N, in order to connect rhizosphere-dependent SOM decomposition with root exudates and soil N availability in situ. C4 plants (*Zea mays*, $\delta^{13}\text{C}$: -13.66‰) were grown in a C3 soil ($\delta^{13}\text{C}$: -24.83‰) with two light intensities (low-L and high-L) and three levels of N fertilizer $[(\text{NH}_4)_2\text{SO}_4$: 0, 170 and 340 mg N kg⁻¹]. Increased light intensity and mineral N significantly promoted root biomass and root-derived CO₂ emission indicating increase in root-exudates. And the effects of light intensity were stronger than mineral N. Over the monitoring 25 days, added mineral N had nil or negative effects on SOM-derived CO₂ emissions regardless of light intensity. However, SOM-derived CO₂ emissions were increased by 17% and 64% with low and high light intensity, which is positive rhizosphere priming effect. Our results indicated that increase in root exudates resulted in greater SOM decomposition, possibly by increasing soil microbial activity or driving a completion of N with plants in rhizosphere. However, rhizosphere priming effect was not enhanced by mineral N with identical root C allocation; therefore, application of mineral N fertilizer in agriculture soils would not raise the risk of decreasing global C sequestration due to extra gaseous CO₂ loss originated from SOM decomposition.*



S11.07-P -9

MANGROVE DECOMPOSITION DYNAMICS IN RESPONSE NUTRIENT ENRICHMENT

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Mangrove forests are sites of intensive carbon sequestration and the amount of carbon stored in mangrove soils is substantial on a global scale. Due to coastal development, mangrove ecosystems are exposed to increased nutrient influxes through wastewater loading and agricultural runoff. The potential consequences for carbon dynamics are large, especially if existing SOC is mineralized at increased rates. We investigated the effects of nitrogen and phosphorus enrichment on litter and SOC decomposition rates, either through direct stimulation or indirect through changing litter quality. On the short term, nitrogen has an inhibiting effect on SOC decomposition in mangrove soils. However, on the long term SOC decomposition is suspected to increase through an increased input of litter having a higher decomposability and a lower amount of tannin production in especially Rhizophora mangroves resulting in a higher expected half life of exo-enzymes. In this presentation we will report on our findings of several long-term incubation studies where we measured microbial biomass, exo-enzyme activity and decomposition rates of mangrove derived SOC and litter after several years of nutrient enrichment. We will present a simple mathematical model of microbial activity parameterized with the data obtained and discuss the long term effects of nutrient enrichment on microbial biomass microbial competition and SOC decomposition rates.



S11.07-P -10

MODELLING THE CHANGES IN DISSOLVED ORGANIC MATTER AROMATICITY CAUSED BY PRIMING EFFECT IN A METAL-CONTAMINATED SOIL

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A description of dissolved organic matter (DOM) quality in soil solution is required to better assess its ability to complex metals. After the rewetting of an air-dried soil, DOM is essentially constituted by hydrophilic non aromatic compounds which are much more degradable than aromatic humic molecules. This high content of easily mineralizable C promotes the decomposition of solid organic matter (SOM) by priming effect and the increase in aromatic ligands prone to complex metals. The quality of DOM is thus susceptible to strongly vary over time after the rewetting of an air-dried soil. The aim of our study was to follow over time at three different soil temperatures (10, 20, 30 °C) the concentration of aromatic molecules in soil solution, after the rewetting of an air-dried soil. The concentration of aromatic molecules was assessed from the absorbance of the soil solution at 254 nm (A254). As expected, an increase in the concentration of aromatic humic molecules was observed over time and with the rise in soil temperature. A model describing the variations in DOC concentration and A254 was tested based on the following assumptions: 1) DOC was initially entirely non aromatic, 2) The mineralization of non aromatic DOC was assumed to follow a first order reaction (time constant: k), 3) The mineralization of each atom of non aromatic C resulted in the apparition of β atom of aromatic C as a result of priming effect, 4) The impact of soil temperature was simulated by modulating the value of k according to the Arrhenius law.



S11.07-P -11

NITROGEN CONTROL OVER MICROBIAL ACTIVITY AND REAL PRIMING EFFECT

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N limitation alters microbial activity and can cause or modify priming effects (PE) – short-term changes in SOM decomposition induced by addition of easily available substances. Using incubation experiments, we estimated PE in a loamy Haplic Luvisol after the application of ^{14}C -labeled glucose and $(\text{NH}_4)_2\text{SO}_4$ (C:N=10:1). The amount of added glucose corresponded to 15% and 150% of microbial biomass C. The experimental design allowed for the calculation of ^{14}C balance and efficiency of fumigation (kEC). The kinetic analysis of microbial growth response was performed after 33 day's incubation at the moment when cumulative respiration in glucose amended soil equals that in glucose + N amended soil. This method allows for a quantification of microbial specific growth rates and the fraction of active microbial biomass. Most pronounced PE amounting for 12-72% of added glucose C was observed during first 3 days after glucose addition and was accounted as apparent PE. It was caused by the increase of microbial C turnover which was not linked with changes in SOM decomposition. A second peak of primed CO_2 (300 mg C per g soil) occurred only in GH treatment without N in 35-57 days after substrate application, and was accounted as real PE as it exceeds the microbial recycling by 4 times. We explain this increase in SOM decomposition by microbial activity caused by N limitation and by high initial supply of glucose. The amount of active microbial biomass at the beginning of second priming peak exceeds 14 times those in control soil.



S11.07-P -12

ORGANIC MATTER ACCUMULATION IN THE SOIL CAN BE DETERMINED BY THE NET NUTRIENT BALANCE OF THE ECOSYSTEM: A MODEL TO EXPLAIN THE COMPLEX NETWORK OF INTERACTIONS BETWEEN MICROBIAL DIVERSITY AND PLANT

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Traditional models of soil organic matter (SOM) decomposition are all based on first order kinetics and assume that SOM pool necessarily reaches equilibrium. Their general applicability can be challenged by the observations of accumulation of organic matter in the soil of numerous ecosystems and that of priming effect in the soil. We aimed at building a model in which SOM decomposition is controlled by the size of microbial population and by the supply of energy-rich litter compounds. Our results show that SOM pool does not attain a steady state and may increase in the soil depending on the nutrient (N) balance of the ecosystem. When net N input to the ecosystem is higher than the net N output of the ecosystem, the SOM pool increases leading to the sequestration of mineral nutrients in it. So, how the plants persist? We explored that the persistence of plant depends on the presence of two microbial functional types in the soil: i) SOM-decomposers, which decompose the recalcitrant carbon (C) in the soil and also degrade the easily degradable C compounds to get energy, ii) FOM-decomposers, which are specialized to decompose the fresh C in the soil. Our model predicts that SOM-decomposers act as miners of SOM pool and release mineral N into the soil and FOM-decomposers act as stockers of SOM pool leading to its sequestration. Thus, these two types of decomposers can allow the C storage and regulation of mineral N into the soil according to its net balance.



S11.07-P -13

PRIMING EFFECT IN TOP AND SUB-SOILS IN THE CONTEXT OF MICROLANDSCAPE.

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The estimation of ecological processes at the ecosystem level is difficult due to varying microclimate conditions within ecosystem mosaics. Both the structure of microbial communities and CO₂ emissions may vary significantly at sites with different microclimate coexisting on small scales. Effect of landscape on carbon fluxes from soil is due to redistribution of rainfall and organic residues entering the soil resulting in larger C content in soils formed on microdepressions versus soils in microelevations. It means that microorganisms in favorable conditions (microdepressions) are ready to degrade organic substrates whereas microbes in energy limited conditions (microelevations) need some time to become active. We hypothesized that the intensity of priming effects depends on microclimate conditions (caused by micro-landscape). This hypothesis was checked by the comparison of priming effects induced by ¹⁴C-glucose in organic (A) horizons of modern as well as of paleo-soils (grey forest soils Moscow region, Pushchino). Priming effect was observed immediately after glucose application and was 3-time greater in A horizons formed on micro-depressions as compared to A horizons formed on micro-elevations of modern soils. Remarkably, that similar tendency was revealed for micro-depressions and for micro-elevations in paleo-soils. We conclude that the decomposition of soil organic matter is strongly dependent on local topographic conditions both in modern and paleo-soils.



S11.07-P -14

PRIMING EFFECT FOLLOWING NITROGEN ADDITION INTO BULK AND GLUCOSE-AMENDED SOILS

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We studied dynamics of microbial carbon (C) and soil organic matter (SOM) mineralization after nitrogen (N) addition into the bulk soil and glucose amended soil (^{13}C labeled glucose, $400 \text{ } \mu\text{g C g}^{-1}$, ca 30% of microbial C, simulation of rhizosphere) of two grassland soils, mineral and organic one. In the bulk soils, N fertilization decreased microbial C at first, resulting in a short-term (1-5 days) apparent PE ($< 1\%$ of microbial C). Later, microbial C slightly grew but SOM mineralization was suppressed in fertilized versus unfertilized soils, leading to a negative PE (30 and $70 \text{ } \mu\text{g C g}^{-1}$ was saved in the mineral and organic soils in 17 days, respectively). In the glucose-amended soils, N fertilization led to an exclusive use of glucose for microbial growth and respiration and caused a negative PE from the same beginning (40 and $100 \text{ } \mu\text{g C g}^{-1}$ was saved in the mineral and organic soil, respectively). Net microbial growth and total soil respiration was lower in fertilized versus unfertilized soils. As a result, N fertilization reduced soil respiration mainly due to a deprivation of microbial metabolism by C limitation. The rate and range of microbial response to fertilization and the amount of saved SOM were larger in the organic versus mineral soil, likely driven by the higher content of microbial biomass and lower SOM degradability in this soil.



S11.07-P -15

THE AFFECT OF PLANT-PLANT INTERACTIONS ON THE RHIZOSPHERE PRIMING EFFECT (RPE)

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Soil respiration, a major component of the global C cycle, mainly consists of rhizosphere respiration and of microbial decomposition of soil organic matter (SOM). The presence of living roots may change the rate of SOM decomposition (RPE) by controlling the microbial activity in the rhizosphere. The RPE is mainly driven by the amount and composition of labile root released C. Plant diversity influences the labile C fraction through species-specific inputs. Therefore, and because of inter-species competition we hypothesized that plant-plant interactions affect RPE. Monocultures and mixtures of sunflower, soybean and wheat were continuously labelled with ¹³C-depleted CO₂. We measured total soil CO₂ efflux during 29-30 and 59-60 days after planting. Different ^{d13}C values were used to separate soil respiration into SOM- and root-derived respiration. RPE was calculated as difference in SOM-derived CO₂ between planted and unplanted soil and compared among the monocultures and mixtures. We also measured plant dry weights, C contents and ^{d13}C values of roots, shoots and soils, and microbial biomass C. Preliminary results of microbial biomass C showed clear differences between monocultures and mixtures, suggesting an affect of plant-plant interactions on RPE. Dynamics of RPE depending on plant age and plant composition will be presented and related to changes of root biomass. Continuous labelling and subsequent analysis of the isotopic composition of soil respired CO₂ is a suitable method to determine RPE and its dynamics. Differences in microbial biomass C between mono- and mixed cultures indicate that RPE is affected by plant-plant interactions.



S11.07-P -16

THE IMPACT OF TEMPERATURE AND SUBSTRATE QUALITY ON SOM PRIMING: EVIDENCE FROM LONG TERM INCUBATIONS AND C3-C4 TRANSITION EXPERIMENTS

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Our research was aimed to study temperature dependence of SOM priming for a wide variety of soils. The direction and magnitude of SOM priming caused by glucose and plant residues addition was assessed in 8-15 mo incubation experiments. In Experiment 1 samples of recent soils and paleosols were taken from boreal, polar and south regions of Russia. Soil samples were enriched with glucose at the rate of 10 mg g⁻¹ soil, adjusted to 70% of WHC and incubated at 2, 12, 22°C. In Experiment 2 the decomposition of plant derived (C4-SOM) and soil derived carbon (C3-SOM) was studied by measuring shifts in natural ¹³C abundance of CO₂ evolved from Chernozem and Phaeozem. The priming action of rhizodeposits was studied in the greenhouse experiment with ¹³CO₂ continuous labeling of cereals planted on Cambisol (Experiment 3). Both rate constants and cumulative losses of CO₂-C respired during glucose decomposition were temperature dependent (Experiment 1). CO₂-C losses were higher than quantity of total glucose C added (SOM positive priming) only in some samples at the temperature of 22°C. CO₂-C losses at 12 and especially at 2°C were always lower than quantity of C added with glucose. SOM priming in recent soils caused by glucose addition did not differ significantly from that in paleosols. The input of plant residues and rhizodeposits caused negative SOM priming even at high temperatures; the magnitude of negative priming was temperature dependent (Experiments 2 and 3). Thus, SOM priming was found to be temperature- and substrate quality- dependent.



S11.07-P -17

THE ROLE OF PRIMING EFFECT IN DECOMPOSITION OF ORGANIC MATTER IN MODERN AND PALEO- SOILS.

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Input of available substrates to soil alters microbial activity resulting in accelerated turnover of native soil organic matter (SOM), i.e. causes priming effects (PE). We hypothesized larger PE in soils with strong nutrient limitations, i.e. in mineral versus organic soil horizons and in buried versus modern soils. These hypotheses were tested by the comparison of priming effects induced by ¹⁴C-glucose in organic and mineral horizons of modern as well as of paleo-soils (podzol sandy soil Yamalo-Nenezky region, Tumen and grey forest soil Pushchino). The following variables were determined in 50-days incubation experiment: 1) the dynamics of CO₂ evolution; 2) the ¹⁴CO₂ originated from the added glucose; 3) the microbial biomass C by substrate-induced respiration. Maximal intensity of SOM mineralization as well as of enzyme activities was observed in 2 -7 days after glucose application. The absolute values of PE were 10 times greater in modern as compared with buried horizons of paleo-soils. However, the relative increase in carbon mineralization (as compared with soil without glucose amendment) was greater in buried than in modern soils, especially in mineral soil horizons. In organic horizons the PE amounted for 20 and 50 % of untreated control in modern and in paleo-soils, respectively. In mineral horizons the PE amount (in % of control) reached 60 % for modern and 250 % for paleo-soils. We conclude that the input of fresh organic matter in paleo-soils as well as in deep soil horizons can induce greater PE as compared with topsoil layers.



S11.07-P -18

UNDERSTANDING MICROBIAL REGULATION OF PRIMING EFFECTS: NEW INSIGHT FROM SMALL-SCALE INVESTIGATIONS AT THE SOIL-LITTER INTERFACE

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Priming effects are often observed after substrate addition to soil. However, the underlying mechanisms still remain unclear and their regulation is poorly understood. Litter carbon is a substrate that regularly enters the soil and, therefore, might induce priming effects. We used the soil-litter interface as a model to study priming effects at a small-scale and to clarify the underlying mechanisms. We hypothesized that litter C transport increases degradation of MCPA, which we used as a model compound for soil organic matter decomposition. After incubation of soil microcosms simulating the soil-litter interface, we analysed microbial MCPA degradation as well as abundance of microbial degraders. Transport of litter compounds was identified as important process, which increased MCPA degradation by regulating the activity of the MCPA degrading community at the soil-litter interface. The increased bacterial and fungal MCPA degradation might be explained by complex regulation mechanisms of MCPA degradation: (1) At the cellular level by co-substrate availability and laccase abundance, and (2) at the community level by the contribution of different degrader communities. Overall, this study illustrates microbial regulation of priming effects using MCPA as a model compound.



S11.08-P - PHYSICO-CHEMICAL PROCESSES GOVERNING THE FATE AND TRANSPORT OF PATHOGENS AND BIOMACROMOLECULES IN SOILS

Monday 02 July 2012 from 17:00 to 18:30. Room Poster Areas

S11.08-P -1

ATTACHMENT OF PATHOGENIC PRION PROTEIN TO HUMIC SUBSTANCES

Christen Smith, Madison - United States

S11.08-P -2

BACILLUS CEREUS, A MODEL FOR STUDYING THE IMPACT OF CLIMATE CHANGES ON FOOD BORNE PATHOGENS FATE AND TRANSPORT IN SOILS? PRELIMINARY EXPERIMENTS

Berard Annette, Avignon - France

S11.08-P -3

DEVELOPMENT AND EVALUATION OF NEW QUANTITATIVE DNA ASSAYS IN SOIL TO PREDICT THE INCIDENCE OF SPECIFIC CROP DISEASES.

Mélanie Bressan, Mont-Saint-Aignan - France

S11.08-P -4

EFFECT OF SOIL TYPE AND GEOCHEMICAL PROPERTIES ON PATHOGEN TRANSPORT IN SOIL COLUMNS

Soile Backnäs, Kuopio - Finland

S11.08-P -5

EFFECTS OF CARBON BASED NANOPARTICLES (CNPS) ON SORPTION AND MOBILITY OF THE SYNTHETIC HORMONE 17A-ETHINYLESTRADIOL (EE2) IN MODEL SOIL SOLUTION AND SOIL

Sina Egerer, Bochum - Germany

S11.08-P -6

EXTRACTABILITY OF P IN MAJOR SOILS OF ANGOLA AS AFFECTED BY FERTILIZER AND LIME APPLICATION

Edgardo Auxtero, Lisbon - Portugal



S11.08-P -7

IMPACT OF INNOVATIVE AGRICULTURAL SYSTEMS ON THE INCIDENCE OF SPECIFIC CROP DISEASES USING NEWLY DEVELOPED QUANTITATIVE DNA ASSAY.

Mélanie Bressan, Mont-Saint-Aignan - France

S11.08-P -8

INACTIVATION OF SOIL-BOUND PRION PROTEIN BY PROTEOLYTIC ENZYMES FROM COMPOST

Clarissa Booth, Madison - United States

S11.08-P -9

INFLUENCE OF MINERAL PARTICLES ON THE INACTIVATION OF PATHOGENIC PRION PROTEIN

Clarissa Booth, Madison - United States

S11.08-P -10

INSECTICIDAL ACTIVITY AND DETECTABILITY OF TRANSGENIC INSECTICIDAL CRY1AB PROTEIN ADSORBED TO SOILS

Michael Sander, Zurich - Switzerland

S11.08-P -11

PREFERENTIAL FLOW AS AFFECTED BY SOIL TEXTURE AND WATER TEMPERATURE

Azadeh Safadoust, Hamedan - Iran, Islamic Republic of

S11.08-P -12

VIRUS ATTACHMENT ONTO CLAY COLLOIDS: BATCH AND TRANSPORT EXPERIMENTS

Vasiliki Syngouna, Patras - Greece



S11.08-P -1

ATTACHMENT OF PATHOGENIC PRION PROTEIN TO HUMIC SUBSTANCES

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Environmental persistence of pathogenic prion protein (PrPTSE) is implicated in epizootics of sheep scrapie and chronic wasting disease in deer, elk, and moose. Strong evidence suggests that soil may serve as a reservoir of PrPTSE, which can persist in the environment for years. In laboratory animals, soil particle-bound PrPTSE exhibits enhanced oral disease transmission relative to that of the unbound agent. Previous studies have examined PrPTSE attachment to soil particles; however, the influence of soil organic matter has not been examined. Here, we directly examined PrPTSE attachment to humic substances (HS) using a combination of optical waveguide lightmode spectroscopy and quartz crystal microbalance with dissipation monitoring. A diverse set of humic-coated surfaces were prepared by electrostatic layer-by-layer assembly of HS and poly-L-lysine. We found that solution pH, ionic strength, and the physicochemical characteristics of the HS significantly influence the extent and reversibility of PrPTSE attachment. Evidence for both electrostatic and hydrophobic contributions to PrPTSE interactions with HS is presented. These results have important implications for the environmental fate of PrPTSE in natural soils.



S11.08-P -2

BACILLUS CEREUS, A MODEL FOR STUDYING THE IMPACT OF CLIMATE CHANGES ON FOOD BORNE PATHOGENS FATE AND TRANSPORT IN SOILS? PRELIMINARY EXPERIMENTS

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In the context of Climate Change, soils that welcome pathogens may then change their ecological niches to them. The soil borne bacterium Bacillus cereus is also a food borne pathogen, with a genetic structure corresponding to groups with different temperature growth abilities and different degrees of virulence. Given these ecological traits, B. cereus is an interesting model for studying the impact of climate change on food borne pathogens. Our problematic deals with the impacts of climate change on the selection, growth and transfer of B. cereus strains living in soil. We propose to develop methodologies (experimental design and microbiological and biomolecular methods) to follow strains of B. cereus in soils and in water percolated from soils. Vegetative cells and spores of B. cereus were inoculated separately and at different concentrations into an agricultural Mediterranean soil, into water percolated from soil (in situ lysimeter system) and into underground water collected from a karstic system, and incubated in standardized conditions of temperature and humidity. During the following days and weeks, we measured bacterial concentration evolution with microbiological methods (vegetative cells and spores) targeting the B. cereus Group. Our preliminary results show: (1) Presence of B. cereus was confirmed in soil samples, in water percolated from soil while very few of B. cereus cells were detected from a ground water sample. (2) An introduced B. cereus strain is able to grow and to sporulate in raw soil. To separate strains of B. cereus, molecular methods (quantitative PCR) are developed.



S11.08-P -3

DEVELOPMENT AND EVALUATION OF NEW QUANTITATIVE DNA ASSAYS IN SOIL TO PREDICT THE INCIDENCE OF SPECIFIC CROP DISEASES.

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^[1]ESITPA ~ AgriTerr - Biosol team ~ Mont-Saint-Aignan ~ France

Soil-borne disease and their consequences on crops yield represent today one major concern in Agriculture. Chemicals have been widely used to control these phytopathogens. However, increasing societal concerns and biological necessity for sustainable agriculture lead to restrictions in their use. Alternative methods are now necessary to control pathogens in soil when no resistant cultivars are available. There is a renewed interest for old agricultural practices which could contribute to reduce disease severity and for disease prediction thanks to prior pathogens detection in soil. Diagnosis approach and evaluation of innovative agricultural practices need the ability to specifically detect and quantify microbial pathogens in soil. In this context, our aim was to develop molecular quantitative DNA assays of chosen fungal pathogens to determine inoculum potential of natural soils and correlate it with observed plant symptoms. We chose to study specific pathosystems of interest in the Normandie region (France). A quantitative PCR approach for each pathogen was first developed using specific appropriate PCR primers on pure and mixed fungal strains. Different primers sets on multi- and mono-copy DNA sequences, varied reaction mixtures and procedures were tested to the final choice of the most specific and sensitive in vitro methods. These quantitative PCR methods were subsequently used for in vivo microcosm experimentations to set up a correlation between inoculum quantities and plant responses on artificially infested soils. Developed DNA assays will be considered for their potential use in predicting crop diseases and for in situ application on natural agricultural soils.



S11.08-P -4

EFFECT OF SOIL TYPE AND GEOCHEMICAL PROPERTIES ON PATHOGEN TRANSPORT IN SOIL COLUMNS

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Pathogenic microbes can migrate from a contamination source through soil to groundwater aquifer where they can enter drinking water and infect humans. In Finland about 90 % of the waterborne epidemics have been associated with groundwater source. We studied the transport of three enteric microbes: norovirus, MS-2 bacteriophage and Escherichia coli (E. coli), through laboratory columns packed with different gravel and sand materials taken from an esker formation. The column tests were performed in saturated conditions with varying flow velocities. KBr was used as a conservative tracer for determination of soil dispersion. Ammonium acetate-, ammonium oxalate- and aqua regia extractable trace elements were analyzed to characterize the soil geochemical properties. Also soil pH and organic matter and carbon contents were analyzed. Pathogen transport parameters were determined from the breakthrough curves. The results show that in general E. coli was retained more effectively than norovirus and MS-2. For norovirus and E. coli the effect of flow velocity was minimal compared to the effect of soil granularity e.g. the smaller the grain size the higher removal rate of the microbes was observed. In addition, the soil geochemical composition had an effect to the retention of the microbes in soils with similar granularity. On the contrary, for MS-2 the flow velocity and geochemical composition e.g. amount of reactive solid surfaces played a central role in the retention mechanism. The results of the study offer new information of pathogen removal in soil passage for pathogen transport modeling and groundwater risk assessments in Finnish aquifers.



S11.08-P -5

EFFECTS OF CARBON BASED NANOPARTICLES (CNPS) ON SORPTION AND MOBILITY OF THE SYNTHETIC HORMONE 17A-ETHINYLESTRADIOL (EE2) IN MODEL SOIL SOLUTION AND SOIL

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The number of consumer products containing engineered nanomaterials (ENMs) is rapidly increasing, however, knowledge about environmental effects of ENMs is still fragmentary. Studies dealing with the behaviour and fate of ENMs in soils are scarce. From studies concerning aqueous systems, however, it is known, that carbon-based nanoparticles (CNPs) strongly interact with xenobiotics such as 17a-ethinylestradiol (EE2). Further, dissolved-organic matter (DOM) was found to facilitate the dispersion of CNPs in aqueous media. Hence the co-occurrence of these compounds in disposed effluents and biosolids may lead to enhanced co-transport of EE2 both in freshwater and soils. This study aims to investigate the effect of CNPs on the fate of EE2 in soil environments. Initially, batch experiments with different model soil solution systems were performed. We found EE2 sorbing up to 30% to CNPs in pure electrolyte solution, thus the formation of EE2/CNPs complexes reduced the freely dissolved EE2. In accordance with studies from aqueous systems, we found that electrolyte concentration strongly influences the CNP aggregation behaviour, the sorption behaviour, however, is not affected to the same extend. Based on these findings, more complex model soil solutions are tested in our on-going experiments comprising reference DOM from the International Humic Substance Society (IHSS) as well as DOM extracted from soil, sewage sludge and wastewater. The sorption behaviour within these solution systems will be compared with batch sorption experiments in presence of sand as soil mineral model substance as well as in presence of agriculturally used soil to estimate whether CNPs affect EE2 mobility.



S11.08-P -6

EXTRACTABILITY OF P IN MAJOR SOILS OF ANGOLA AS AFFECTED BY FERTILIZER AND LIME APPLICATION

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The extractability of different forms of phosphorus (P) from applied fertilizers may be highly dependent on the colloidal constituents that typify major soil systems from Angola. Information regarding P extractability is therefore essential for appropriate P management on these soils. Sequential P extraction procedure, using a modified Hedley fractionation procedure was carried out to determine the amounts and proportions of labile extractable P, chemisorbed, occluded and residual P fractions in the surface and subsurface horizons representing major soils of Angola, which was applied with 4 rates of superphosphate and rock phosphate (Fertigafsa), and 4 rates of lime (CaCO₃), incubated for 6 months. The amounts of P fractions and their proportions were compared and their associations with soil colloidal constituents were also assessed. The total extractable P fractions doubled with the addition of 500 kg superphosphate and rock phosphate ha⁻¹ in the surface and subsurface horizons, and decreased with the addition of 3.6 t CaCO₃ ha⁻¹ in both horizons. The application of superphosphate showed lowest proportions of labile P fraction in the surface and subsurface horizons (20 and 12%, respectively). Similar trend was observed with the application of rock phosphate in both horizons (15%). Lowest proportion of labile fraction was also observed in limed surface and subsurface horizons (13 and 15%, respectively), indicating generally low status of freely extractable P. Moderately extractable inorganic P with HCl and non labile residual P fractions in fertilized surface and subsurface horizons were strongly correlated with active constituents of Fe and Al.



S11.08-P -7

IMPACT OF INNOVATIVE AGRICULTURAL SYSTEMS ON THE INCIDENCE OF SPECIFIC CROP DISEASES USING NEWLY DEVELOPED QUANTITATIVE DNA ASSAY.

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Numerous soil-borne diseases are persistent and recurrent problems in crop production resulting in reduced marketable yield. For some of these diseases, chemicals spread and seed treatments could provide some control. But today, environmental issues lead to try to minimize the chemical input in soil. A more sustainable approach is to conceive adapted crop production systems that mitigate outbreaks of plant disease and reduce the disruption of the agroecosystem. Old agricultural practices such as crop rotation or labour are now reconsidered because of their known ability to influence incidence of plant disease caused by soil fungi. Follow-up of the spatiotemporal pattern of pathogens in agricultural soils is necessary to evaluate these new strategies and design the best adequate solution for plant disease management. In this context, our aim was to determine the dynamics of fungal pathogens by spatial and temporal follow-up in innovative low-input agricultural systems in the Normandie region (France). For that purpose, we used new quantitative DNA assays developed previously for chosen fungal pathogens and tested in in vitro and in vivo experiments. Pathogens dynamics are determined in natural soils, on several cultural seasons in our studied low-input systems. Results obtained are then compared with dynamics observed in more conventional systems and in organic farming to evaluate the impact of the new practices on pathogens and disease incidence. All dynamics observed will be considered in link with surrounding physical, chemical and microbial soil properties determined in parallel.



S11.08-P -8

INACTIVATION OF SOIL-BOUND PRION PROTEIN BY PROTEOLYTIC ENZYMES FROM COMPOST

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Prions are the etiological agents responsible for transmissible spongiform encephalopathies (TSEs), a class of fatal, neurodegenerative disorders affecting humans and other mammals. Prions are novel infectious particles, believed to be composed primarily, if not entirely, of a misfolded conformer of the prion protein denoted PrPTSE. The PrPTSE conformer is rich in β -sheet structure and forms ordered aggregates. The conformation of PrPTSE confers physicochemical properties to the protein not shared by the normal, benign conformer, including increased hydrophobicity, predisposition for aggregation, and resistance to proteolysis. Soil has been implicated in the transmission of sheep scrapie and chronic wasting disease (CWD) of cervids. Prions have been shown to bind strongly to clay particle surfaces. Processes controlling prion inactivation in soil are unclear however, natural mechanisms of biodegradation appear insufficient to degrade prions, as infectivity is known to persist in the soil environment for years. There exists a need for land decontamination in TSE infected areas to limit the spread of scrapie and CWD, and safe, effective methods are limited. Few enzymes have demonstrated prion-degrading abilities, and most require temperature and pH extrema for successful inactivation. We demonstrate that proteolytic enzymes isolated from a thermophilic manure-based compost rapidly (<24 hr) degrade PrPTSE under mild conditions (pH 8, <60°C), and we examine the effect of prion attachment to soil particles on the efficacy of compost enzymes to degrade PrPTSE. We have identified a unique, endogenous set of enzymes capable of environmentally relevant prion degradation and having the potential for land remediation.



S11.08-P -9

INFLUENCE OF MINERAL PARTICLES ON THE INACTIVATION OF PATHOGENIC PRION PROTEIN

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Prions are proteinaceous particles recognized as the infectious agent of transmissible spongiform encephalopathies (TSEs). Prions are believed to be predominately, if not entirely composed of PrPTSE, a β -sheet-rich conformer of the prion protein. Considerable evidence points to the soil environment serving as a reservoir of prion infectivity and contributing to transmission of sheep scrapie and cervid chronic wasting disease. Prions are known to be persistent in the environment and unusually resistant to most conventional pathogen inactivation treatments. Prions adsorb strongly to clay particles and resist desorption. Prion-clay complexes have been shown to enhance oral disease transmission relative to unbound agent. Attachment to mineral surfaces may protect prions from inactivation in the soil environment or the digestive system, and contribute to their persistence in contaminated environments. Here, we examine the extent to which attachment to montmorillonite clay protects PrPTSE against treatments demonstrated to hydrolyze the protein in solution and show that the effect of attachment to montmorillonite differed among treatments. For example, attachment to montmorillonite appeared to protect the protein from degradation by proteinase K, and attenuated total reflectance-Fourier transform infrared spectroscopy revealed that attachment stabilized PrPTSE conformation against the effect of the chaotrope guanidinium chloride. In contrast, attachment to montmorillonite had little effect on the kinetics and extent of inactivation by concentrated sodium hydroxide.



S11.08-P -10

INSECTICIDAL ACTIVITY AND DETECTABILITY OF TRANSGENIC INSECTICIDAL CRY1AB PROTEIN ADSORBED TO SOILS

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*Genetically modified Bt crops produce insecticidal Cry proteins that may enter soils via various pathways. Concern has been raised that Cry proteins may adversely affect non-target soil-dwelling organisms. To address these concerns and to assess the fate of Cry proteins in soils requires reliable methods to detect adsorbed Cry proteins and to measure their bioactivity. Here we determine whether soil adsorbed Cry1Ab, a commercially important Cry protein, retains its insecticidal activity, and systematically assess the effects of extraction buffer composition and Cry1Ab-soil contact time on the extractability in spike-recovery experiments. We determined the activity of Cry1Ab adsorbed to eight soils and to major soil constituents by an in vivo diet-incorporation bioassay with *Ostrinia nubilalis* and growth inhibition as the toxicity endpoint. In all cases, Cry1Ab retained full insecticidal activity when adsorbed, suggesting that Cry1Ab does not lose its bioactive conformation during adsorption-desorption cycles in soils. Commonly used extraction buffers with circumneutral pH yielded only low recoveries (<40%) of Cry1Ab in soils after two hours of contact. Significantly higher recoveries (60%) were obtained with high pH and ionic strength extraction buffers containing nonionic detergents, consistent with the attenuation of Cry1Ab-sorbent electrostatic interactions and the hydrophobic effect. However, recoveries decreased with increasing Cry1Ab-soil contact time. These findings highlight the need for optimized extraction procedures and demonstrate that recoveries determined in short-term laboratory experiments may not be applicable to the extraction of Cry proteins from field samples in which the protein has been in contact with the soil for weeks to months.*



S11.08-P -11

PREFERENTIAL FLOW AS AFFECTED BY SOIL TEXTURE AND WATER TEMPERATURE

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In this study the transport of E. coli NAR and Br through two soils of sandy loam (SL) and clay loam (CL) were investigated. Saturated flow conditions were applied at two temperatures of 5 and 20 °C using infiltrometer. Leaching was done using large repacked soil columns which had been subjected to physical and biological weathering. Treatments effects on time at maximum concentration (Cmax) of E. coli NAR were in order of CL < SL for all layers. Both tracers had fast BTCs within the short time after the injection of suspension. Leaching of 40% of E. coli NAR and 79% of Br through 45 cm soil column indicates that the groundwater vulnerability of microbes into shallow water bodies could be the greatest in structured soil. In both soils the effluent concentration of E. coli NAR and Br reached to a peak, and then tailed quickly to a constant low level up to end of leaching period. This indicates the presence of preferential flow paths in the experimental system as a result of media heterogeneity regenerated by physical and biological weathering. Leaching with cold water (5 °C) led to decrement of flow rate and consequently increment of bacterial filtration in the two soils. Bacterial adsorption onto clay particles, and decrement of water velocity at 5 °C led to high-energy bonding between particles and bacteria and consequently greater attachment of bacteria onto the sorption sites.



S11.08-P -12

VIRUS ATTACHMENT ONTO CLAY COLLOIDS: BATCH AND TRANSPORT EXPERIMENTS

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This study aims to gain insights into the interaction of virus particles with clay colloids in batch and transport experiments. Bacteriophages MS2 and FX174 were used as model viruses, and kaolinite (KGa-1b) and montmorillonite (STx-1b) as model colloids. The experimental data obtained from batch experiments of MS2 and FX174 attachment onto KGa-1b and STx-1b suggested that virus attachment is adequately described by the Freundlich isotherm equation. Both MS2 and FX174 were attached in greater amounts onto KGa-1b than STx-1b with MS2 having greater affinity than FX174 for both clays. Furthermore, extended-DLVO interaction energy calculations explained that the attachment of viruses onto model clay colloids was primarily caused by hydrophobic interaction. Moreover, virus transport in porous media in the presence of suspended clay colloids was examined under three different pore water velocities. The results revealed that the presence of clay colloid has a significant influence on the mode and magnitude of irreversible particle deposition, for the conditions investigated. The observed reduction in virus recovery at the column exit is attributed to virus attachment onto clay colloids, which are retained onto the solid matrix of the column. The theoretical and experimental results of this study were found to be in good agreement with previous findings.



S11.09-P - UNDERSTANDING MINERAL-ORGANIC-MICROBIAL INTERACTIONS IN SOILS AND THE CONSEQUENCES FOR BIOLOGICAL AND BIOCHEMICAL ACTIVITY AND THE EFFICIENCY OF ROCK FLOUR AMENDMENTS

Thursday 05 July 2012 from 17:00 to 18:30. Room Poster Areas

S11.09-P -1

APATITE-BIOTITE-CARBONATITE FROM STJERNØY (N-NORWAY) – CAN BARIUM CONTENT STOP A PROMISING MULTI-NUTRIENT ROCK-FERTILIZER?

Michael Heim, Aas - Norway

S11.09-P -2

BIOTITE-RICH ROCK FLOUR COMBINED WITH APATITE-CONTAINING ROCK FLOUR (RF) AS SLOW-RELEASE FERTILIZER

Marina Azzaroli Bleken, Aas - Norway

S11.09-P -3

CHOICE OF EXPERIMENTAL PLAN FOR PLANT GROWTH EXPERIMENTS WITH ROCK FLOUR (RF) IS COMPLEX

Marina Azzaroli Bleken, Aas - Norway

S11.09-P -4

ACID PHYTASES STABILIZATION AFTER ADSORPTION ON ALLOPHANIC SYNTHETIC COMPOUNDS AND MONTMORILLONITE NANOCCLAYS

Daniel Menezes-Blackburn, Temuco - Chile

S11.09-P -5

ACIDITY ATTRIBUTES IN SOIL WITH SUCCESSIVE APPLICATIONS OF PIG SLURRY UNDER NO TILLAGE SYSTEM

Carlos Alberto Ceretta, Santa Maria - Brazil

S11.09-P -6

ADSORPTION OF LICHEN LACCASES ON HYDROXYALUMINUM-KAOLINITE: PROPERTIES OF IMMOBILIZED ENZYMES AND THEIR ROLE IN SYNTHESIS OF HUMIC ACIDS

Anna Zavarzina, Moscow - Russian Federation



S11.09-P -7

DOES PEDOGENIC CARBONATES PRECIPITATION INTERACT WITH AGGREGATION IN SEMI-ARID SOILS? INSIGHTS FROM MICROSCOPY AND NATURAL ISOTOPIC ABUNDANCE.

Iñigo Virto, Pamplona - Spain

S11.09-P -8

FRACTIONATION OF NATURAL SOIL ORGANIC MATTER DUE TO REACTION WITH FERRIHYDRITE

Karin Eusterhues, Jena - Germany

S11.09-P -9

IMPACT OF AZADIRACHTIN ON MICROBIAL RESPONSE VARIABLES IN SOIL

Ridvan Kizilkaya, Samsun - Turkey

S11.09-P -10

INFLUENCE OF GLUCOSE ON PHOSPHORUS MOBILISATION BY CITRATE IN SOIL

Michael Rose, Clayton - Australia

S11.09-P -11

MICROBIAL REGULATION OF MCPA DEGRADATION IN ARTIFICIAL SOILS

Franziska Lang, Stuttgart - Germany

S11.09-P -12

MICROBIAL RESIDUES ARE INDICATORS OF CROP EFFECTS ON ORGANIC CARBON OF AN OXISOL UNDER NO-TILLAGE

Jose Eduardo Cora, Jaboticabal, SP - Brazil

S11.09-P -13

MODELING ORGANIC MATTER DECOMPOSITION IN HETEROGENEOUS SOIL STRUCTURE AT MICROBIAL HABITATS SCALE

Laure Vogel, Thiverval-Grignon - France

S11.09-P -14

POSSIBLE CORRELATION BETWEEN BACTERIAL DIVERSITY, PEDOLOGICAL PROPERTIES AND LEVEL OF INFECTION BY ROSELLINIA NECATRIX IN AN APPLE TREE ORCHARD BIOLOGICALLY MANAGED

Nadia Vignozzi, Firenze - Italy



S11.09-P -15

THE EFFECT OF SOIL COMPACTION ON SOIL RESPIRATION ACTIVITY IN BOTH CLAY AND SAND SOIL TEXTURE

Sahar Akhavan, Rasht - Iran, Islamic Republic of

S11.09-P -16

THE IMPACT OF FACTORS (PF, TOC, WAY OF LAND USE) ON TOTAL DNA CONCENTRATION AND DEHYDROGENASE ACTIVITY

Agnieszka Wolinska, Lublin - Poland

S11.09-P -17

THE IMPACT OF MICROBIOLOGICAL PREPARATIONS ON SOIL CHARACTERISTICS AND ON THE RYEGRASS (LOLIUM PERENNE, L.) BIOMASS

Anita Jakab, Debrecen - Hungary

S11.09-P -18

THE INFLUENCE OF LAND USE IN MOUNTAIN SOILS ON THE LABILE ORGANIC CARBON CONTENT

Agnieszka Józefowska, Kraków - Poland

S11.09-P -19

THE VIABILITY OF GRAM POSITIVE BACILLUS SP. AND TRICHODERMA SP. IN LIQUID AND SOLID FORMULATION

Nasim Ashkhasi, Karaj - Iran, Islamic Republic of



S11.09-P -1

APATITE-BIOTITE-CARBONATITE FROM STJERNØY (N-NORWAY) – CAN BARIUM CONTENT STOP A PROMISING MULTI-NUTRIENT ROCK-FERTILIZER?

Heim Michael^[1], Marina Azzaroli Bleken^[1], Elin L. Gjengedal^[1], Maria H. Hillersøy^[1]

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*Rocks applicable as multi-nutrient rock-fertilizers may have high contents of unfavorable, even toxic elements, that might make the rock unsuitable as rock-fertilizer. Here a possible case. Whole-rock powder of apatite-biotite-carbonatite (ABC) from the Lillebukt alkaline complex on Stjernøy is agro-chemically a lime (40 wt% calcite) with additional potassium (K) (2.6 wt%), magnesium (Mg) (2.1 wt%) and phosphorus (P) (1.3 wt%), contained in the silicates biotite and nepheline, and apatite. Previous K-fertilizing trials with ABC rock-powder have provided promising crop yields comparable to those obtained with potash (KCl). An in situ field study on Stjernøy showed high values of plant available calcium (Ca), Mg, and K in soils and corresponding contents in plants, but low P-values. One underlying problem with ABC is high barium (Ba) content (up to 15 g/kg). Barium, potentially toxic, substitutes K in biotite and is expected to be plant available when mica disintegrates. The in situ study indicated a strong plant species dependence of Ba-content, with relatively high concentration in the only N-fixing legume (*Vicia cracca* L.) present, intermediate concentration in herbs and low level in grasses. Regression analysis showed that Ba in plants was correlated positively to Ca- and K-content and negatively to sulphur (S) in plants. However species and plant part (stem, leaf, seed) modified this relationship. There was no significant correlation with Ba in soil and bedrock. Renewed plant experiments to document the overall effect of ABC rock-powder and a PhD-study dealing with the Ba-aspects will hopefully clarify the suitability of ABC as rock-fertilizer.*



S11.09-P -2

BIOTITE-RICH ROCK FLOUR COMBINED WITH APATITE-CONTAINING ROCK FLOUR (RF) AS SLOW-RELEASE FERTILIZER

Bleken Marina Azzaroli^[1], Krogstad Tore^[1], Heim Michael^[1]

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Potassium, one of the elements needed in greatest amount by plants, is characterized by being extremely mobile in the soil solution and easily absorbed by plants. Soils with low cation exchange capacity are prone to K-deficiency, particularly in rainy regions and in combination with yields of fresh plants, as in the case of grass silage. Biotite can function as a slow-release K-fertilizer, reducing the risk for K-loss through leaching as well as providing other important elements and influencing other soil properties as soil pH. Addition of apatite-containing RF may provide a complete slow-release fertilizer. This study is part of a major effort to improve practical recommendation for RF application. A pot trial was run for 3 to 4 consecutive cuts of ryegrass and clover, using two different RFs added to a nutrient poor sandy soil. Results showed weak positive effects for the biotite-rich RF applied at a rate of 13 ton/ha, but increasing the RF dose reduced yield. Addition of apatite-containing RF increased yield, but not through increased P-uptake. The beneficial effect was due to other elements. However, when a low dose P-fertilizer was given, apatite-containing RF had an additional positive effect on P uptake and yields were similar to a whole dose compound fertilizer. The results confirm the potential benefit of rock powder but also underpin the need for more scientific-based knowledge on the chemical reactions in the soil, in order to avoid negative effects on crops.



S11.09-P -3

CHOICE OF EXPERIMENTAL PLAN FOR PLANT GROWTH EXPERIMENTS WITH ROCK FLOUR (RF) IS COMPLEX

Bleken Marina Azzaroli^[1], Krogstad Tore^[1], Heim Michael^[1]

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Easily weathering minerals have a potential to provide plants with nutrients. Large attention has been given to P, but also K and other nutrients can be provided by addition of rock flour as demonstrated by pioneer field trials already in 1920-1930. In spite of these early positive studies, RF has gained little popularity. The large variability of rock materials and the even larger spectrum of chemical reactions when exposed to different soil types makes it difficult to provide recommendation. Pot experiments can be cost effective in this respect. This note highlights some difficulties in designing good pot experiments, illustrated by two recent studies. Maintaining a good K supply is most difficult on sandy soil, particularly when exposed to abundant precipitation and cultivated with K-removing crops as grass silage. Therefore a nutrient poor sandy soil was used in pots planted with ryegrass or white clover (3 to 4 regrowths). Three rocks were used: biotite-rich gneiss, apatite-containing gabbro and apatite-biotite carbonatite. There were three controls (limed sand, fertilized sand, both limed and fertilized sand) and several amounts of rock powder, alone or in combination with fertilizer. Significant positive effects of rock flour on yield and chemical composition were found when applied in addition to soluble fertilizer, while negative effects could be observed when rock powder was applied alone. Examples of nutrient uptake by plants will be presented, leading to a discussion on the choice of adequate treatments and substrates in plant growth experiment with RF.



S11.09-P -4

ACID PHYTASES STABILIZATION AFTER ADSORPTION ON ALLOPHANIC SYNTHETIC COMPOUNDS AND MONTMORILLONITE NANOCLEASES

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Enzyme-clay associations have been extensively studied because of their effect on enzyme protection against proteolysis and thermal denaturation. Volcanic soils (Andisols) of Southern Chile have a high content of allophane clays and organic phosphorus (P), yet little is known about allophane-enzyme interaction and its impact on organic P cycling. The aim of this work was to study the stabilization of the activity of two microbial phytases (Aspergillus niger and Escherichia coli) after adsorption on nanoclays. Synthetic allophane, synthetic iron-coated allophanes and natural montmorillonite were chosen as solid supports for phytase immobilization. Phytase immobilization patterns at different pH values were strongly dependent on both enzyme and support characteristics. After immobilization, the residual activity of both phytases was higher under acidic conditions. Immobilization of phytases increased their thermal stability and improved resistance to proteolysis, particularly on iron-coated allophane (6% iron oxide), which showed activation energy (Ea) and activation enthalpy (?H#) similar to free enzymes. Montmorillonite as well as allophanic synthetic compounds resulted in a good support for immobilization of E. coli phytase, but caused a severe reduction of A. niger phytase activity.



S11.09-P -5

ACIDITY ATTRIBUTES IN SOIL WITH SUCCESSIVE APPLICATIONS OF PIG SLURRY UNDER NO TILLAGE SYSTEM

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Pig slurry application as soil manure can alter the chemical attributes of the soil and affect its acidity, modifying the environment to culture development. The objective of this study was to evaluate the chemical attributes related to soil acidity submitted to successive applications of pig slurry. The experiment was done in May of 2000, in the experimental area of the Federal University of Santa Maria (UFSM) under a no-tillage system. It was conducted until January of 2008. Nineteen surface applications of 0, 20, 40 e 80 m³ ha⁻¹ of pig slurry were performed, during a period of 93 months. At the end, soils were collected at layer levels of 0-2, 2-4, 4-6, 6-8, 8-10, 10-12, 12-14, 14-16, 16-18, 18-20, 20-25, 25-30, 30-35, 35-40, 40-50 e 50-60 cm. The application of pig slurry increased soil pH values, being that the increase could reach the depth of 8 cm without alteration in potential acidity values. It also promoted accumulation of Ca and Mg exchangeable levels on the surface soil layers, increasing the base saturation values and lowering the Aluminum saturation. Long term applications enabled the increase of organic matter level in depth. However, the effect of this waste over a CTC potential was less significant and restricted to the surface layers.



S11.09-P -6

ADSORPTION OF LICHEN LACCASES ON HYDROXYALUMINUM-KAOLINITE: PROPERTIES OF IMMOBILIZED ENZYMES AND THEIR ROLE IN SYNTHESIS OF HUMIC ACIDS

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Lichens comprise the dominant vegetation in high mountain elevations and high latitudes and participate in soil formation via rock disintegration and weathering. It has recently been found that representatives of the order Peltigerales produce laccases and tyrosinases (Laufer et al., 2006 ab, 2009; Zavarzina and Zavarzin, 2006). These enzymes in free-living fungi are involved in organic matter transformation (Zavarzina et al., 2011). Once leached into the soil lichen phenoloxidases may also participate in humus synthesis and transformation, suggesting possible biochemical role of lichens in pedogenesis. The aims of this work were to study adsorption of lichen laccases on natural supports, to study physico-chemical properties of immobilized enzymes and their role in synthesis of humus polymers from monomeric precursors. Two laccase forms - large/dimeric (ScLL) and small/monomeric (ScSL) - were extracted from soil stabilizing lichen Solorina crocea, purified and immobilized on hydroxyaluminum-kaolinite. Immobilized laccase of basidiomycete Panus tigrinus (PtL) was used for comparison. Immobilization resulted in higher thermostability of ScSL and lower thermostability of ScLL and PtL if compare with free enzymes. Storage of free and immobilized laccases at 5°C and 22°C showed higher stability of adsorbed enzymes. Interestingly, the ScLL was rather unstable in comparison with ScSL and PtL; ScSL was close by its properties to basidiomycetous laccase. During incubation of immobilized ScSL with a mixture of phenolic and nitrogenous compounds, dark polymeric product was formed on the mineral surface. Thus, leached-out laccase of S.crocea has a potential to participate in synthesis of polymeric organo-mineral compounds in the soil.



S11.09-P -7

DOES PEDOGENIC CARBONATES PRECIPITATION INTERACT WITH AGGREGATION IN SEMI-ARID SOILS? INSIGHTS FROM MICROSCOPY AND NATURAL ISOTOPIC ABUNDANCE.

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Carbonates interfere with aggregation in semi-arid soils by promoting the formation of stable macroaggregates. The mechanisms of this interaction are not completely known but are likely related to carbonates dissolution and (re)precipitation phenomena. In this work we investigated the relationship between soil carbonates precipitation at the micro scale and aggregation in a semi-arid carbonate-rich soil in NE Spain. As pedogenic carbonates accumulation implies a shift in the isotopic composition of carbonates-C, we first studied the natural abundance of ¹³C in particle-sizes, which proved the existence of dissolution and precipitation processes, especially important in the finest soil fractions. We then isolated aggregates of different sizes, following the hierarchical model of aggregation, and investigated their fabric, carbonates concentration and isotopic composition of their finest (clay size) fraction. Carbonates were present in all aggregate sizes and types. The fine fraction in small (i.e. older) aggregates was depleted in carbonates in comparison to non-aggregated clay-size particles and the fine fraction of small aggregates held within larger (i.e. younger) aggregates, suggesting that calcite dissolution was related to the aggregation cycle. However, no differences attributable to pedogenic carbonates formation or accumulation were observed in the isotopic composition of carbonates in the fine fraction. Similar results were observed in samples from the same soil after 7 years of irrigation, which noticeably increased aggregation. This implies that the hypothesis of carbonates precipitation at the micro-scale as a major agent of aggregate stabilization could not be verified in our experiment.



S11.09-P -8

FRACTIONATION OF NATURAL SOIL ORGANIC MATTER DUE TO REACTION WITH FERRIHYDRITE

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Ferrihydrite, a poorly crystalline Fe oxyhydroxide, is known to be highly reactive towards soil organic matter (OM) and may play an important role in its long-term stabilization. To investigate composition and maximum OM loading of ferrihydrite-OM associations, we performed adsorption and coprecipitation experiments at pH 4.5 using the water-extractable OM of a Podzol forest-floor layer. Reaction products were studied by NMR, FTIR and the analysis of hydrolyzable neutral polysaccharides. To better understand the behavior of polysaccharides, adsorption and coprecipitation experiments were also done with glucose, galactose and glucuronic acid. Adsorption and coprecipitation of the forest-floor extract yielded similar maximum loadings of 195 and 170 mg C g⁻¹ ferrihydrite. Relative to the original forest-floor extract, the ferrihydrite-associated OM was enriched in polysaccharides, but depleted in aliphatic C and carbonyl C, especially when adsorption took place. Moreover, mannose and glucose were bound preferentially to ferrihydrite, while fucose, arabinose, xylose and galactose remained in the supernatant. This fractionation of sugar monomers was more pronounced during coprecipitation. Experiments with synthetic sugar monomers resulted in relatively low maximum loadings of ~15 and ~25 mg C g⁻¹ for glucose and galactose, whereas glucuronic acid produced a maximum loading of 72 mg C g⁻¹. We conclude that the observed preferential association of polysaccharides from natural OM with ferrihydrite is not caused by direct interaction of the neutral polysaccharides' hydroxyls. We assume that the enrichment of glucose and mannose in the ferrihydrite-associated OM may be explained by a preferential association of these monomers with carboxyl-rich compounds.



S11.09-P -9

IMPACT OF AZADIRACHTIN ON MICROBIAL RESPONSE VARIABLES IN SOIL

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Chemical insecticides have been used successfully for many decades, but their effect on environment pollution, soil microbial response variables, and the development of resistance to chemicals have focused attention on alternative pest control methods. One such alternative is use of natural plant products such as azadirachtin that have pesticidal activity. This research was conducted to determine the effects of azadirachtin on soil microbial response variables under field conditions in Perm, Russia. We studied the effects of adding of different doses of azadirachtin on microbial response variables such as microbial biomass (Cmic), basal respiration (BR) and metabolic quotient (qCO₂) in loamy soil. Changes in the microbial response variables were determined in soil samples taken in 7, 14 and 21 days after the field experiment was conducted. The results of experiment showed that considerable variations in all microbial response variables were found for the different application doses at different soil sampling times. Statistically significant variations were found in Cmic, BR, qCO₂ and Cmic:Corg ratio at various application doses of azadirachtin. It was determined that high application doses of azadirachtin had high amounts of Cmic, BR and Cmic:Corg ratio at all sampling times. Furthermore, after azadirachtin application a rapid and significant increase in Cmic, BR and Cmic:Corg ratio was observed in soils followed by a progressive increase in the Cmic, BR and Cmic:Corg ratio in soils. At the 21 days, the Cmic and BR measured azadirachtin applied soils were significantly different from those measured in the control soils.



S11.09-P -10

INFLUENCE OF GLUCOSE ON PHOSPHORUS MOBILISATION BY CITRATE IN SOIL

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Increased concentrations of organic anions, such as citrate, malate and oxalate, are known to mobilise soil-adsorbed orthophosphate under certain conditions. It has been hypothesised that plants exuding higher rates of organic anions are more efficient in acquiring phosphorus. However, gross exudation rates of organic anions per gram of root weight are often reported without any reference to the exudation of other compounds. The question arises: if other easily metabolised carbohydrates are also exuded at higher rates, how will this influence the availability of soluble orthophosphate as a consequence of microbial growth? We report the dynamics of soluble and microbial biomass phosphorus in a ferrosol during extraction (0-72 h) under conditions of increasing organic anion concentration (0, 0.5 and 5 mM citrate, pH 5.5) concurrently with increasing concentrations of glucose (0, 5 and 50 mM glucose). The highest rate of citrate (5mM) increased peak soluble orthophosphate concentrations, but the 0.5 mM treatment was not significantly different from control (no citrate) solutions. Addition of glucose to the extraction buffer decreased peak concentrations of soluble orthophosphate by between 15-30% in all citrate treatments, with the difference in soluble orthophosphate concentration between glucose-amended and non-glucose treatments increasing over time, concurrently with increasing levels of microbial biomass phosphorus. These results suggest that greater attention needs to be given to the composition of root exudates, the effect that these have on microbial growth rates, and the turnover of microbial biomass, in order to accurately assess P availability to plant roots and other soil biota.



S11.09-P -11

MICROBIAL REGULATION OF MCPA DEGRADATION IN ARTIFICIAL SOILS

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Abundance, diversity and function of MCPA (2-Methyl-4-Chlorphenoxyessigsäure) degrading bacteria are regulated by several factors such as, e.g., substrate availability. However, the role of the micro-habitat is still unclear. The use of artificial soils gives us the possibility to study the interaction between microorganisms and organo-mineral surfaces. We created eight different artificial soils by mixing minerals in different combinations with homogeneous organic material. First results show that there are differences in the phospholipid fatty acid composition, which indicates that the mineral composition affects the structure of the microbial community. These results will be verified by quantification of eight different bacterial taxa. Based on an existing experimental set-up we developed a new micro-incubation system for small amounts of soil (1g per sample). We will use this system to study the effect of mineral composition on the abundance, structure and function of the MCPA degrading community. After pre-incubation with MCPA (20 mg kg⁻¹) for 21 days at 20°C, the artificial soils will be incubated at 20°C for 6 and 18 days with ¹⁴C-MCPA (50 mg kg⁻¹) in our new system. Release of ¹⁴C-CO₂ will reflect the degradation potential of the different artificial soils. After sampling, we will quantify the composite MCPA degrading community as well as the abundance of the *tfdA* gene classes.



S11.09-P -12

MICROBIAL RESIDUES ARE INDICATORS OF CROP EFFECTS ON ORGANIC CARBON OF AN OXISOL UNDER NO-TILLAGE

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Crop type should be the most important management factor controlling soil organic matter quantity and quality, and microorganisms are mediators of crop impact on soil organic matter. The objective was to determine the effects of 28 crop sequences on soil amino sugars and microbial biomass and their relationship to total soil organic C (SOC) content and SOC distribution in particle-size fractions of an Oxisol under no-tillage system. Soil samples were taken 7 years after 14 crop cycles. Bacterial muramic acid (B MurN) and fungal glucosamine (F GlcN) were affected by crop sequences. Mixed summer crop rotations potentiated the impact of winter crops on microbial amino sugars, which suggests that increased plant diversity increases the sensitivity of the microbial community to winter crop cultivation. Soybean/corn rotation provided higher soil microbial biomass C (MBC) content than continuous corn when combined with most of the winter crops. Continuous corn for 14 crop cycles provided the lowest soil MBC and soil particulate organic C (POC) contents, showing that the lack of diversity of plant materials entering the soil caused a decline in soil biochemical quality. Contents of B MurN and F GlcN in soil are closely linked with SOC, which is likely a reflection of the participation of microbial cell wall residues in the refractory soil organic C (SOC) pool. F GlcN was most closely related to POC. Our results evidenced that the dynamics of accrual of fungal and bacterial cell wall residues in an Oxisol under no-tillage system are coupled with SOC buildup.



S11.09-P -13

MODELING ORGANIC MATTER DECOMPOSITION IN HETEROGENEOUS SOIL STRUCTURE AT MICROBIAL HABITATS SCALE

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At microscopic scale, soil pores constitute microbial habitats with changing physicochemical settings, where cells and organic residues are heterogeneously distributed. Soil Organic Matter (SOM) decay is thus controlled not only by the activity of the microbial communities but also by abiotic processes such as the diffusion of extracellular enzymes and dissolved organic carbon (DOC) in hydrologically connected soil pore space. We present a carbon decomposition model (inspired by Schimel and Weintraub, 2003) where the processes are spatialized in the soil structure. Decomposition is seen as sequential with a first stage for particulate organic matter (POM) hydrolysis and a second one for DOC assimilation by bacteria. DOC and enzymes may enter adsorbed pools and hence be temporarily preserved from degradation. The biological model is coupled to the TRT-Lattice Boltzmann model (Ginzburg, 2005). The latter applies statistical physics principles that simulate collisions and propagation of fluid particles using a discrete method. It reproduces water flows and solutes diffusion at the pore scale. This approach enables to take into account easily the complex 3D geometry of soil pore space and the heterogeneous distribution of the water/air, POM and bacteria within the pores. 3D images of the soil pore space are obtained from X-Ray computing microtomography scans of soil samples. A parameters sensitivity analysis of the coupled model will finally allow us to estimate soil structure impact on biological, physical and physicochemical mechanisms controlling SOM decomposition.



S11.09-P -14

POSSIBLE CORRELATION BETWEEN BACTERIAL DIVERSITY, PEDOLOGICAL PROPERTIES AND LEVEL OF INFECTION BY ROSELLINIA NECATRIX IN AN APPLE TREE ORCHARD BIOLOGICALLY MANAGED

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Rosellinia necatrix is a pathogenic fungus very harmful for many fruit tree and in orchard. Studies in the last decade have pointed out the effective antagonistic action against *R. necatrix* exerted by some bacterial species living in soil. We evaluated the relationship between physical and chemical properties of soil, the degree of pathogenic attack and the bacterial diversity in a biologically managed apple tree orchard in Tuscany; in addition, we screened some cereal varieties as cover crops in order to increase the bacterial diversity of the Plant Growth Promoting Rhizobacteria (PGPR) or bacteria producing antibiotic, to counteract *R. necatrix* diffusion. We collected disturbed and undisturbed samples at 0-20 and 20-40 cm depth from three sites with plant differently affected by the fungus. We measured soil texture, pH, Electrical Conductivity (EC), total CaCO₃, Total Organic Carbon (TOC), Bulk density (BD), Available Water Capacity (AWC) and soil macroporosity. The same samples were used for direct DNA and RNA extraction and DGGE (Denaturing Gradient Gel Electrophoresis) analysis, to evaluate the bacterial genetic and functional diversity (16S rDNA and rRNA) and the relative biodiversity indexes. Chemical and physical analysis showed significative differences for many parameters; biomolecular analysis gave different results particularly, in layer 0-20 cm, where the presence of trees determines the composition (DNA) of bacterial community, while the ongoing infection selects the active microflora (RNA). Multivariate analysis of the whole data set pointed out a strict correlation between biodiversity indexes and some chemico-physical soil properties



S11.09-P -15

THE EFFECT OF SOIL COMPACTION ON SOIL RESPIRATION ACTIVITY IN BOTH CLAY AND SAND SOIL TEXTURE

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Soil compaction includes increasing the bulk density of the soil into the mechanical pressure on it leads to decreasing at the soil porosity. Soil Biological properties as respiration rate and soil nitrogen mineralization are influenced by compaction. This study performed to survey the compaction effect on the soil respiration activity in both clay and sand texture of soil under wheat cultivation in Guilan University Faculty of Agriculture. Compaction in three levels of (natural compaction, %10 and %20), soil type in two levels of (sand and clay) and two measuring time stages (14 and 60 days after planting) and three replications of soil respiratory activity under cultivation of wheat was studied. Carbon dioxide production and soil organic matter in different treatments showed significant differences. The soil compaction lead to decreasing of produced carbon dioxide and the soil organic matter. Respiration and soil organic matter at the end of the culture were significantly reduced. Soil respiration also correlated significantly with soil organic matter, so reduced organic matter, soil microorganism activity also decreases and the decrease of soil respiration. soil respiration of microorganism was affected texture so that the clay soil produced carbon dioxide is more than from the sandy soil, but significant differences in organic matter, soil texture did not show. Concluding, the soil compaction resulted in decreasing produced carbon dioxide by soil microorganisms so decreases the soil respiration that is the index of microbial activity measurement and organic matter analysis.



S11.09-P -16

THE IMPACT OF FACTORS (PF, TOC, WAY OF LAND USE) ON TOTAL DNA CONCENTRATION AND DEHYDROGENASE ACTIVITY

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The aim of the study was the statistical evaluation of the impact of water potential (pF), total organic carbon content (TOC) and human agricultural activities on total DNA concentration and dehydrogenase activity level (DHA) in the Mollic Gleysol. Soil material was taken in October 2008 from the village Kosiorów (SE part of Poland). Three soil layers were tested: surface (0-20 cm), subsurface (20-40 cm) and subsoil (40-60 cm). Soil samples were taken from the two neighbouring areas: agriculturally exploited (AE) by fertilization and pasturage, and fallow land (FL), which served as the control area. Moisture content was determined for a range of pF values (0, 1.0, 1.5, 2.0), which corresponded to availability of water usable by microorganisms and plant roots. TOC analyses were performed with use of automatic analyser TOC-V SSM 5000A (Shimadzu). Soil DHA was tested according to the method of Casida et al. (1964). Soil DNA was extracted using the procedure of Sambrook and Russel (2001), whereas concentration of DNA was determined spectrophotometrically at 260 nm (Shimadzu, UV-1800, Japan). It was found that soil taken from the surface and subsurface layers of the control area displayed higher DHA (c.a. by 50%) and DNA concentration (c.a. by 25%) than soil from AE object. Our results revealed also significant ($p < 0.05$) positive relationships between soil DNA content and both DHA ($r = 0.28^$) and TOC ($r = 0.49^*$). Importantly, intensive and systematical agricultural soil usage resulted in reduction of its dehydrogenase activity and DNA content.*



S11.09-P -17

THE IMPACT OF MICROBIOLOGICAL PREPARATIONS ON SOIL CHARACTERISTICS AND ON THE RYEGRASS (*LOLIUM PERENNE*, L.) BIOMASS

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Nowadays the application of different microbial products has been spreading in agricultural cultivation. Different bacterial and fungal strains, enzymes and vitamins are allocated into the soil which characterize the use of varied composition of different biofertilizers. The effect of microbial products were studied in a pot experiment that was set up in the greenhouse of the Institute of Agrochemistry and Soil Science, Centre for Agricultural and Applied Economic Sciences, Faculty of Agricultural and Food Sciences and Environmental Management University of Debrecen, in 2011. The soil applied was a loamy calcareous chernozem soil with neutral acidity, and with medium nitrogen and high phosphorus and potassium content. The testplant examined was perennial ryegrass (*Lolium perenne*, L.). The treatments applied of the experiment were the following; control, NPK fertilization and wheat straw treatment in different combinations with microbiological preparations (Bactofil A, EM-1, MicrobionUNC). The products are available in commerce. The physical, chemical and microbiological parameters of soils, and the biomass of ryegrass were measured in laboratory. Moisture content, Arany-type plasticity index and clay-and-silt-content were the measured physical properties. Chemical parameters were examined the soluble nutrient content of soil (nitrat, phosphorus and potassium). The measured microbiological features were the amount of bacteria (the total number of bacteria, -cellulose decomposing and nitrifying bacteria) and microscopic fungus, and the features of microbiological activities. The biomass of ryegrass was measured. For the examination of the statistically justifiable differences between the values of the results we applied factor and correlation analysis of variance on statistical data.



S11.09-P -18

THE INFLUENCE OF LAND USE IN MOUNTAIN SOILS ON THE LABILE ORGANIC CARBON CONTENT

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Labile organic carbon (CL) is a very small but important part of organic carbon in soil. The aim of this research was to check the effects of different land uses and soil properties on contents of diverse fraction CL in horizons layers of arable and grassland soils. In 18 soil samples from humus layers collected from 6 places of the Little Beskids (Poland) fractions: C microbial biomass (CB), light fraction (LF) and dissolved organic carbon (DOC) in cold water (WSC) and in hot water (HWC) were determined. Light fraction constituted 1.5% of the arable soil and 7.7% in grassland soils (almost five times more). The average content of CB in arable soils was $387.0 \mu\text{g} \cdot \text{g}^{-1}$ and it was two times less than in grassland soils ($850.6 \mu\text{g} \cdot \text{g}^{-1}$). On all analyzed sites, the surface horizons of the arable soils contained smaller amounts of dissolved organic carbon too. The content of different fraction of CL was positively correlated with total porosity of soils. CB was significant correlated with mesopores ($r=0,5511$, $p<0,05$) and HWC with macropores ($r=0,5074$, $p<0,05$). The concentration of HWC was related to clay content ($r=-0,5864$, $p<0,05$). The DOC is an important source of energy for microorganisms. We have found strongly relation between biological activity (expressed by enzymatic activity) and fraction HWC and CB.



S11.09-P -19

THE VIABILITY OF GRAM POSITIVE BACILLUS SP. AND TRICHODERMA SP. IN LIQUID AND SOLID FORMULATION

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Background Formulation is a crucial aspect for producing inoculants containing an effective bacterial or fungi strain and can determine the success or failure of a biological agent. Achieving efficient formulation and providing mixed treatments of bacteria and fungi in order to provide mixed microbial inoculants and studying the effects of additives on the viability of these microorganisms were the aims of this research. Methods Formulation of selected isolations of Trichoderma sp. and Bacillus sp. was designed in liquid and solid forms. Treatments of solid formulation were as follows: B1:control, B2:formulated bacteria, B3(B+T), T1:control, T2:formulated Trichoderma, T3(T+B). They were granulated, air-dried and stored for 295 days. Treatments of liquid formulation were as mentioned before and incubated for 295 days at 27° C. The populations of treatments were evaluated by plate count method on day 0, 15, 30, 45, 60, 75, 295. Results 1. The population of Bacillus sp. and Trichoderma sp. in both formulations had significant difference compared with controls(=0.01). 2. B3 and T3 had the most population in comparison with their individual treatments in both formulations. 3. The type of formulation had effect on the population of Bacillus sp. and Trichoderma sp..So, B3 and T3 had the most population in liquid formulation. Conclusion 1. Being the best treatment of B3 and T3 in both formulations indicated that there is a synergistic relation between Bacillus sp. and Trichoderma sp. 2. High efficiency of mixed treatments in formulations indicated that we can use the combination of bacteria and fungi in the same formulation as well as their individual formulations.



W11.01-P - THROUGH EYE OF THE NEEDLE: THE SOIL MICROBIAL BIOMASS CONCEPT FROM NUTRIENT CYCLING TO GLOBAL WARMING - Dedicated to the memory of Professor David Jenkinson

Tuesday 03 July 2012 from 17:00 to 18:30. Room Poster Areas

W11.01-P -1

INFLUENCE OF FLOODING AND ORGANIC ENRICHED WATER ON PHOSPHORUS MOBILIZATION AND INTERACTIONS TO REDOX POTENTIAL

Artur Banach, Lublin - Poland

W11.01-P -2

INTERACTIONS OF SOIL PHOSPHORUS AND CARBON CYCLING DURING DRYING AND REWETTING EVENTS

Else K. Bünemann, Zurich - Switzerland

W11.01-P -3

OVER WINTER CHANGE OF SOIL PHOSPHORUS DYNAMICS AS AFFECTED BY TILLAGE PRACTICES IN A LONG-TERM SOYBEAN-MAIZE ROTATION

Noura Ziadi, Quebec - Canada

W11.01-P -4

P AND N AVAILABILITY CONSTRAINS SOIL MICROORGANISMS AND PASTURE PRODUCTIVITY IN THE TROPICAL MOUNTAIN RAINFOREST REGION OF SOUTH ECUADOR

Alexander Tischer, Tharandt - Germany

W11.01-P -5

ROCK PHOSPHATES AS A VALUABLE PHOSPHOROUS SOURCE IN ACID SOILS

Camilla Giovannini, Bologna - Italy

W11.01-P -6

SOIL P STATUS VERSUS P BUDGET OVER 16 YEARS UNDER NO-TILL AND MOULDBOARD PLOUGHING WITH ANNUAL COMBINATIONS OF N AND P FERTILIZATION

Aime Jean Messiga, Quebec - Canada



W11.01-P -7

SOIL PHOSPHORUS FRACTIONS FOLLOWING TILLAGE AND PHOSPHORUS FERTILIZATION IN A LONG TERM MAIZE-SOYBEAN ROTATION

Noura Ziadi, Quebec - Canada

W11.01-P -8

SOIL TEST P CONCENTRATIONS IN THE SOIL PROFILE OF A GRASSLAND AFTER 8 YEARS OF CONTRASTING N AND P FERTILIZATION

Aime Jean Messiga, Quebec - Canada

W11.01-P -9

THE DYNAMICS OF NITROGEN AND PHOSPHORUS CONTENT IN THE SOIL DURING DECOMPOSITION OF CUT PLANT RESIDUES ON SWARD SURFACE

Karin Kauer, Tartu - Estonia

W11.01-P -10

EFFECTIVENESS OF 3,4-DIMETHYLPYRAZOLE PHOSPHATE (DMPP) AS NITRIFICATION INHIBITOR IN SOIL AS INFLUENCED BY FERTILIZER, TEMPERATURE AND SOIL BIOLOGICAL PROPERTIES

Alessandro Florio, Rome - Italy

W11.01-P -11

EFFECTS OF LONG-TERM APPLICATION OF BIOGAS SLURRY ON SOIL FERTILITY UNDER CONDITIONS OF ORGANIC FARMING PRACTICE

Stefanie Wentzel, Kassel - Germany

W11.01-P -12

EFFECTS OF THE NITRIFICATION INHIBITOR 3,4-DIMETHYLPYRAZOLE PHOSPHATE (DMPP) ON SOIL MICROBIAL COMMUNITIES AFTER BOVINE EFFLUENT APPLICATION IN EXPERIMENTAL MICROCOSMS

Alessandro Florio, Rome - Italy

W11.01-P -13

INFLUENCE OF ORGANIC FERTILIZATION WITH NITRIFICATION INHIBITOR (3,4 DMPP), ON SOIL BIOLOGICAL PARAMETERS AND MICROBIAL DYNAMICS IN A MICROCOSM EXPERIMENT SYSTEM

Anita Maienza, Viterbo - Italy



W11.01-P -14

INTERACTIONS OF MUSTARD PLANTS AND SOIL MICROORGANISMS AFTER APPLICATION OF SUGARCANE FILTER CAKE AND PEA RESIDUES TO AN ANDOSOL

Rainer Georg Joergensen, Witzenhausen - Germany

W11.01-P -15

THE CULTIVATION POSSIBILITIES OF METHANOTROPHIC BACTERIA POPULATIONS ISOLATED FROM TWO COAL BED ROCKS OF LUBLIN COAL BASIN

Jakub Ciepielski, Lublin - Poland

W11.01-P -16

WORKING WITH CFE METHODS FOR MORE THAN 30 YEARS – HOW USEFUL IS IT?

Hana Santruckova, Ceske Budejovice - Czech Republic



W11.01-P -1

INFLUENCE OF FLOODING AND ORGANIC ENRICHED WATER ON PHOSPHORUS MOBILIZATION AND INTERACTIONS TO REDOX POTENTIAL

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The aim of the experiment was to estimate the role organic enriched floodwater on P biogeochemistry in soils of different land use. This is urgent problem as there is increasing tendency in flood events worldwide. Moreover, flooding of agricultural lands lead to severe eutrophication problems due to enhanced nutrient cycling. Soil samples (Haplic Phaeozem, 0-20 cm) originated from two meadows (cultivated and waste filed) of the former floodplain of the Vistula River in Poland. The samples were incubated at 20°C for 49 days under following treatments: flooded and C enriched (+F+C), flooded without C addition (+F-C), moist with C enrichment (-F+C) and without any manipulation (-F-C). Flooding led to reducing conditions ($E_h < 100$ mV) which together with C addition caused P mobilization up to 8 mg L⁻¹ (higher in cultivated soil) and ammonium production up to 10 mg L⁻¹. Decomposition of added C was responsible for observed P levels (up to 18 mg L⁻¹) in water layer and non flooded soil ($r=0.68$). High and increasing concentrations of Fe (up to 10-13 mg L⁻¹) ions under flooded conditions indicated the redox-related P mobilization form Fe-P soil fraction. In conclusion, flooding itself stimulated P mobilization whilst C-enrichment strengthened that effect enforcing decomposition process. This emphasises the important role of C in soil biogeochemistry during anaerobic conditions and indicates that agricultural lands exposed to inundation would suffer much stronger due to decay of plant material. The way of land use determines nutrients levels in soil what also affects soil response to flooding.



W11.01-P-2

INTERACTIONS OF SOIL PHOSPHORUS AND CARBON CYCLING DURING DRYING AND REWETTING EVENTS

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Drying and rewetting (DRW) of soils often causes a substantial pulse in soil respiration. The additionally released CO₂ can originate from lysed microbial cells, released intracellular solutes or from soil organic matter liberated due to physical changes in the soil. Pulses in phosphorus (P) availability have also been observed, but the underlying processes are not well understood and the potential linkage to C dynamics remains largely unexplored. Using a permanent grassland soil low in available P as a model, our objectives were i) to quantify P and C flushes after DRW as depending on the extent of drying before rewetting and ii) to assess the contribution of physical soil disruption vs. rupture of microbial cells to the release of P and C. Microbial P was more sensitive to DRW events than microbial C, resulting in a widening of the C:P ratio from 10 before to 20 after DRW. A significant increase in available P after DRW was also observed in soils sterilized by autoclaving or gamma-irradiation, whereas dissolved organic C was not affected. Dried soils had reduced aggregate stability, resulting in slaking upon rapid rewetting. It was shown that increased soil dispersion by DRW or addition of sodium indeed releases both inorganic and organic forms of P. Based on these results and a literature review, we will present a conceptual model of the processes of P and C dynamics during DRW events.



W11.01-P -3

OVER WINTER CHANGE OF SOIL PHOSPHORUS DYNAMICS AS AFFECTED BY TILLAGE PRACTICES IN A LONG-TERM SOYBEAN-MAIZE ROTATION

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Agriculture management, such as tillage practices, could affect soil P dynamics during winter season with crop residue left in the field after crop harvest. The main objective of this study was to investigate the effect of tillage on over winter changes of soil P including total P (TP), inorganic P (Pi), organic P (Po), Mehlich-3 P (PM3) and microbial biomass P (MBP) under different tillage practices in a long-term maize-soybean rotation established since 1992 in eastern Canada. Soil samples were collected in October 2009, February 2010, and April 2010 at 0-10 cm layer from plots under mouldboard plough (MP) and no-till (NT) management and fertilized with 0, 17.5, and 35 kg P ha⁻¹. Results showed that TP, Pi, and PM3 significantly increased from October 2009 to April 2010 by 30%, 21%, and 49% under NT, but no variation was shown under MP. However, Po significantly increased by 8% under MP, but no variation was observed under NT from October 2009 to April 2010. The content of SMB-P was increased by 50% both in MP and NT from October 2009 to April 2010. However, there is a significant decrease under MP from October 2009 to February 2010 but no variation was shown under NT. Under MP, SMB-P was negatively correlated to PM3 ($P = 0.044$), and positively correlated to Po ($P = 0.003$). We conclude that NT had a greater effect on soil P transformation, especially in Po mineralization in the process of residue decomposition over winter compared with MP.



W11.01-P -4

**P AND N AVAILABILITY CONSTRAINS SOIL MICROORGANISMS AND PASTURE
PRODUCTIVITY IN THE TROPICAL MOUNTAIN RAINFOREST REGION OF SOUTH ECUADOR**

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Phosphorus is a limiting resource in many ecosystems, especially in the tropics. P availability has the potential to restrict or enhance carbon- and nutrient cycling with impacts on ecosystem development/functioning. In the South-Ecuadorian Andes vast areas are subjected to conversion from tropical mountain rainforests to pastures. Currently less than 1/3 of these sites are still in use. 2/3 have been abandoned due to the suppression of the pasture grass *Setaria sphacelata* by the invading tropical bracken fern *Pteridium arachnoideum*. Understanding pasture degradation processes is a key for a sustainable land management in the tropical mountain rainforest region of the study area. We compiled results from field surveys along a land-use gradient, a pasture fertilization experiment and laboratory incubations and highlighted aspects of soil microbial responses to land-use induced changes in resource availability. Conversion of forest to pasture by slash-and-burn increased stocks of SOC, TN, S and P of active pasture sites. The improved nutrient availability and increased soil pH enhanced microbial growth and gross-N-mineralization. A further improvement of nutrient availability by pasture fertilization with N and P increased grass biomass production but had no influence on soil microbial biomass C, N or P. Without fertilization, the plant available, NH_4F -extractable P-pool was exhausted in aged pastures followed by the NaOH -extractable P-pool. The decline of the NaOH -extractable P-pool back to forest level might be of special importance for the degradation of pastures and the decline of soil microbial biomass. Laboratory incubations indicated N and P limitations of soil microorganisms in abandoned pastures.



W11.01-P-5

ROCK PHOSPHATES AS A VALUABLE PHOSPHOROUS SOURCE IN ACID SOILS

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Phosphorus (P) is critically needed to improve soil fertility in many parts of the world. The presence of indigenous phosphate deposits in some countries provides an incentive for direct application or local chemical treatment at low cost to improve the solubility of low reactive phosphate rocks (PRs). The main problem for the direct application of PRs to soils is the failure of PRs to release P into the soil solution in amount to satisfy plant growth. Several alternatives have been used to increase P availability in PRs and one of the most challenging could be inducing microbial solubilisation of PR by adding soil organic amendments. The main objectives of this research was to investigate the effects on different soil P pools exerted by incubations of RP in an acid soil amended with two different composts characterized by high and low quality and with a humic acid-based organic activator (Act). The results obtained demonstrated that the organic activator was more effective in solubilizing P from RP respect to the two composts. In fact, in the soil treated with RP+Act, the Olsen-P and the biomass-P, considered the P forms more available to plants, showed the highest values. Part of the available P was also immobilized as Fe-phosphates as indicated by the high values of P extracted with NaOH solution (NaOH-P). However soil biological properties, usually correlated to soil microbial activities (e.g. soil respiration, soil microbial biomass, soil enzymatic activities), were more affected by the two composts with respect organic activator treatment.



W11.01-P-6

SOIL P STATUS VERSUS P BUDGET OVER 16 YEARS UNDER NO-TILL AND MOULDBOARD PLOUGHING WITH ANNUAL COMBINATIONS OF N AND P FERTILIZATION

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More information is needed about the agronomic effects of conservation tillage in temperate and humid regions. Our objective was to determine whether NT management affects the relationship between P budgets and soil test P in a maize-soybean rotation. The study site was established in 1992 on a clay loam soil (Dark Grey Gleysol). The experimental design is a split plot with no-till (NT) and mouldboard plough (MP) treatments assigned to main plots and nine combinations of 3 N (0, 80, and 160 kg N ha⁻¹) and 3 P (0, 17.5, and 35 kg P ha⁻¹) additions to subplots. Soil samples (0-15 cm) collected in all plots between 2001 and 2008 were analyzed for Mehlich-3 P (PM3). Soil tests PM3 concentrations in the control were similar in the NT and MP. NT maintained greater PM3 than MP in the fertilized P treatments. Under MP, we calculated that a P budget change of 100 kg P ha⁻¹ would change PM3 by 12 kg ha⁻¹. Under NT, a linear relationship was not obtained across P treatments, but for the unfertilized P treatment the rate of decrease of PM3 was similar to those obtained under MP. In the conditions of this study, the P budget approach was not appropriate to monitor the soil P status in the rooting zone of fertilized NT soils. We therefore suggest a more detailed sampling that integrates the variability caused by the absence of mixing the fertilizer with soil.



W11.01-P-7

**SOIL PHOSPHORUS FRACTIONS FOLLOWING TILLAGE AND PHOSPHORUS
FERTILIZATION IN A LONG TERM MAIZE-SOYBEAN ROTATION**

Yichao Shi^[1], Ziadi Noura^{*[1]}, Aimé Messiga^[1], Roger Lalande^[1], Zheng-yi Hu^[2]

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Seasonal change of soil P, especially between fall and spring, could be affected by agricultural managements, which influenced soil P cycling process. This work aimed to assess the effects of season, tillage and P fertilization on soil P fractions over the 6-year period. Soil samples (0–15 cm) were collected at different dates during 2001-2008 from plots under mouldboard plough (MP) and no till (NT) management and fertilized with 0, 17.5 or 35 kg P ha⁻¹ in long-term maize-soybean rotation experiment established since 1992 in eastern Canada. Soil samples were analyzed for different parameters including P fractionation. Results showed that all soil P fractions decreased with time. Total P was reduced by 14% over 6 years, with decrease from fall to spring being accounted for 58-67% of the total reduction over 6 years. The annual variation of P fractions could be mainly ascribed to soil P variations between fall and spring and probably enhanced by biotic and abiotic conditions prevailing during winter. The residual P, HCl-P, and NaOH-P_o were the main contributors to the reduction of total P from fall to spring. No-till practice had no significant influence on P fractions compared with MP. Inorganic P forms increased with increasing P additions but P_o and residual-P remained constant. Soil P variation between fall and spring is more enhanced by P fertilization than tillage practices due to accumulations of P derived from fertilizers in the inorganic fractions.



W11.01-P-8

SOIL TEST P CONCENTRATIONS IN THE SOIL PROFILE OF A GRASSLAND AFTER 8 YEARS OF CONTRASTING N AND P FERTILIZATION

Messiga Aime Jean*^[1], Noura Ziadi^[1], Gilles BÉlanger^[1], Christian Morel^[2]

^[1]AGRICULTURE AND AGRIFOOD CANADA ~ CROPS AND SOILS RESEARCH AND DEVELOPMENT CENTRE ~ Quebec ~ Canada ^[2]Institut National de la Recherche Agronomique ~ Unité mixte de recherche 1220, Transfert sol-plante et cycle des éléments minéraux dans les écosystèmes cultivés (INRA-ENITAB) ~ bordeaux ~ France

Soil testing for grassland P recommendations in eastern Canada relies on soils sampled to a 15-cm depth whereas evidence in other countries suggests the use of a 5-cm depth. Our objective was to examine soil P concentrations at two soil depths (0-5 and 5-15 cm) in a long term grassland established in 1998 on a gravely-sandy loam soil in Quebec, Canada. The experimental design was a split-plot with four P additions (0, 15, 30, and 45 kg P/ha [triple super phosphate]) as main plots and four N additions (0, 60, 120, and 180 kg N/ha [calcic ammonium nitrate]) as subplots with four replicates. Fertilizers were applied annually in the spring (1999-2006) and timothy was harvested twice a year until 2007. Soil samples were collected in spring 2010 for this study. In P-fertilized plots, Mehlich-3 P (PM3) concentrations were approximately three-fold greater in the 0-5 cm (63 to 128 mg/kg) than in the 5-15 cm soil layers (23 to 33 mg/kg). The PM3 concentrations increased with increasing P additions in the 0-5 cm soil layer. In the 5-15 cm soil layer, however, PM3 concentrations were similar for all P additions but were lower when no P was applied. This P accumulation in the 0-5 cm soil layer of P-fertilized plots appears to be caused by a lack of mixing of applied fertilizer because similar trends were observed for total N and P. Our results suggest that the depth of soil sampling for grassland fertilizer recommendations in eastern Canada should be reexamined.



W11.01-P -9

THE DYNAMICS OF NITROGEN AND PHOSPHORUS CONTENT IN THE SOIL DURING DECOMPOSITION OF CUT PLANT RESIDUES ON SWARD SURFACE

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The objective of this research was to study the decomposition of cut plant residues from different swards and nitrogen (N) and phosphorus (P) release during decomposition. Also we studied the effect of returning cut plant residues on the plant available phosphorus (P_{avail}) and the total N (N_{tot}) content of swards soil. The sward had been established in 2003 with turfgrass mixture (Festuca rubra and Poa pratense) and with grasses-clover mixture (Phleum pratense, Lolium perenne and Trifolium repens). The fertilizer treatments for turfgrass sward were: N0P0K0, N80P11K48, N160P22K96 and N400P56K240 kg ha⁻¹ and for grasses-clover sward: N0P0K0 and N80P26K50 kg ha⁻¹. After the mowing the cut plant residues were returned to the plots or were removed from them. The mowing frequencies were 13-15 times for turfgrass and 4-5 times for grasses-clover sward per growing season. Litterbags were used in 2006 to study the decomposition of plant residues. In autumn 2006 the N_{tot} and P_{avail} content in 0-5 cm soil layer were determined. The decomposition of turfgrass residues was faster (61%) than of grasses-clover residues (54%). The fertilization had no impact on the decomposition of turfgrass residues, but increased the N mineralisation and decreased the P mineralisation during decomposition. Fertilization reduced the decomposition of grasses-clover residues and N and P release from decaying residues. More P was released from turfgrass residues (52%) compared to the grasses-clover residues (21%) but the P_{avail} content in soil did not differ significantly. The fertilization and returned plant residues did not influenced the N_{tot} content in soil.



W11.01-P -10

EFFECTIVENESS OF 3,4-DIMETHYLPYRAZOLE PHOSPHATE (DMPP) AS NITRIFICATION INHIBITOR IN SOIL AS INFLUENCED BY FERTILIZER, TEMPERATURE AND SOIL BIOLOGICAL PROPERTIES

Florio Alessandro^{*[1]}, Dell'abate Maria Teresa^[1], Felici Barbara^[1], Benedetti Anna^[1]

^[1]CRA – Research Centre for the Soil-Plant System ~ RPS ~ Rome ~ Italy

The element nitrogen (N) is an essential nutrient for plant development and its intake is a key factor for crop production; however, its real availability in soil, as well as its chemical form, are crucial for the N uptake by crops. The main N losses in soil driven by microbial processes like nitrification, leaching and denitrification involve NO₃⁻ as key point, so limiting NO₃⁻ in the soil is a potential tool to restrict N leaching, NO_x emissions and even NH₃ volatilization from soils in one hand, and increasing N use efficiency on the other hand, obtaining both environmental and economic benefits (Jenkinson, 1982). The application of nitrification inhibitors to soil offers the chance to reduce N losses and to increase fertilizer use efficiency. The present study therefore aimed to evaluate the influence of both inorganic and organic N fertilizer, temperature and soil biological properties on the effectiveness of DMPP in a long-term incubation experiment. The application of ammonium sulphate and a cattle effluent as inorganic and organic N fertilizer respectively to a low biological fertility soil resulted in a reduction of the nitrification rate starting from the second week of incubation until at least the fourth week, while the nitrification inhibition occurred immediately in the higher biological fertility soil but after four weeks there was no difference with respect to the control. The temperature (20°C and 30°C) had little or no effect on potentially mineralized N.



W11.01-P -11

EFFECTS OF LONG-TERM APPLICATION OF BIOGAS SLURRY ON SOIL FERTILITY UNDER CONDITIONS OF ORGANIC FARMING PRACTICE

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Organic fertilizer in livestock farms are an important part of soil organic matter and nutrient balance in organic farming systems. The growing relevance of energy production by biogas leads to an increasing use of biogas slurry as fertilizer in organic farms. On the subject of biogas slurry previous research dealt mainly with their nitrogen effect. Organic fertilizers not only affect the soil chemical properties but also the soil biological properties, such as microbial activity and biomass. Therefore, we studied the long-term effect of biogas slurry and animal manure on microbial biomass (C, N), microbial activity (basal respiration) and microbial residues (amino sugars) in soils of organic farms and determine impacts of biogas slurry and animal manure application on the nutrient management and conservation of soil fertility. First results showed that the contents of soil organic carbon and total N are significant higher for animal manure treated fields (0-30 cm). The microbial biomass C and N (20 and 25%), fungal ergosterol (16%) and microbial activity (16%) tend to be higher in fields with animal manure compared to fields treated with biogas slurry. The microbial biomass C to organic carbon ratio (2,2) was significant higher in animal manure -fields and exhibited clear inverse relationship between metabolic quotient. The ergosterol/microbial biomass C ratio (0,2 %) was also significant higher in animal manure -fields. In summary, the first results showed that long term application of animal manure influences soil microbial biomass and nutrients significant higher than biogas slurry.



W11.01-P -12

EFFECTS OF THE NITRIFICATION INHIBITOR 3,4-DIMETHYLPYRAZOLE PHOSPHATE (DMPP) ON SOIL MICROBIAL COMMUNITIES AFTER BOVINE EFFLUENT APPLICATION IN EXPERIMENTAL MICROCOSMS

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The application of animal manure to soil can result in increased gaseous emissions such as NH₃, N₂O, CO₂ and CH₄ as well as nitrate leaching, contributing to climate warming and ground and surface water pollution. The application of nitrification inhibitors to soil offers the chance to reduce N losses and to increase fertilizer use efficiency. In this study, we assess the effects of the nitrification inhibitor 3,4-dimethylpyrazole phosphate (DMPP) on microbial community-level physiological profiling (CLPP) and on the abundance of ammonia-oxidizing bacteria (AOB) using RT-qPCR in soil microcosms amended with bovine effluent. DMPP reduced the nitrification rate starting from the second week of incubation until at least the fourth week. DMPP treatments induced rapid changes in microbial heterotrophic metabolism showing significant differences after 24h of incubation: DMPP seemed to decrease metabolic activity when applied without a N source but AWCD values were increased in DMPP + bovine effluent treatment, suggesting that a few effluent strains were the main responsible of substrates consumption. As expected, total bacteria population was higher where bovine effluent was applied, as it contains its own microbial population, but no massive differences were found between treatments in qPCR. On the contrary, rapid changes in gene expression occurred in DMPP + effluent treatment: after 24h amoA gene copy numbers were lower with respect to the effluent treatment, due to a high efficacy in the inhibition of the ammonia-oxidizing populations, but even bacteria 16S gene expression was reduced, suggesting a possible effect on non-targeted populations by DMPP.



W11.01-P-13

INFLUENCE OF ORGANIC FERTILIZATION WITH NITRIFICATION INHIBITOR (3,4 DMPP), ON SOIL BIOLOGICAL PARAMETERS AND MICROBIAL DYNAMICS IN A MICROCOSM EXPERIMENT SYSTEM

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The application of animal manure to soil in the Mediterranean area is a common fertilization practice. However, there are environmental and economic problems related to the disposal of these N-rich waste materials, and, uncontrolled application can result in an excess of nitrate in soil and eventually in ground water pollution. The use of nitrification inhibitors together with animal effluents may be beneficial for nutrient recycling, soil quality, plant productivity and greenhouse gas emission, and offers economic advantages to make it an alternative to conventional fertilizers. We compared the effectiveness of a nitrification inhibitor, 3,4 dimethylpyrazole phosphate (DMPP), together with the addition of fresh organic matter (bovine effluent, BE) to the soil of a short rotation forestry. A microcosm experiment was conducted to determine the biochemical and microbial dynamics. BE increased microbial respiration and biomass, and stimulated microbial enzymatic activity. DMPP addition together with BE inhibited part of this effect; the treated soil had lower microbial activity, but still higher than the control. DMPP also influenced bacterial and fungal growth. A Principal Component Analysis of the phospholipids fatty acid (PLFA) patterns revealed a significant BE effect and also an effect of the DMPP application. The microcosm experiment suggested that the combined use of DMPP and BE could be a good solution to limit the drastic effect of BE application on soil biological properties and microbial dynamics. On the basis of this microcosm study, field experiments were planned to confirm the results.



W11.01-P -14

INTERACTIONS OF MUSTARD PLANTS AND SOIL MICROORGANISMS AFTER APPLICATION OF SUGARCANE FILTER CAKE AND PEA RESIDUES TO AN ANDOSOL

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^[1]University of Kassel ~ Soil Biology and Plant Nutrition ~ Witzenhausen ~ Germany

*In a pot experiment using a strongly P fixing Andosol from Nicaragua, the effects of sugarcane filter cake application on the growth of white mustard (*Sinapis alba* L.) were compared with that of ¹³C-labeled pea residues. The application of pea residues led to a 50% increase in soil organic matter-derived microbial biomass C and that of filter cake to a 30% decrease in comparison with the control. In contrast, the application of filter cake resulted in a four times higher content of substrate-derived microbial biomass C than that of pea residues. The application of organic substrates generally increased microbial biomass N and P, in most cases significantly. The increasing effect was stronger for the pea residues than for the filter cake. More substrate-derived soil organic C and microbial biomass C remained in the presence of mustard plants, indicating a decrease in microbial turnover. Mustard growth led to highly significant increases in Bray-1 extractable P and microbial biomass P and a significant decrease in the microbial biomass C/P ratio. These effects were stronger in the filter cake treatment. The application of pea residues had no effect on the yield of shoot C but a positive effect on the yield of root C in comparison with non-amended control. In contrast, the application of filter cake significantly depressed yields of shoot C and root C.*



W11.01-P -15

**THE CULTIVATION POSSIBILITIES OF METHANOTROPHIC BACTERIA POPULATIONS
ISOLATED FROM TWO COAL BED ROCKS OF LUBLIN COAL BASIN**

Stepniewska Zofia^[1], Ciepielski Jakub*^[1], Pytlak Anna^[1], Kozuch Izabela^[1]

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Oxidation of the atmospheric methane occurs due to photochemical and biological reactions. Methane utilizing bacteria are an important element of the global carbon cycle responsible for 5-10% of the atmospheric methane oxidation and have a significant influence on the global warming effect reduction. It was found recently that they are present also in coal mine environments. Those bacteria play important role in diminution of methane concentration and possible explosion in mines. In the study susceptibility of coal mine methanotrophs to the cultivation was investigated based on methanotrophs originating from two coal bed rocks (Lublin Coal Basin), excavated from the depths of S1 914,4 m (ceiling) and S2 996,95 m (sill) under surface. Methanotrophic activity defined as maximal consumption of methane and in tested samples was range from 1.05 $\mu\text{mol CH}_4 \cdot \text{g rock}^{-1} \cdot \text{day}^{-1}$ for S1 and 1.40 $\mu\text{mol CH}_4 \cdot \text{g rock}^{-1} \cdot \text{day}^{-1}$ for S2. The difference of activity was observed in both medium (NMS and M2M) also. However methane consumption was higher for material from S2 sample in M2M medium what coincides with growing curve. This dissimilarity was effect of various types of copper complexes. Isolation of methanotrophic bacteria consortium from coal mine bed rock allow to inoculation in methane high rate (~ 10%) environments.



W11.01-P -16

WORKING WITH CFE METHODS FOR MORE THAN 30 YEARS – HOW USEFUL IS IT?

Santruckova Hana*^[1]

^[1]University of South Bohemia, Faculty of Science ~ Ecosystem Biology ~ Ceske Budejovice ~ Czech Republic

The first goal of the contribution is to give an overview of the constraints and advantages of chloroform fumigation methods. Use of the chloroform fumigation method in combination with ^{13}C and ^{15}N will be discussed. The second goal is to show change in microbial biomass across different world ecosystems (forests, grasslands, alpine meadows, wetlands, steppe and tundra - Europe, Siberia, Canada and Australia). Change in microbial biomass with soil organic matter content, mean annual temperature and texture will be documented.



S12.01-P - PEDOLOGICAL PROCESSES AND SOIL POLLUTION

Friday 06 July 2012 from 17:00 to 18:30. Room Poster Areas

S12.01-P -1

THE EFFECT OF CHEMICAL FERTILIZERS, ANIMAL MANURE AND SAWDUST ON REDUCE OIL POLLUTION BY NATIVE MICROORGANISM

Soheila Ebrahimi, Gorgan - Iran, Islamic Republic of

S12.01-P -2

A RADIO-ISOTOPIC DILUTION TECHNIQUE FOR CHARACTERISING ASSOCIATIONS BETWEEN METAL(LOID)S AND NATURALLY OCCURRING SOIL NANOPARTICLES

Ehsan Tavakkoli, Adelaide - Australia

S12.01-P -3

ADHESION OF MICROORGANISMS ENHANCES THEIR BIODEGRADATION POTENTIAL

Alena Cejkova, Prague - Czech Republic

S12.01-P -4

AVAILABILITY OF BA, CR, CU, NI AND ZN IN TROPICAL SOILS SUBJECTED TO THE ADDITION OF SEWAGE SLUDGE

Larissa Macedo Dos Santos, Pato Branco - Brazil

S12.01-P -5

BIOAVAILABILITY OF METALS AND RADIONUCLIDES IN VENEZUELAN BAUXITE RESIDUE

Brenda Omaña Sanz, Lille - France

S12.01-P -6

BIODIVERSITY AND PAH-DEGRADING POTENTIAL OF THE BACTERIAL COMMUNITY OF A POLLUTED SOIL AS STUDIED BY STABLE ISOTOPE PROBING

Jouanneau Yves, Grenoble - France

S12.01-P -7

BIOGEOCHEMICAL CRITERIA TO ASSESS RECLAMATION EFFORTS FOLLOWING OIL SANDS MINING

Sylvie Quideau, Edmonton - Canada



S12.01-P -8

BIOREMEDIATION OF A PCP CONTAMINATED SOIL BY USING FUNGI AND COMPOST

Rosalia Scelza, Portici - Italy

S12.01-P -9

COLLOID-FACILITATED TRANSPORT OF METAL AND METALLOIDS IN A TECHNOSOL: A COLUMN LEACHING STUDY

Bo Hu, Limoges - France

S12.01-P -10

COMPARAISON OF SOIL SOLUTION CHEMISTRY SAMPLED BY TWO TYPES OF SUCTION PROBES

Fanny Coutelot, Pessac - France

S12.01-P -11

COMPARATIVE ANALYSIS OF TOTAL PETROLEUM HYDROCARBONS BY INDIGENOUS AND NON-INDIGENOUS MICROORGANISMS IN SOIL

Soheila Ebrahimi, Gorgan - Iran, Islamic Republic of

S12.01-P -12

COMPARISON OF TWO SEQUENTIAL EXTRACTION PROCEDURES FOR THE FRACTIONATION OF ZINC IN AGRICULTURAL CALCAREOUS SOILS OF IRAN

Akbar Forghani, Rasht - Iran, Islamic Republic of

S12.01-P -13

CONTENT OF POLYCYCLIC AROMATIC HYDROCARBONS IN SOILS OF URBAN AREAS

Evgeny Lodygin, - Russian Federation

S12.01-P -14

DETERMINATION OF WATER/LNAPL CONTENT IN A POROUS MEDIA BY ADSORPTION ON ACTIVATED CARBON

Svatopluk Matula, Prague - Czech Republic

S12.01-P -15

DIOXINS AND PCBS – NO END IN SIGHT. SOIL AS A SINK AND SOURCE OF POLLUTANTS

Bernd M Bussian, Dessau - Germany



S12.01-P -16

ECOTOXICITY TESTS TO ASSESS LANDFILLING OF POLLUTED SOILS IN FUNCTION OF METAL AVAILABILITY

Yann Foucault, Toulouse - France

S12.01-P -17

EFFECT OF INORGANIC FERTILIZER MANUFACTURED WITH COAL ASH ON SOIL QUALITY AND CROP GROWTH IN UPLAND

Jae E. Yang, Chuncheon - Korea, Republic of

S12.01-P -18

EFFECT OF SOIL PHOSPHOGYPSUM RECLAMATION ON THE LEAD AND CADMIUM FORMS IN CHERNOZEM

Anatoly Endovitsky, Persianovka - Russian Federation

S12.01-P -19

EFFECT OF THE PARTICLE-SIZE DISTRIBUTION ON THE ADSORPTION OF COPPER, LEAD, AND ZINC BY CHERNOZEM

Tatiana Minkina, Rostov-on-Don - Russian Federation

S12.01-P -20

EVALUATING BIOAVAILABILITY OF HEAVY METALS WITH VARIED EXTRACTANTS IN AGRICULTURAL FIELD

Jae E. Yang, Chuncheon - Korea, Republic of

S12.01-P -21

EVALUATING RECLAMATION FEASIBILITY OF COAL ASH FOR OVERBURDEN IN COAL MINE: COLUMN LEACHING EXPERIMENT

Jae E. Yang, Chuncheon - Korea, Republic of

S12.01-P -22

EVALUATION OF POLLUTION LEVEL OF SOILS OF ECOLOGICAL VOLNERABLE AREAS AROUND AGARAK TOWN AND SUGGESTION OF IMPROVEMENT WAYS

Karen Ghazaryan, Yerevan - Armenia

S12.01-P -23

EVALUATION OF THE MICROBIAL POPULATION IN DIFFERENT CONDITIONS OF OIL POLLUTION REFINEMENT

Soheila Ebrahimi, Gorgan - Iran, Islamic Republic of



S12.01-P -24

FRACTIONATION CHANGES OF CADMIUM WITH TIME IN SOILS TREATED WITH CADMIUM CHLORIDE IN DIFFERENT MOISTURE REGIMES

Akbar Forghani, Rasht - Iran, Islamic Republic of

S12.01-P -25

FRACTIONATION OF HEAVY METALS AND THEIR TRANSFORMATION TO RADISH IN SOIL AMENDED WITH DIFFERENT RATE OF SWAGE SLUDGE

Ghasem Rahimi, Hamedan - Iran, Islamic Republic of

S12.01-P -26

GREEN MANURE CROPS FOR SOIL QUALITY RESTORATION IN KITCHEN GARDENS

Yann Foucault, Toulouse - France

S12.01-P -27

HEAVY METALS CONTENT IN URBAN SOILS OF ISFAHAN, CENTRAL IRAN

Zahra Rasaei, Shahrekord - Iran, Islamic Republic of

S12.01-P -28

IMPACT OF A TRACE METAL CONTAMINATION FROM MINING ACTIVITY ON SOIL MICROBIAL COMMUNITIES AND RESPIRATION ACTIVITY OF IRRIGATED KASTANOZEMS IN GEORGIA

Hülya Kaplan, Giessen - Germany

S12.01-P -29

IMPACT OF SOUR EL GHOZLANE'S CEMENT PLANT'S EMISSIONS ON SOIL AND VEGETATION

Yacine Bellout, Boumerdes - Algeria

S12.01-P -30

INFLUENCE OF SOME POTENTIALLY HARMFUL ELEMENTS CONTAMINATION ON THE BIOLOGICAL ACTIVITIES IN SOILS

Jaume Bech, Barcelona - Spain

S12.01-P -31

INVESTIGATION OF PEDOGENESIS AND WEATHERING PROCESSES ON AGGTELEK KARST (NORTH-EAST HUNGARY)

Nóra Czirbus, Szeged - Hungary



S12.01-P -32

METAL AND METALLOID BEHAVIOUR IN COLLUVIOSOLS LOCATED ALONG A TRANSECT OF INCREASING SOIL CONTAMINATION

Catherine Keller, Aix-en-Provence - France

S12.01-P -33

NONYLPHENOL ON SOIL: EFFECTS ON AGGREGATE STABILITY, WATER RETENTION AND MICROBIAL ACTIVITY

Gerardo Ojeda, Coimbra - Portugal

S12.01-P -34

RAILWAY RELATED SOIL POLLUTION: THE TURIN-LYON HIGH-SPEED RAIL CASE

Massimo Zucchetti, Torino - Italy

S12.01-P -35

REMOVAL OF ANTHRACENE FROM A SURFACTANT-AMENDED SOIL

Gabriela Salomón-Hernández, México - Mexico

S12.01-P -36

RESISTANCE OF RHODOCOCCLUS ERYTHROPOLIS BIOFILM, POTENT DEGRADER OF AROMATIC COMPOUNDS, TO ATTACK OF (BIO)SURFACTANTS

Jan Masak, Prague - Czech Republic

S12.01-P -37

SOIL PROTECTION ON CONSTRUCTION SITES: 10 YEARS OF EXPERIENCE

Elena Havlicek, Bern - Switzerland

S12.01-P -38

SOIL PROTECTION SPECIFIC REQUIREMENTS WITHIN THE FRAMEWORK OF CARBON DIOXIDE CAPTURE AND STORAGE (CCS) ACTIVITIES

C. Florian Stange, Hannover - Germany

S12.01-P -39

SOIL RECLAMATION AND ENVIRONMENT CONSERVATION WITH GEOGRID IN THE ARID AREA (CHANDAB BASIN-IRAN)

Kaveh Khaksar, Karaj - Iran, Islamic Republic of



S12.01-P -40

STUDY OF ADSORPTION OF Cu, Ni, Cd, Pb AND Zn BY SOILS OF THE NEGRO RIVER'S BASIN IN THE BRAZILIAN AMAZON

Paulo Sergio Tonello, Sorocaba - Brazil

S12.01-P -41

SUDAN GRASS (SORGHUM SUDANENSE PERS.) IN GREEN MANURING OF SANDY DEPOSOLS IN STANARI MINING AREA

Mihajlo Markovic, Banja Luka - Bosnia and Herzegovina

S12.01-P -42

THE ASSESSMENT OF PHOSPHORUS FORMS IN LAKE SEDIMENTS AND ITS INFLUENCE ON WATER QUALITY

Ghasem Rahimi, Hamedan - Iran, Islamic Republic of

S12.01-P -43

THE EFFECT OF HEAVY METALS DEPOSITED IN SILT OF THE SO-CALLED "BIAŁOGON POND" ON CHARACTERISTICS OF DRINKING WATER FOR THE CITY OF KIELCE (POLAND)

Anna Swiercz, Kielc - Poland

S12.01-P -44

TRICLOSAN BIOAVAILABILITY DETERMINED BY WHEAT PLANTS GROWN IN SOILS TREATED WITH BIOSOLIDS

Inés Ahumada, Santiago - Chile

S12.01-P -45

URBAN SOILS AND GROUNDS AS A SOURCE OF GREENHOUSE GASES IN ATMOSPHERE

Svetlana Kulachkova, Moscow - Russian Federation

S12.01-P -46

USING SPATIAL DISTRIBUTION MAPS TO DEFINE POLLUTION SOURCE OF SOILS WITH HEAVY METALS

Giorgi Ghambashidze, Tbilisi - Georgia



S12.01-P -1

THE EFFECT OF CHEMICAL FERTILIZERS, ANIMAL MANURE AND SAWDUST ON REDUCE OIL POLLUTION BY NATIVE MICROORGANISM

Doustaky Maryam^[1], Ebrahimi Soheila^{*[1]}, Movahedi Naeini Seyed Alireza^[1], Olamaee Mohsen^[1]

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Bioremediation as a natural process refers to the use of microorganisms to degrade pollutants that pose environmental and especially human risks. Availability nutrient required for microorganisms and optimizations of environmental conditions have significant impact in increasing decomposition of petroleum hydrocarbons. This study investigated the impact of chemical fertilizers, animal manure and sawdust on reducing of total petroleum hydrocarbons in soils around Tehran's refinery. Hence, a mix of urea, potassium chloride and super phosphate triple fertilizers with ratio 20:5:1, and animal manure and sawdust, respectively, with ratios of 5 and 10 percent were used. In five specified time, analysis process of petroleum were compared during the tests in the different treatments. Results showed that the first order, chemical fertilizers together with animal manure treatment (22% reduction), the Secondary, animal manure treatment (21% reduction) and the third complex fertilizers with sawdust treatment (20% reduction), had the maximum efficiency in reduce initial contamination(38%) in control treatment. Results indicated that over time and establishment of oil-eating microorganisms in soil, they couldn't able to optimize population and create adequate potential for efficient oil decomposition. These may be caused inappropriate environmental conditions including nutrient deficiency and increasing the ratio of C / N by entering carbon of petroleum hydrocarbons.



S12.01-P -2

A RADIO-ISOTOPIC DILUTION TECHNIQUE FOR CHARACTERISING ASSOCIATIONS BETWEEN METAL(LOID)S AND NATURALLY OCCURRING SOIL NANOPARTICLES

Tavakkoli Ehsan^{*[1]}, Donner Erica^[1], Naidu Ravi^[1], Juhasz Albert^[1], Lombi Enzo^[1]

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Metal(loid)s strongly partition to soil organic matter and inorganic materials, and a fraction of these soil constituents are mobile in the environment in the form of natural nanoparticles. As a consequence, metal(loid)s adsorbed to, or occluded in, naturally occurring nanoparticles may be readily mobile in the environment. Isotopic dilution has been widely employed for estimating the chemically reactive/labile pool of metal(loid)s in soils (E-values). However, some issues have been encountered in the derivation of realistic E-values as the presence of nanoparticles can potentially lead to an overestimation of the E-values for Cd, Cu, Zn and P. While isotopic dilution techniques have been modified using resin purification procedures to overcome this issues, E-value overestimation may still occur as a result of nanoparticle-resin associations. This may be problematic particularly when anion exchange resins are used to study anion (i.e. P, As) exchangeability. This study investigated the possibility of overcoming this issue by developing alternative methods based on dialysis techniques. Exchange resins were incorporated into dialysis tubing (membrane size ~ 1 KDa) to determine the proportion of Zn, Cd, P and As in soil solution that may be associated with naturally occurring nanoparticles. In addition, the effect of filter size on the determination of 'leachable' metal(loid)s and their potential availability was investigated.



S12.01-P -3

ADHESION OF MICROORGANISMS ENHANCES THEIR BIODEGRADATION POTENTIAL

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Microbial adhesion and subsequent biofilm formation significantly increase resistance microorganisms to environmental stress factors (toxicity, temperature, red-ox, pH, etc.). Growth of microorganisms in the biofilm is associated with the change of phenotype. This often results in the expansion utilized/degraded substrates. The majority of microbial cells in soil ecosystems is anchored on the soil particles. Consequently, the range of degradation activity of the microorganisms, both indigenous and nonindigenous degraders, depends on their ability to adhere in the matrix of environment (decontaminated soil, biobarrier, etc.). We have studied the adhesive abilities of different types of microbial cells, depending on environmental conditions and physico-chemical properties (e.g. hydrophobicity) of cell envelopes and applied carriers. Suitable materials to provide a stable biofilms have been found and subsequently effective biocatalysts for degradation of toxic pollutants were prepared. Rhodococcus erythropolis CCM2595 is able to efficiently degrade various aromatic compounds (e.g. phenol, catechol, benzoate, p-hydroxybenzoate and aniline). The rate degradation of phenol in biofilm catalyst was 14 mg / l / h, which was more than doubled compared to suspension population. Biocatalyst based on yeast Candida maltosa biofilm reached phenol biodegradation rate 115 mg/l/h. Suspension population was about 4 times slower (30 mg/l/h). Fungus Fusarium proliferatum, isolated from soil in a chemical factory, is an excellent degrader of acetone. Biofilm F. proliferatum on the surface of sintered soil particles could degrade 350 mg / l / h of this pollutant. But the population growing in suspension degraded only 45 mg / l / h of acetone.



S12.01-P -4

AVAILABILITY OF BA, CR, CU, NI AND ZN IN TROPICAL SOILS SUBJECTED TO THE ADDITION OF SEWAGE SLUDGE

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Considering the agronomic importance of the provision of agricultural sewage sludge, and its growing concerning environmental point of view, in this work it was evaluated the availability of Ba, Cr, Cu, Ni and Zn in two tropical soils, Typic Eutrorthox and Typic Haplorthox, subjected to the addition of sewage sludge for 11 consecutive years. Sequential extraction, and a methodology for determining the availability of elements potentially toxic in soils subjected to the addition of sewage sludge from the assessment of humic fractions, fulvic acid 1, fulvic acid 2, humic acid and humin + mineral obtained during the chemical fractionation of soil organic matter was proposed. Availability studies presented significant amount of Cr, Cu, Ni and Zn bounded to the Mn and Fe oxides and residual fractions, suggesting the low availability of these elements in the evaluated conditions. The chemical fractionation of soil organic matter showed results confirming the high concentration of potentially toxic elements in the oxides in the Typic Eutrorthox soil and in the humic acid in the Typic Haplorthox soil. Although the sewage sludge added to soil increase the levels of potentially toxic elements, these are present in the most stable fractions of soil. In other words, less available or less mobile.



S12.01-P -5

BIOAVAILABILITY OF METALS AND RADIONUCLIDES IN VENEZUELAN BAUXITE RESIDUE

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The bauxite residue also known as "red mud" is the by-product of the alumina production in the aluminum industries. Several studies have shown successful effects of bauxite residue application for environmental remediation. However, for any given application it must be demonstrated that the associated risk is less than the risk associated with continued storage. Bauxite residue of Venezuelan alumina plant is considered as detrimental waste for storage due to its volume (15 million m³) and its content of various metals in concentrations above regulatory soils limits. In this work two kind of samples (acid treated and no treated) were used to study the bioavailability and mobility potential to groundwater or nearby soil of Zn, Pb, Cu, Cd, Fe, and Al. The use of solutions with gradually increasing extraction capacity provide comparative information to trace metal mobility in changing environmental conditions, such as pH or redox potential. According to the levels of U and Th found in the preliminary measures (23 and 443 mg.L⁻¹ respectively) it was decided to study the radioactivity and the bioavailability of radionuclides. The trace metal concentrations in H₂O extracts of red mud were low, except for Cu, whereas the immobile fraction extracted with EDTA was higher, in particular in the acid neutralized samples. The results suggest that some of the metals in bauxite residue may not be readily released under natural conditions.



S12.01-P -6

BIODIVERSITY AND PAH-DEGRADING POTENTIAL OF THE BACTERIAL COMMUNITY OF A POLLUTED SOIL AS STUDIED BY STABLE ISOTOPE PROBING

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The bacterial community of a PAH-polluted soil was investigated by stable isotope probing (SIP) in order to identify bacterial taxa responsible for PAH removal in situ. Soil samples were spiked with ¹³C -phenanthrene, and mineralization was monitored upon subsequent incubation in microcosms. Utilization of the ¹³C-substrate resulted in a specific labeling of relevant PAH-degraders, which could be identified from the analysis of 16S rRNA gene sequences amplified from labeled DNA extracted from soil. In a constructed wetland collecting road runoff from a highway, soil PAH degraders were shown to be dominated by members of the Betaproteobacteria, including Acidovorax, Rhodoferax, Hydrogenophaga and unknown Rhodocyclaceae. The critical role of Betaproteobacteria was further evidenced by quantitative PCR data. In order to explore the biocatalytic potential of main PAH degraders, most of which are unrelated to known isolates, a metagenomic analysis has been undertaken based on high throughput sequencing of labeled DNA recovered from soil. Besides, the diversity of genes encoding PAH-specific ring-hydroxylating dioxygenases was examined based on PCR amplification of alpha-subunit genes from soil DNA. Phylogenetic comparison of deduced protein sequences revealed that they were distantly related to dioxygenases from the Alpha- and Betaproteobacteria. In order to learn about the catalytic activity associated to these proteins, a new approach involving the construction, overexpression and assay of hybrid dioxygenases has been implemented. Preliminary results on the PAH selectivity of some enzyme hybrids will be presented.



S12.01-P -7

BIOGEOCHEMICAL CRITERIA TO ASSESS RECLAMATION EFFORTS FOLLOWING OIL SANDS MINING

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The extent of disturbed land from surface mining in the Athabasca Oil Sands region of northeastern Alberta, Canada, reached 600 km² in 2009. Following mining, entire landscapes are reconstructed and soil-like profiles are built using salvaged soil materials and mining by-products. In this region, peat is the main source of soil organic amendment due to its availability in large portions of the mining footprint. This research program aimed to assess the long-term sustainability of reconstructed soils by comparing their range of structural and functional variability with that of undisturbed boreal forest soils. Reconstructed soils covering different reclamation treatments and age classes were compared to forest soils spanning a range of representative ecosystems in the region. Selected soil biogeochemical criteria included nutrient availability, organic matter quality, and microbial communities. Nutrient availability was determined in situ with resin probes as well as during laboratory incubations. Organic matter pools were isolated and described using ¹³C nuclear magnetic resonance spectroscopy and cupric oxide oxidation. Composition of soil microbial communities was characterized through molecular fingerprinting, and functional potential was evaluated from enzyme activities. Significant differences in some of the measured parameters were detected among natural ecosystems, which were related to the different dominant tree covers. When analyzed together, all reclamation treatments differed significantly from the range of natural variability. However, several parameters of nutrient availability and organic matter quality showed an evolution with time since restoration towards conditions observed at the undisturbed forest soils.



S12.01-P -8

BIOREMEDIATION OF A PCP CONTAMINATED SOIL BY USING FUNGI AND COMPOST

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*Bioremediation of contaminated sites can be realized introducing directly into a contaminated system micro-organisms able to consume selectively the target compound (bioaugmentation) or increasing the microbial indigenous population by addition of nutrients in form of organic and/or inorganic fertilizers such as urea, sawdust, compost, manure and biosolids (biostimulation). Main goal of the current study was a long-term evaluation, under controlled conditions, of the remediation capability of both naturally selected microorganisms and nutrient addition. Indigenous fungi, *Byssosclamyces nivea* and *Scopulariopsis brumptii*, and a compost from urban wastes were used to bioremediate a PCP artificially contaminated soil. Fresh soil, amended with compost and spiked with PCP (25 mg kg⁻¹) was inoculated with the two fungal species, singularly or in combination. Control samples without PCP, with compost and/or fungi were also taken into account. After 0, 7, 14, and 28 days extractable PCP was evaluated. Some biological and biochemical soil properties, such as microbial biomass, basal respiration, FDA hydrolases and dehydrogenase activities were measured after 28 day-incubation time and compared with values detected at zero time. The obtained results showed that soil enzyme activities were stimulated mainly by compost, whereas soil biomass and respiration strongly depleted over time. The extractable PCP decreased during the incubation time for all the samples, in particular when both fungi were present in amended soils thus indicating that bioaugmentation and biostimulation efficiently occurred.*



S12.01-P -9

COLLOID-FACILITATED TRANSPORT OF METAL AND METALLOIDS IN A TECHNOSOL: A COLUMN LEACHING STUDY

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Mining industry is one of major anthropogenic contaminant resources since it generates a large amount of wastes highly contaminated in metals and metalloids (e.g. As, Sb and Pb). These elements could be mobilized and present serious hazards for environment, particularly for groundwater and food chain. In order to investigate the role of colloid on the mobility of As, Sb and Pb at an abandoned gold mine in French Massif Central, we set up a column leaching experiment by extracting an undisturbed soil column (diameter = 25cm, height = 11cm) from the mine residue disposal basin upon which a Technosol formed. The leachates are filtered to 0.45µm followed by an ultrafiltration of 3000 Dalton. Subsequently, the leachates are characterised in terms of physicochemical (i.e. pH, Eh, electrical conductivity, turbidity, dissolved organic carbon), geochemical (ICP-MS and ionic chromatography) and mineralogical (XRD, SEM and TEM) properties. This study highlights that the soil releases approximately 13.6% of its Sb that is almost double of its As leached (6.9%) and Pb is the most stable (only 0.3% leached). The results show that about 70% of As, Sb and Pb are in colloidal form and this is in accordance with the partition of organic matter. Mineralogical characterisation indicates that the As, Sb and Pb carriers are principally beudantite, scorodite and symplectite. As a result, the organo-mineral colloids have a crucial role on the transport of As, Sb and Pb in this Technosol.



S12.01-P -10

COMPARAISON OF SOIL SOLUTION CHEMISTRY SAMPLED BY TWO TYPES OF SUCTION PROBES

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The unsaturated zone is a great importance for matter fluxes in terrestrial ecosystems. A complete chemical analysis of soil pore water represents a powerful diagnostic tool for the interpretation of soil chemical phenomena (ETM mobility). This requires an optimal sampling system to avoid changes of the extracted soil water chemistry. Variables needed to characterize solute transport in soils are soil water pressure (SWP) and solute concentration. In this paper, soil solution chemistry sampled by Rhizon soil moisture sampler connected to two types of suction probes have been studied with the purpose of investigating systematic differences between them. A syringe method was compared to a tube kept under vacuum which allowed maintaining the soil moisture condition in the sampling profile similar to that in the natural soil profile. We investigated the effects of different vacuum in Cr, Zn, Ca, Mg, Pb, As, Li and Pb concentration repacked soil columns with metal-polluted topsoil and unpolluted subsoils at various irrigation rates with Rhizon installed at centimeter intervals over depth. About half 9 variables measured showed a significant difference between the sampling methods used. Typically the syringes probes overestimate the ETM concentration in soil water.



S12.01-P -11

COMPARATIVE ANALYSIS OF TOTAL PETROLEUM HYDROCARBONS BY INDIGENOUS AND NON-INDIGENOUS MICROORGANISMS IN SOIL

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*Petroleum is a highly toxic composition and gradual accumulation of it in soil, may causes significant problems such as disorder in the normal function of soil, reduction in crop yield and change in properties of contaminated soil. The purpose of this study was to compare the natural process of decomposition of petroleum hydrocarbons, with indigenous and non-indigenous microorganisms. Hence, soil samples were taken from the polluted area around the refinery Ray. Decomposition of petroleum hydrocarbons by assuming establishment of suitable native microbial communities in contaminated soils were studied by 13 different treatments which were including treatments of inoculation complex of non-indigenous bacteria includes *Bacillus Megaterum*, *Subtilis* and *Pseudomonas putida*, different fertilizer treatments, the manure and sawdust. Then, the reduction trend of total hydrocarbon pollution was analyzed by time. Results in five consecutive time showed that oil pollutions, in all treatments decreased with time. But most of increase in oil decomposition was related to non-indigenous bacteria treatments with decreased 23% compared to dry control, while the treatments containing indigenous microorganism was 22% reduction in petroleum hydrocarbons. in this case, by optimization of environmental conditions for oil-eating indigenous microorganisms, a significant reduction in the total amount of oil pollution occurred. Comparison of results in total five time in this case area, showed that providing appropriate environmental conditions, can be irritating indigenous microorganisms to oil degradation. Finally, by entering non-indigenous bacteria, the speed of oil break down may be raised in two cases; either the number of indigenous microorganisms in soil was adequate.*



S12.01-P -12

COMPARISON OF TWO SEQUENTIAL EXTRACTION PROCEDURES FOR THE FRACTIONATION OF ZINC IN AGRICULTURAL CALCAREOUS SOILS OF IRAN

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Twenty soil samples with a wide range of chemical and physical properties were collected from calcareous soils of South-West Iran, characterised in general by their relatively high calcium carbonate contents (average 32%). The extractability and solid-phase fractionation of zinc (Zn) in the soils was determined by the single extraction procedure (DTPA extractability) and two different sequential extraction procedures: a seven-step Singh method (procedure A) and the three-step BCR method (procedure B). For total and residual Zn analysis, samples were digested in a 1:5 HClO₄:HF acid mixture for procedure A, and aqua regia extractions following the procedure ISO 11466 for procedure B. The DTPA extractable Zn levels were low (0.02-1.01 mg kg⁻¹). Zinc in these soils was dominantly associated with mineral lattices (procedure A; 91%, procedure B; 75.2%). In the results obtained by using procedure A, reducible fraction was the greatest among non-residual forms while oxidisable fraction was the greatest in the results obtained by procedure B. The work indicates that interpretation of results must not be based on the mineralogical fraction targeted but rather on the reagent used, implying a perfect knowledge of its action on the solid phase, therefore, the Zn fractionation is dependent on the method used.



S12.01-P -13

CONTENT OF POLYCYCLIC AROMATIC HYDROCARBONS IN SOILS OF URBAN AREAS

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Concentrations of priority polycyclic aromatic hydrocarbons (PAHs): phenanthrene, anthracene, fluoranthene, pyrene, benzo[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, dibenzo[a,h]anthracene, and benzo[g,h,i]perylene were determined in soils of St. Petersburg. In general, they were very high; thus, the concentration of benzo[a]pyrene exceeded the maximum permissible concentration (MPC) in all the collected samples, and the maximum concentration exceeded the MPC by 50 times. Concentrations of other PAHs in the studied urban soils also exceeded their concentrations in the background soils of the region. The major contaminants were fluoranthene, pyrene, benzo[b]fluoranthene, benzo[a]pyrene, and benzo[g,h,i]perylene, whose portion in the total sum of PAHs comprised 65–80%. It should be noted that soil contamination with polyarenes is mostly determined by light PAHs involved in the aerotechnogenic migration. Pair correlation coefficients between the contents of different PAHs in urban soils were calculated. It was shown that motor vehicles represent the major source of PAHs in the upper soil horizons. Application of natural organic material (peat) had a significant effect on the concentrations and qualitative composition of PAHs; the soils with added peat material were enriched in heavy polyarenes. This work was supported by the Russian Foundation for Basic Research (no. 11-04-00086-a).



S12.01-P -14

DETERMINATION OF WATER/LNAPL CONTENT IN A POROUS MEDIA BY ADSORPTION ON ACTIVATED CARBON

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Activated carbon is highly porous form of carbon, which has exceptionally large surface area (1 100 m² g⁻¹). The activated carbon is due to its high adsorption potential used in many applications such as air, water, wastewater or chemical purification. In this study, following the work of Matula et al. (2008), pelletized activated carbon was tested for qualitative and quantitative water/LNAPL determination in a porous media. Medicinal grade white oil was used as a suitable representative of LNAPL substances. It is a colourless, transparent, and odourless oily liquid with a superior chemical inertness. Silica sand with a very high content of SiO₂ (98.9 %) with small portions of Fe₂O₃, K₂O, Na₂O, CaO, MgO and middle grain size of 0.15 mm was selected as a porous media for the laboratory testing. Adsorption properties of the activated carbon were tested by three sets of experiments: i) water/LNAPL adsorption from water/LNAPL vapours; ii) water/LNAPL adsorption from water/LNAPL itself; and iii) water/LNAPL adsorption from the porous material of different water/LNAPL and both water + LNAPL contents. Also experiments optimising the sampling interval were carried out. This relatively easy and inexpensive method is showing very good results for LNAPL detection in a porous media and is quite promising also for quantitative determination of water/LNAPL contents. However, the method still need to be verified and detailed calibration studies need to be carried out before the method can be applied in praxis. This research was financially supported by grant agency "CIGA CZU v Praze", project 20112036.



S12.01-P -15

DIOXINS AND PCBS – NO END IN SIGHT. SOIL AS A SINK AND SOURCE OF POLLUTANTS

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The dioxin issue has recently become an emerging topic in environmental policy and health related consumer protection. Monitoring studies indicate a background of dioxins and dl-PCBs in soils of about 1 ng WHO-TEQ/kg d.m., while in specific animal products the dioxin burden is higher than the levels given in food and feed regulations. At present several pathways can be identified, however a ranking of the relevance for dioxin and PCB contamination is not possible: - Waste handling and disposal techniques significantly contribute to the PCB burden. - Frequently flooded areas show higher PCB and dioxine levels than the main land. - Monitoring data prove, that in view of the significant reduction of dioxine and PCB emissions the re-vitalisation of PCB pools is an increasingly relevant issue. Therefore the focus should be set mainly on PCBs. - Whether new sources (e.g. household fires) contribute significantly to PCB and dioxin emissions is still under discussion. In line with the precautionary principle, measures have to be taken to reduce the exposure of the environment, and of food and feed by PCBs and dioxins. Trigger values for soils and guidelines for good agricultural practice are measures to be taken. Additionally further research is needed to gain data of PCB and dioxin concentrations in the relevant matrices to undermine the understanding of transfer and carry-over. This paper will provide an overview about the state-of-the-art knowledge of the pollution of soils and will illuminate its relevance for food and feed in the context of EU regulations.



S12.01-P -16

ECOTOXICITY TESTS TO ASSESS LANDFILLING OF POLLUTED SOILS IN FUNCTION OF METAL AVAILABILITY

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*With the rise of sustainable development, rehabilitation of brownfield sites located in urban areas has become a major concern. Remediation of contaminated soils is therefore a strong aim with the development of bioremediation and tools for risk assessment. Actually, criteria for landfilling are based on leaching tests that represent the mobilized fraction and therefore may present a risk in case of transfer. However, ecotoxicological tests to guide the landfill are not yet currently used. Nevertheless, their use seems very relevant to assess the actual toxicity of the leachate and better reflects the reality of effects on living organisms. Standard leaching tests (EN 12457-2) asked by European authorities to guide landfilling were first performed on ten samples of soil taken from a site recycling lead-acid batteries. This experiment determines the fraction potentially be mobilized and therefore poses a risk if transferred. Physico-chemical parameters from all samples were also determined (pH, lead total concentrations, etc.). Toxicity of leachate was evaluated by *Daphnia magna* (OCDE 202) and *Alivibrio fischeri* (*Vibrio fischeri*, ISO 11348) bioassays. Besides, four modified *Escherichia coli* stains with luminescence modulated by heavy metals were also used to assess the toxicity of these pollutants. Results shown that although total lead concentrations can be very high (up to 40 000 mg / kg), only a small fraction was solubilised. Chemical analysis and ecotoxicological bioassays were well correlated. This study highlighted the use of modified bacteria strains sensitive to metals will be useful tools for the end-users for environmental monitoring of contaminated sites.*



S12.01-P -17

EFFECT OF INORGANIC FERTILIZER MANUFACTURED WITH COAL ASH ON SOIL QUALITY AND CROP GROWTH IN UPLAND

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Recently, generated amount of coal ash from thermal power plant has been rapidly increased because of high energy demand and consequently, managing coal ash is a critical problem in Korea. The main objective of this research is to examine the feasibility of manufacturing inorganic fertilizer using coal ash and to evaluate its beneficial effect on crop growth. Coal ash was mixed with calcium hydroxide ($\text{Ca}(\text{OH})_2$) and bentonite as a 3:6:1 ratio for making inorganic lime fertilizer. Result of chemical analysis showed that manufactured inorganic fertilizer contains 52% of alkalinity, 50% of calcium oxide, and 17% of magnesium oxide which make suitable for inorganic lime fertilizer. For cultivation study, manufactured inorganic lime fertilizer was applied for tomato cultivation and its effect on crop growth was compared with conventional management. After applying inorganic lime fertilizer in soil, average soil pH and available P_2O_5 were increased 0.4 unit and 20% respectively compared to control (pH 5.6, available P_2O_5 : 530 mg/kg) during cultivation period. In terms of crop growth, no statistical difference was observed with conventional management. Furthermore, heavy metal concentration in edible part of tomato was averaged as 0.15 mg/kg for Cd and 0.04 mg/kg for Pb that all values are lower than control (0.28 mg/kg for Cd and 0.22 mg/kg for Pb). Based on this result, coal ash can be used to manufacture inorganic lime fertilizer and no adverse effect was observed compared to conventional management in terms of crop growth and residuals of heavy metal concentration in crop.



S12.01-P -18

EFFECT OF SOIL PHOSPHOGYPSUM RECLAMATION ON THE LEAD AND CADMIUM FORMS IN CHERNOZEM

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The thermodynamic conditions of lead and cadmium at the application of phosphogypsum to soil (10, 20, and 40 t/ha) were studied. The carbonate calcium equilibrium (CCE) of soil solution is the factor of its chemical compound formation, chemical balance in soil solution. The CCE is under the influences of ions association, individual ion balance in soil solution. The CCE in soil includes mobile balances. Each balance is characterized quantitatively by corresponding constant, which determines the material structure of a solution. The estimation of a real condition of the main and micro ions in soil solutions should be carried out in a view of their association. Computation of associated ionic forms (pairs) activity is based on the additional group of the equations of ionic pairs taking into account the dissociation constants of ionic pairs. The mathematical model was proposed to calculate the forms of ions in soil. It was revealed that application of the maximum rate of phosphogypsum increased the total content of lead in the soil by 4.9% on the average and that of cadmium by 20%. The concentrations of the water-soluble forms of these metals increased by 21 and 17%, respectively. Because of ion association, the average molar portions of free Pb²⁺ and Cd²⁺ ions in the water extract from the original soil were 3.5 and 48% of their total water-soluble forms. The application of phosphogypsum to the soil increased their portions to 7.4 and 57%, respectively.



S12.01-P -19

EFFECT OF THE PARTICLE-SIZE DISTRIBUTION ON THE ADSORPTION OF COPPER, LEAD, AND ZINC BY CHERNOZEM

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Parameters adsorption of Cu²⁺, Pb²⁺, and Zn²⁺ cations by soils and their particle-size fractions were studied. Adsorption of metals by soils and strength of their fixation on the surface of soil particles under both mono- and polyelement contamination decreased when proportion of fine fractions in soil decreasing. Adsorption capacity of the chernozems from Lowest Don for Cu²⁺, Pb²⁺, and Zn²⁺ depending on the particle-size distribution decreased in the following sequence: clay loamy ordinary chernozem ~ clay loamy southern chernozem > loamy southern chernozem > loamy sandy southern chernozem. According of adsorption parameters by different particle-size fractions (C_{max} and k), heavy metal cations form a sequence analogous to that obtained for entire soils: Cu²⁺ = Pb²⁺ > Zn²⁺. Parameters of the heavy metal adsorption by similar particle-size fractions separated from different soils decreased in the following order: clay loamy chernozem > loamy chernozem > loamy sandy chernozem. The extensive adsorption characteristic, namely, maximum adsorption (C_{max}), was a less sensitive parameter characterizing the soil adsorbing capacity than the intensive characteristic of adsorption process – adsorption equilibrium constant (k).



S12.01-P -20

EVALUATING BIOAVAILABILITY OF HEAVY METALS WITH VARIED EXTRACTANTS IN AGRICULTURAL FIELD

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Exceed amount of heavy metals in agricultural fields can have adverse effect on human health due to their transfer from soil to crops. For this reason, estimation of heavy metal bioavailability is necessary to prevent a risk not only for ecosystem but also for human health. In this study, total of 4 extractants (0.1M HCl, 0.01M CaCl₂, 5mM DTPA, 1M NH₄NO₃) were compared to predict bioavailability of heavy metals in paddy field where amendments were applied for remediation purpose. Heavy metal concentration extracted with 4 different extractants was ranged as 0.01 – 1.31 mg/kg for Cd and 0.01-120.55 mg/kg for Pb and 0.03-35.65 mg/kg for Cu in soil. In case of rice, heavy metal concentration was ranged 0.02-0.07 mg/kg for Cd and 0.02-0.24 mg/kg for Pb and 0.00-0.30 mg/kg for Cu. Result of correlation analysis between heavy metal concentration in soil and rice showed that the strongest correlation ($r^2 = 0.66$) was observed for Cd when 0.01M CaCl₂ was used. In case of Cu, 0.1M HCl showed significantly high correlation ($r^2 = 0.95$) between soil and crop. However, no significantly high correlation was observed for Pb using all extractants. Although exact mechanism was not verified in this study, overall result indicated that suitable extractant for predicting heavy metal bioavailability can be differed depending on heavy metal species. In conclusion, further research should be conducted to select the best method for predicting heavy metal bioavailability in agricultural field.



S12.01-P -21

EVALUATING RECLAMATION FEASIBILITY OF COAL ASH FOR OVERBURDEN IN COAL MINE: COLUMN LEACHING EXPERIMENT

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Enormous amount of wastes were remained on the slopes near at the coal mines causing detrimental effects on surrounding environment such as sedimentation and acid mine drainage. In order to prevent this problem, alkaline materials have been used for remediation purpose. In this study, coal combustion ash (CCA) as alkaline material was evaluated whether it can be utilized for reclamation of overburden in coal mine. Column experiment was conducted and total of six treatments were installed depending on mixing ratio between coal wastes and CCA (0, 20, 40%). In addition, mixing method (completely mixing and layered) was also varied. Artificial acidic rain (pH 5.6) was used for feeding solution with flow rate of 0.05 mL min⁻¹. Result showed that pH in leachate was increased as more CCP was applied (20%: 3.8-4.6, 40%:4.0-5.9) compared to control (3.7-4.3). Average iron concentration was also decreased as more CCP was applied in the column (control: 10.33 mg/kg, 20%: 2.93 mg/kg, 40%: 2.44). Between two mixing method, completely mixing showed the high efficiency in terms of increasing pH (control: 3.98, completely mixing: 4.79, layered: 4.14) and decreasing Fe concentration in the leachate (control: 10.33 mg/kg, completely mixing: 3.61 mg/kg, layered: 10.52 mg/kg). Based on overall result, CCP showed the high efficiency to neutralize AMD in the leachate of coal mine waste and can be used as remediation materials in future.



S12.01-P -22

**EVALUATION OF POLLUTION LEVEL OF SOILS OF ECOLOGICAL VOLNERABLE AREAS
AROUND AGARAK TOWN AND SUGGESTION OF IMPROVEMENT WAYS**

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Lands of studying area belong to the class of brown soils of mountain forests. Metalurgical industry is developed in this area. This sphere of industry is one of the main sources of pollution with heavy metals (Pb, Cu, Ni, Cd, As, Mo, etc.) which are considered dangerous pollutants causing desertification of soils. 10 more risky regions and 1 unpolluted region as checker are selected for study. Sdudies revealed that surface of soils was mainly 10-30% naked in this area. The main vegetation was herbage. Studied soils were medium and strong erosionated. Erosion processes were result of climatic conditions, large gradient of slopes and anthropogenic high impact. Pollution of soils with heavy metals also is studied. As content of metals and non-metals is specific and depend on compound of soil producing rocks and soil producing conditions obtained results were compared with checker sample to determine pollution level. Obtained results revealed content changes of the following metals: Mn, Co, Ni, V, Cu, Zn, Cr, As, Mo, Ag, Cd, Sn, Sb, Ba, Pb, Bi, U. Significant changes of molybdenum and copper content compare of checker sample (near 15 times) were observed which was due to high content of these elements in ore. Taking account all of this it is necessary to implement recultivation works to prevent negative impacts on above-mentioned areas. Recultivation works are desirable to implement by hydroseeding method which is considered the class of biological recultivation.



S12.01-P -23

EVALUATION OF THE MICROBIAL POPULATION IN DIFFERENT CONDITIONS OF OIL POLLUTION REFINEMENT

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Petroleum pollutants constitute one of common sources of environmental destruction in the industrialized world. Whereas, these compounds have a high potential in destructive and harmful ecological effects, attention to methods of clean up this pollutants is necessary. The objective of this study was evaluating the changes of microbial population of petroleum contaminated soil as an indicator of microorganism's activity, on reducing oil pollution in different conditions. For this purpose changes in soil microbial community was evaluated on contaminated soil area of Tehran's refinery in the different treatments. These treatments were including a complex of oil-eating bacteria (two Bacillus and one Pseudomonas species), chemical fertilizers, animal manure and sawdust. Results, in six consecutive time showed that the total number of bacteria was increased in bacteria treatment, bacteria associated with animal manure treatment and bacteria associated with sawdust treatment than others after the time. So that, population was increased in bacteria treatment of 5.8×10^6 to 1.8×10^8 and in bacteria associated with animal manure treatment of 1.5×10^7 to 1.4×10^8 and microorganisms population was increased of 6.8×10^5 to 8.1×10^6 in wet soil treatment by supplying moisture. But microorganism's population of dry control treatment remained almost without change, while this treatment also had the highest pollution. Although in population of all indigenous and non- indigenous microorganisms treatments increasing trend was observed. It seems that every what reduction in oil pollution were higher, the population of microorganism also has increased. This issue could indicate high performance microorganisms in the decomposition of petroleum hydrocarbons.



S12.01-P -24

FRACTIONATION CHANGES OF CADMIUM WITH TIME IN SOILS TREATED WITH CADMIUM CHLORIDE IN DIFFERENT MOISTURE REGIMES

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Cadmium (Cd) is one of the most toxic heavy metals in human and animal food chain. This element is very mobile in soil and easily be absorbed by the plant roots. Therefore, understanding the factors affecting the availability and transformation of Cd in soil is of great importance. A laboratory incubation study was conducted to examine the dynamics of transformation of Cd in soils polluted by Cd-enriched compost or cadmium chloride under field capacity (0.033Mpa) and saturated moisture regimes. Soils incubated in $25\pm3^{\circ}\text{C}$ for 16 weeks. Cadmium transformation was investigated by sequential extraction procedures scheme of Singh et al.)1988 (to obtain the following fractions: soluble + exchangeable, carbonate bound, Mn oxide bound, amorphous Fe oxide bound, crystalline Fe oxide bound and residual. Result showed that depended on soil type, there are 36-47 and 27-33 percent of cadmium in soluble + exchangeable and carbonate forms in CdCl_2 treatments and compost treatments respectively. So seems to be organic matter is an effective factor in reducing availability of cadmium. Carbonate fraction is dominating form in more soils, so cadmium lean to enter carbonate fraction. After 16 weeks of incubation, Cd in MnOx form conversion to organic and carbonate forms in acidic soils. In alkaline soils that Cd added through Cd-enriched compost was transformed from soluble + exchangeable and carbonate fraction into the residual form, Cd added through cadmium chloride transformed from water soluble + exchangeable and carbonate fraction into organic and the residual fractions.



S12.01-P -25

FRACTIONATION OF HEAVY METALS AND THEIR TRANSFORMATION TO RADISH IN SOIL AMENDED WITH DIFFERENT RATE OF SWAGE SLUDGE

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Amendment of agricultural soils with sewage sludge (SS) may provide such plant nutrients and organic matter. Accumulation of heavy metals is widely concerned over the potential risks to agricultural crops, animals and humans. Metal behavior in soils and plants are dependent on the nature of the metal, sludge/soil physico-chemical properties and plant species. A pot experiment was therefore conducted by mixing SS at 20% and 50% (w/w) ratios to the loamy soil in greenhouse of Bou-Ali Sina University, Hamedan, Iran. Accumulation and transformation of heavy metal was studied on amended soil and vegetable (e.g,Radish). As a result of soil fractionation, residual fraction was dominant in both treated and untreated (control) soils. The trend of Cu bounded to organic fraction significantly increased with the SS rate increasing. It was limited for other metals. The accumulation of Zn, Cd, Cu, Pb and Ni in leaves and roots of Radish were significantly increased with the trend of soil amendment in comparison with control. Transfer factor (TF) from soil to plant of amended soil showed higher amount of Cd than control and followed by Cu, Ni and Zn. The concentration of all metals in leaves were higher than roots, but they were reverse for Ni. Maximum and minimum concentration in both roots and leaves was Zn and Cd respectively.



S12.01-P -26

GREEN MANURE CROPS FOR SOIL QUALITY RESTORATION IN KITCHEN GARDENS

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*Rehabilitation and restoration of soil quality of kitchen gardens and brownfields in urban areas is nowadays a major issue. Among the techniques to clean up sites contaminated with heavy metals, phytoremediation is based on the natural abilities of certain plant species to extract (phytoextraction) or stabilize (phytostabilisation) these elements. Usually used in agriculture, green manures improve the bio-physico-chemical properties of soils thanks to a highly developed root system and a production of exudates. The scientific question posed is: green manure crops are they effective to improve quality of soils contaminated by metals and metalloids? Three species of green manures (*Phacelia stala*, *Borago officinalis*, *Symphytum officinalis*) are grown during 3 months in various pollution conditions (400 to 4000 mgPb.kg⁻¹; other contaminants: Cd, As, Sb...), and type of soil (SOM content, pH, texture). Plant tolerance to contamination is estimated by germination tests and growth (root and leaf). Improving soil quality is controlled by measures of metal phytoavailability through CaCl₂ extractions, influence of earthworms, and sanitary risk reduction is evaluated by bioaccessibility test according to the Barge protocol. The comparison of species in terms of phytotoxicity shows the following sensitivity: phacelia > borage > comfrey. Results are encouraging for an original use of green manures in the rehabilitation and soil quality restoration of industrial sites and gardens that also would present significant metal pollution. Ultimately, the goal is to develop a rational strategy for innovative brownfield redevelopment based on monitoring the phytoavailability, ecotoxicity and speciation of metals, rather than total concentrations.*



S12.01-P -27

HEAVY METALS CONTENT IN URBAN SOILS OF ISFAHAN, CENTRAL IRAN

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Various heavy metals have been reported as dangerous elements to the human health and wildlife when they occur in the environment at high concentrations. The environmental exposure to heavy metals is a well-known risk factor for cancer. Cadmium and lead compounds are classified as human carcinogens by several regulatory agencies. Gastrointestinal cancers (GI Ca) are common malignancies all over the world. Twenty five percent of all cancer-related deaths are attributed to GI Ca. We investigated the levels of two different heavy metals (Cd, Pb) in the soils of Lenjanat region, Isfahan province, Central Iran where intensive agriculture surrounded by different industries like steel and cement making factories and mining. According to database, many peoples suffered from gastrointestinal cancers in this region. Two hundred topsoil samples (0–20 cm depth) were collected the soils of the region and analyzed for heavy metals. Results showed that the amount of heavy metals decreased with increasing the distance from the factories. The concentration of Pb and Cd was more than 55 and 5 mg kg⁻¹, respectively. Total Cd concentration in most of the samples exceeded the suggested thresholds (0.8 mg kg⁻¹). It seems that aerosols originated from industries and mining activities are the main sources for heavy metals in agricultural soils of the area. Thus, analyzing heavy metal contents in dust could provide us a better insight to solve the problem.



S12.01-P -28

IMPACT OF A TRACE METAL CONTAMINATION FROM MINING ACTIVITY ON SOIL MICROBIAL COMMUNITIES AND RESPIRATION ACTIVITY OF IRRIGATED KASTANOZEMS IN GEORGIA

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The study area is located about 80 km south of Tbilisi in SE Georgia in the Mashavera valley. Land used for agriculture is irrigated with water of the Mashavera river. The water is burdened with suspended particles resulting from mining activity, which show high concentrations of sulfidic metals (Cu, Zn, Cd). Habitat quality was evaluated by determination of pH-value, organic matter, soil texture and total as well as mobile (Aqua regia-, EDTA-, NH₄NO₃-extraction) trace metal concentrations. Total contents ranged between 284 mg kg⁻¹ and 1,193 mg kg⁻¹ for Cu, between 303 mg kg⁻¹ and 975 mg kg⁻¹ for Zn, and between 1.4 mg kg⁻¹ and 5.9 mg kg⁻¹ for Cd. Basal and substrate induced respiration of the microorganisms were measured by an infrared gas analyser, which determined the carbon dioxide production. Low respiration rates were measured in samples with high trace metal contents. From this follows a reduced microbial activity in soils irrigated with contaminated Mashavera water. The analysis of microbial community structure by polymerase chain reaction - single strand conformation polymorphism (PCR-SSCP) shows differences in the structural diversity of soil bacteria between contaminated and uncontaminated soils. Due to the exposure a shift of the native microbial community structure is shown by a decrease in microbial diversity. Cloning for the phylogenetic classification is still in process. Results will be presented.



S12.01-P -29

IMPACT OF SOUR EL GHOZLANE'S CEMENT PLANT'S EMISSIONS ON SOIL AND VEGETATION

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*Nowadays, pollution is one of the most important problems in the world. It largely contributes to the functioning imbalance of biological systems at various levels. The cause of this pollution is mainly of anthropological origin, related to the industrial production and the use of different sources of energy. Sour El Ghazlane's cement plant is the main industrial unit that causes atmospheric pollution in the region. The main emissions are the emanations of gas, particularly CO₂, and the emissions of dusts at every level of production of the cement. In fact, the values of gases and dusts measured at the chimneys exceed the standards set by the Algerian regulations. The chemical analysis of sedimentable dusts, in soil and leaves samples, shows that the origin is Sour El Ghazlane's cement plant. These dusts altered the mineral constitution of the soil and the vegetation, in particular the leaves of *Juniperus Oxycedrus* - the dominant species in the area. A comparative study, between soil-vegetation and dust, proved that the mineral constitution (calcium and silica) of the leaves is largely influenced by the fallout of dusts from the cement plant.*



S12.01-P -30

INFLUENCE OF SOME POTENTIALLY HARMFUL ELEMENTS CONTAMINATION ON THE BIOLOGICAL ACTIVITIES IN SOILS

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The potentially harmful elements in soils derive from two main sources: natural and anthropogenic; contaminated soils results in various negative environmental effects such as a decrease in biological diversity. In this work, the influence of heavy metal contamination in Spanish Mediterranean soils (from Valencia and Andalucia Communities) on its biological activity was studied. Non-polluted soils and heavy metal contaminated soils were sampled from different sites affected by several industrial activities. Soil characteristics, heavy metals (As, Ba, Cd, Cr, Cu, Ni, Pb, Se, Sr, Zn and V), soil organic matter, microorganism numbers, biomass microbial carbon, soil respiration and some enzymatic activities were determined. Except to a rice farming soil, the results indicate that soils with high concentrations of As, Cd, Cr, Cu, Ni, Pb, Sr and Zn showed low soil respiration, biomass carbon and some enzymatic activities with respect non-polluted soils with similar characteristics. Our results confirm that these parameters allow us to evaluate the effect of the metals weighed on the biological activity in the soil environment, as well as that the accumulation of Cr, Pb and As in the soils has very negative effects on the microbiological activity of the soil, with the consequent loss of his biological diversity. These facts suppose a very important decrease of the soil quality, suggesting a major risk for the appearance of ecotoxicological effects. Once again, these facts also confirm the role of microbiological processes in soil functions and that soil is an ecosystem element responsible for maintaining environmental quality.



S12.01-P -31

INVESTIGATION OF PEDOGENESIS AND WEATHERING PROCESSES ON AGGTELEK KARST (NORTH-EAST HUNGARY)

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By the detailed examination of the organic and inorganic geochemistry of soils we can study different soil-chemical processes and determine geochemical boundaries. The aim of this work was to investigate mineral and organic geochemical characteristics of soils on the basis of element distribution (XRF) in the soil profile, to characterize soil organic matter by Rock-Eval pyrolysis and to examine the effects of climatic conditions in connection with weathering processes. Samples were collected from 1 km² area of Aggtelek Karst (Aggtelek-Rudabánya Mountain, NE Hungary). The studied soils have developed on red clay relic soil which is located on limestone. Mineral composition of red clay rendzina shows different climatic condition effects during pedogenesis. The presence of hematite and kaolinite in the whole soil profile indicates warm humid climate. Besides kaolinite, vermiculite and smectite were also detected in some horizons showing temperate climatic conditions. In the soil samples the amount of magnesium is higher than it can come from dolomite. Therefore we supposed that magnesium originated not only from dolomite but mostly from Fe-Mg-silicates, which could also be the source of the Fe-content in hematite. In the soil profiles the higher Cu-, Zn- and Pb contents are natural because the presence of Cu together with Zn, Pb indicates ore formation. Our results suggest that we can determine borders of the mining area by using geochemical data. The project was supported by the Hungarian National Science Foundation (K 81181).



S12.01-P -32

METAL AND METALLOID BEHAVIOUR IN COLLUVIOSOLS LOCATED ALONG A TRANSECT OF INCREASING SOIL CONTAMINATION

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Although considered as a hotspot of biodiversity, the Calanques massif, located in the surroundings of Marseille (Southern France) is heavily threatened by urban development and pollution. The Mediterranean coast stands in a paradoxical situation i.e. high endemism and rarity of the flora under environmental and anthropic growing perturbations. Historical brownfields have been left abandoned and were, and still are, a source of metallic and metalloid contaminations, through waste dumping and atmospheric outputs. We sampled 7 soil profiles at 6 locations along a transect of increasing contamination. The 6 locations were chosen in such a way that all soils were Colluviosols (RP) except for one Lithosol (RP) sampled next to a Colluviosol. Sampling was performed according to the soil horizons and the stony layers topping the profiles were also sampled. The aim of the study is to identify the role of the soil development, especially the role of colluvial inputs to the metallic and metalloid trace elements behaviour in the soil profile and their relative contribution as compared to the underlying bedrock.



S12.01-P -33

NONYLPHENOL ON SOIL: EFFECTS ON AGGREGATE STABILITY, WATER RETENTION AND MICROBIAL ACTIVITY

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Surfactants are widely used in many different industries such as agrochemicals or cleaning agents and most end up dispersed on soil, water or sediment compartments. Recently, the toxicity of 4-nonylphenol (NP) has received considerable attention due to their endocrine disruption consequences on the reproduction of aquatic organisms, but their effects on soil organisms and properties are less known. The main aim of this study was to increase the knowledge about the effects of NP on: (i) soil aggregate stability, (ii) soil water retention and (iii) soil biological activity (respiration, microbial biomass) and their interaction with an humic material. Lysimeters with soil mixed with and without peat (Haplosaprist) were treated with NP (25 and 50 mg NP/Kg soil) and analyzed the same day, 24 hours and 1 week after NP addition. Although a fast reduction of NP concentration on soil was observed during the first week after NP addition, soil aggregate stability and water retention were increased at short term, markedly on soil mixed with peat and treated with NP. Respect to soil respiration, microbial biomass and remainder biological activity indexes (coefficient of mineralization, $C_{\text{microbial}}:C_{\text{organic}}$ ratio, metabolic quotient), NP stimulated microbial activity at low dose but high dose inhibit. However, when peat was added to soil, NP effects were attenuated.



S12.01-P -34

RAILWAY RELATED SOIL POLLUTION: THE TURIN-LYON HIGH-SPEED RAIL CASE

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Countries within the European Union have different insight in the degree of soil pollution in general and on railway related pollution in particular. In half of the EU countries requirements for soil protection are a regular part of the license of railroad related activities. In more than half of the countries there is (some) legislation on soil remediation in force for railroad and railroad related activities. The total number of inventoried polluted railway sites in the nine main EU countries is about 25,500, with a mean of about 2,800 each. About one third of the railway companies can provide examples of railroad operations being restricted or cancelled because of soil pollution. The main railway related soil pollution cases deal with: • spill of dangerous goods, • building and construction projects, • ballast • protection of groundwater. More than two third of the companies can give examples showing authorities prescribing an investigation of soil pollution or a soil remediation before a railroad operation. The case of the high-speed railway proposed for the connection of Turin (Italy) and Lyon (France) is addressed in the paper. Main soil pollution problems dealing with the railway construction are addressed. The case due to the presence in the Susa Valley of geological formations with asbestos and uranium is of particular concern, also considering the final destination of the extracted inert. Also, the questions related with local hydrogeology and its perturbations are addressed



S12.01-P -35

REMOVAL OF ANTHRACENE FROM A SURFACTANT-AMENDED SOIL

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The contamination of soils and groundwater by toxic and/or hazardous organic pollutants is a widespread environmental problem and the removal of hydrophobic organic compounds (HOCs) from them is becoming a major concern. Surfactants can increase the solubilities of HOCs by partitioning them into the hydrophobic cores of surfactant micelles above the critical micelle concentration (CMC). The sorption of surfactants onto soils has a significant effect on the performance of surfactant enhanced desorption. In this study, the efficiency of surfactants in enhancing desorption for polycyclic aromatic hydrocarbons (PAH) contaminated soils. Surfactants have been applied to soil to accelerate removal of hydrocarbons, but in a previous experiment no increase in dissipation of anthracene (Anthra) was found when a non-ionic surfactant Surfynol® 485 (ethoxylated 2,4,7,9-Tetramethyl-5-decyne-4,7-diol) was added. The application rate of the surfactant might have been too low so a soil spiked with anthracene (Anthra) using acetone as solvent was amended with 0.49, 0.98, and 2.45 ml a non-ionic surfactant Surfynol® 485 or left unamended. Dynamics of C and N and concentration of Anthra were monitored for 56 days. The sampling site is located in Otumba in the State of México (19° 42' N 98° 49' W) and the soil was classified as Typic Fragiudepts. The soil is mainly cultivated with maize for > 20 years, receiving a minimum amount of mineral fertilizer.



S12.01-P -36

RESISTANCE OF RHODOCOCCUS ERYTHROPOLIS BIOFILM, POTENT DEGRADER OF AROMATIC COMPOUNDS, TO ATTACK OF (BIO)SURFACTANTS

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The microorganisms growing in a biofilm usually have an increased ability to degrade toxic pollutants. The application of surfactants often increases efficiency of biodegradation processes, especially in the case of hydrophobic pollutants. However, surfactants can affect the biofilm as well as individual microbial cells in different ways. An external application of synthetic surfactants or biosurfactants often results in partial or complete destruction of the biofilm and in the case of high concentration also has a toxic effect on microbial cells. Finding a suitable surfactant and its concentration, which would minimize the negative effects mentioned above, would allow to construct an effective bioremediation processes using both the benefits of a biofilm and surfactant. In this context Gram-positive bacterium Rhodococcus erythropolis, which has a wide potential for biodegradation of aromatic compounds, was chosen. High surface hydrophobicity of its cells, determined mainly by the presence of mycolic acids in the envelope layers, allows formation of stable biofilms. Three synthetic surfactants (two nonionic, one anionic) and biosurfactant rhamnolipid (anionic) isolated from several strains of Pseudomonas aeruginosa were applied in a concentration range from 0 to 1.5 times of the critical micelle concentration (CMC) at various phases of R. erythropolis biofilm formation. Nonionic surfactant Novanic, applied in concentrations below the CMC had a positive effect on biofilm development on hydrophobic materials. Rhamnolipid in concentrations above the CMC even stabilized biofilm of R. erythropolis. The rhamnolipid is of natural origin and is environmentally friendly. The biofilm based biodegradation process takes advantage of biosurfactant was designed.



S12.01-P -37

SOIL PROTECTION ON CONSTRUCTION SITES: 10 YEARS OF EXPERIENCE

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The Swiss Soil Science Society delivers expertise to normative and legislative processes and draws attention to their repercussions on soil. Since its foundation, the SSSS has been committed to anchoring soil protection in the legislation. The development of guidelines and courses to protect soil during construction has been one particular success of the SSSS: Construction involves heavy machinery and moving of soil potentially causing soil compaction. Soil protection consultants advise construction experts on how to prevent damage to the soil and loss of soil fertility on construction sites. The SSSS strives for high quality standards in the area of soil protection. With this aim in mind, the society has issued a certificate of the "SSSS Soil Protection Experts on Construction Site" and was involved in the setting up of a course for these experts. This procedure was developed in close collaboration between the SSSS, cantonal soil protection authorities, construction experts and the Federal Office for the Environment. After ten years of experience a study showed that the certified experts are well accepted by authorities as well as by construction companies.



S12.01-P -38

SOIL PROTECTION SPECIFIC REQUIREMENTS WITHIN THE FRAMEWORK OF CARBON DIOXIDE CAPTURE AND STORAGE (CCS) ACTIVITIES

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Mitigation of Climate Change is a challenge which requires efforts in different fields. Carbon capture and storage (CCS) in geological formations is discussed as a possible contribution to reduction of CO₂-emission. Risk analyses taking into account possible risks for the soil compartment are necessary for a well-founded decision. CO₂-leakage from the geological storage may be the main risk for soil. Currently there are no reliable assumptions about the possible amount of leakage, flux densities and the extent of the affected areas. Natural analogues show, that soil functions and soil ecology near to geological CO₂-sources are strongly influenced. Most studies compare areas with extremely CO₂-concentrations (>90%) with unaffected areas (control) and they show, that enhanced soil CO₂-concentrations are likely to change the chemistry of nutrients, lower the soil pH, mobilize heavy metals, and decrease plant growth. Systematic studies focussing on the influence of different CO₂-concentrations on soil functions are scarcely. Simulation studies with/without additional CO₂-sources can help to identify sites which are very susceptible to additional CO₂-input into the soil. Sensitivity analysis studies found in literature and modelling results from HYDRUS-1D in this project show the applicability of deterministic models to calculate concentration profiles in soils under the assumption of a small CCS-born CO₂-flux. Uncertainty analysis will be presented and discussed. Additionally a practical approach will be proposed to derive tolerable CO₂-fluxes (Critical Loads) into the soil ecosystem without causing damage to important soil functions.



S12.01-P -39

SOIL RECLAMATION AND ENVIRONMENT CONSERVATION WITH GEOGRID IN THE ARID AREA (CHANDAB BASIN-IRAN)

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The objective of this paper was to study the efficiency of geogrid materials in technical aspects for high slope stabilization. To determine geogrid works, plots of 12x2 meters were constructed. Different treatments were considered for the research. Two slope (85% & 110%) and there replication were among the treatments 9 events were recorded. The receipted data has been analyzed with Spss program. The effect of slope and soil covering of plots, also their reciprocal effects to amount sediment concentration has been evaluated with two ways on variance analysis. This investigation and other studies suggest that the use of geogrid to issue in soil conservation and soil stability in the steep slopes (road trench and railway lines) and prevent erosion of rivers and dam borders. The percentage of vegetation covering is variable in the different seasons. Vegetation covering has been increase more in the slope of 85%. In the plots more than 110% of slope the quantity of vegetation covering in the plots of first treatment has been increased from 1 to 13.5 %. In the plots of second treatment vegetation covering has been increased from 1 to 17 %. In Iran where the most parts of it are mountainous, this method can be useful for agricultural development. The results could be applied for reclamation of hard soils for agriculture and stabilization of slopes next to dam reservoirs or trenches resulted by road construction.



S12.01-P -40

STUDY OF ADSORPTION OF Cu, Ni, Cd, Pb AND Zn BY SOILS OF THE NEGRO RIVER'S BASIN IN THE BRAZILIAN AMAZON

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The bioavailability of metals in soil and its toxicity are related to their physico-chemical properties. The removal of metals from the soil solution can occur by interactions with mineral structures and/or complexation with organic matter (OM). The soil properties that influence the retention and mobility of metals are: pH, CEC, OM, clay and ion competition. In this study, soils samples from the Negro river's basin in the Brazilian Amazon, in the depth 0-10cm, were collected in three regions along river. The total concentrations of Cu, Ni, Cd, Pb and Zn in the samples were correlated with the physico-chemical properties of soil by Pearson's correlation coefficient. Kinetic study of metals was carried out by using the soil sample and multielement standard solution of metal (1:10; 100mgL⁻¹; pH4.5). Aliquots of 10.0mL of solution were collected at the times 0.5, 1.0, 2.0, 4.0, 6.0 and 8.0 hours, were filtered and the metals, determined by FAAS. Results were adjusted to Langmuir and Freundlich isotherms. Were determined the parameters b, k and the sorption soil coefficient Kd. The results indicated that: Pb showed the best correlations with the physico-chemical properties of soils; the b parameter indicated the major influences on the maximum sorption capacities: CEC (Cu, Cd); C/N (Cu, Cd); pH (Cd); %sand (Cu, Cd); %silt (Cu, Cd); %clay (Pb) and concentrations of Fe and Al (Pb). Kd coefficient indicated the major influences on specific adsorption of ions: CEC (Cu, Cd); OM (Cu, Cd); pH (Cu, Cd); %silt (Cu, Cd) and concentration of Fe (Pb).



S12.01-P -41

SUDAN GRASS (*SORGHUM SUDANENSE PERS.*) IN GREEN MANURING OF SANDY DEPOSOLS IN STANARI MINING AREA

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ABSTRACT The results of Sudan grass (*Sorghum sudanense Pers.*) growing on the reclaimed deposol part of the mine Stanari are presented in this paper. Implementation of Sudan grass growth was performed with the green manuring fertilization of deposol soil and it represents an agro-technical phase of reclamation within the mine. This research was performed in two years period (2009/2010), on the experiment plot of technogenic soil of the mine, within the inside part of overburden deposition site, near Raskovac pit, which is the part of Stanari coal mine. Two varieties of Sudan grass were used, with two treatments of fertilization. Analyses of soil types show sandy and not very fertile soil. The highest yield of green mass (28.45 t ha⁻¹) as well as dry matter (9.90 t ha⁻¹) was achieved by fertilization with nitrate fertilizer with genotype Piper Sweet. The lowest yield of green mass (14.40 t ha⁻¹) and dry matter (4.42 t ha⁻¹) was observed with genotype Srem without any fertilization in 2010. Statistically significant differences were present between the applied treatments, and continuous monitoring over the years has shown the influence. Only the certain variety of grass and fertilization with the reasonably high amount of nitrate will be able to significantly increase organic matter in deposol.
Key words: reclamation, nitrate, variety, green mass, Stanari



S12.01-P -42

THE ASSESSMENT OF PHOSPHORUS FORMS IN LAKE SEDIMENTS AND ITS INFLUENCE ON WATER QUALITY

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Occurring in the fresh water, Eutrophication is a main problem resulted from over fertilizing and/or manure treatment in the upland areas. Phosphorus is one of the most important elements contributed to the eutrophication during the soil erosion and sedimentation process. Deposited sediment from eroded upper land soils in surface waters plays an important role in P adsorption/desorption to/from water depending on P concentration in water column. To investigate the relationship between P forms and its influence on water quality and also to determine the high degrees of P saturation (DPS) sampling point, 50 samples were studied from surface sediment (0-5 cm) in Ekbatan Dam, Hamadan, Iran. Results show that the DPS values were above critical level in five sediment samples. Maximum total P and the DPS were 3285.52 mgKg⁻¹ and 79.11 percent respectively. There were significantly correlation between the DPS with residual P and TP, and also between water soluble P and loosely bound P ($p=0.01$). The TP concentration in lake water was averagely 0.33 mgL⁻¹ (SEM= 0.02). Dissolved Reactive Phosphorus (DRP) in lake water (0.006-0.028 mgL⁻¹) was lower than water soluble P ($p=0.0001$) which may be due to high proportion of particulate P, carried in lake from upper land areas.



S12.01-P -43

THE EFFECT OF HEAVY METALS DEPOSITED IN SILT OF THE SO-CALLED “BIAŁOGON POND” ON CHARACTERISTICS OF DRINKING WATER FOR THE CITY OF KIELCE (POLAND)

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The study area was located in the protection zone of the municipal water intake for the city of Kielce. In this terrain, there is a large accumulation of heavy metals in silt of the so-called “Białogon Pond”, having been deposited there for 200 years. The present studies were undertaken in order to evaluate whether and to what extent deposition of these pollutants can pose a threat to the municipal water intake. The results were compared with chemical composition of water from deep wells of the municipal water intake. The studies demonstrated the greatest pollution in the terrain adjacent to the Kielce Pump Factory and in the area of the dam. The pollution sources, like metallurgical slag, post-moulding sand, galvanization wastes derived from the Alexander Smelter and from deposits carried by the Silnica River from the Kielce agglomeration. Pollutants deposited in the past have persisted at similar high level. Their bioavailability has been decreased by a relatively high pH values and a considerable contribution of organic matter and clay minerals. No tendencies towards changes were also seen after drainage of the “Białogon Pond” in 1993 and the level of pollutants in underground water did not diverge from hydrochemical background in this region. It resulted from a weakly acidic and weakly basic pH (ranging from 5 – 8) which did not allow for metal leaching from polluted soils and their migration in underground waters.



S12.01-P -44

TRICLOSAN BIOAVAILABILITY DETERMINED BY WHEAT PLANTS GROWN IN SOILS TREATED WITH BIOSOLIDS

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The wastewater treatments, brings with it the biosolids generation. One of the best options for the final disposition for these residues is its application in soils, due to its high content of organic matter and macro and micro nutrients incorporation. On the other hand, the biosolids may contain organic pollutants such as triclosan (5-chloro-2-(2,4-dichlorophenoxy) phenol), which can cause harmful effects on the environment. The aim of this study, was to determine the total and the bioavailable fraction of triclosan in soils treated with different biosolid rates, using as bioindicator, wheat plants (*Triticum aestivum*). Two soils of the Mollisol order, Polpaico and Taqueral Series were used. These soils were treated with biosolids in rates of 0, 30, 90 and 200 Mg ha⁻¹. Plants were grown for a month. Plant samples were extracted with ethyl acetate using an ultrasonic bath in three stages from 15 minutes each. The samples clean-up was performed according to the procedure described by Chu and Metalcafe². Triclosan was determined by GC-MS, after derivatization treatment through the addition of N-(terbutildimetilsilil)-N-metiltrifluoroacetamida (MTBSTFA). It was found that the concentration of triclosan in biosolids was 0.100 mg kg⁻¹, and that the bioavailability of the compound depended on the soil type and the organic matter content. It was also found biosolid application to soils influence the compound bioavailability. References 1. Ying, Guang-Guo and Kookana R. *Environment International* 33 (2007) 199-205. 2. Chu, Shaogang and Metalcafe, C. *Journal of Chromatography A*, 1164 (2007) 212-218. Acknowledgements: Fondecyt Project 1110115



S12.01-P -45

URBAN SOILS AND GROUNDS AS A SOURCE OF GREENHOUSE GASES IN ATMOSPHERE

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Concentrations of atmospheric carbon dioxide and methane are steadily growing that influences greenhouse effect and negatively affects human health. The long inhalation of the air with carbon dioxide content above 0,08 % leads to diseases: from headaches and the speeded up pulse to acidosis and deterioration of reproductive function (Robertson, 2006). Methane is toxic only in very high concentration, but its accumulation in grounds can have fire and explosion risks for objects constructed on them. Objects of our research are anthropogenic soils and soil-like formations on gas generating made grounds at urban territories with recent or only planned building. Such grounds are formed in the process of filtration fields recultivation, drainage network and ravines filling up with a ground containing construction and household waste of illegal dumps, building of the territories with peat deposits and wetlands. Made grounds contain organic matter which decomposition is accompanied with greenhouse gases emission. Accumulation of organic matter amplifies by eutrofication, incoming of anthropogenic nitrogen and phosphorus oxides. Reductive conditions with methane generation are created by technogenic filling, flooding or sealing. Carbone dioxide is generating in aerobic conditions. Conservative properties and parameters of soils and grounds functioning are identified. Regularities, factors and intensity of processes greenhouse gases generation, consumption and emission by urban soils and grounds in various conditions at gas generative territories are considered, soils ecological functions are revealed. The flux mass balance is calculated and risks of atmosphere pollution by methane and carbon dioxide are estimated for the Moscow region.



S12.01-P -46

USING SPATIAL DISTRIBUTION MAPS TO DEFINE POLLUTION SOURCE OF SOILS WITH HEAVY METALS

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Soil contamination with five heavy metals – Cu, Mn, Ni, Pb and Zn was studied in soils of central part of Georgia. The area is affected by ferro-manganese factory representing the biggest industrial site of the region. There are some previous publications showing considerable pollution rate by several heavy metals in close surroundings of the factory, but there were no data on a regional scale. The aim of the current research was to evaluate present condition and to create spatial distribution maps for studied metals, which makes it easier to understand a real impact of the factory on high metal concentrations in soils. Samples were taken from natural landscapes to avoid any possible anthropogenic influence on metal accumulation due to agricultural production. The results of metals spatial distribution has shown, that ferro-manganese factory has considerable input on high metal content, but it is not as crucial as argued in previous works, even highest concentrations of studied elements are substantially low in comparison to those known from the literature, only Mn returned relatively high values, which was expected at the beginning of the study.



S12.02-P - EMERGING ORGANIC POLLUTANTS - FROM THE WASTEWATER TREATMENT FACILITY TO THE AGRICULTURAL FIELD

Wednesday 04 July 2012 from 17:00 to 18:30. Room Poster Areas

S12.02-P -1

DISTRIBUTION OF A PROTEAN BIOPOLYMER APPLIED ON AGRICULTURAL DEGRADATED SOILS AS STRUCTURAL CONDITIONER

Alina Gherghina, Bucharest - Romania

S12.02-P -2

EFFECTS OF CARBON BASED NANOPARTICLES ON THE BIOAVAILABILITY OF THE SYNTHETIC 17 β -ETHINYLESTRADIOL (EE2) IN SOIL SOLUTION

Britta Stumpe, Bochum - Germany

S12.02-P -3

END-O-SLUDG (MARKETABLE SLUDGE DERIVATIVES FROM SUSTAINABLE PROCESSING OF WASTEWATER IN A HIGHLY INTEGRATED TREATMENT PLANT.)

Bryan Griffiths, Wexford - Ireland

S12.02-P -4

KINETICS OF MODULARLY FUNCTIONALIZED ANATASE NANOPARTICLE ATTACHMENT TO HUMIC ACIDS

Kurt Jacobson, Madison - United States

S12.02-P -5

MICROBIAL POLLUTION OF SOME VEGETABLES IRRIGATED WITH UNTREATED MUNICIPAL WASTEWATER IN HAMEDAN, (IRAN)

Ali Akbar Safari Sinegani, Hamedan - Iran, Islamic Republic of

S12.02-P -6

MOBILE INTEGRATED SYSTEM FOR TREATMENT OF ORGANIC WASTEWATER

Iggy Litaor, Kiryat Shemona - Israel

S12.02-P -7

MODIFIED ZEOLITE FOR SOIL MIX TECHNOLOGY PERMEABLE REACTIVE BARRIERS

Zhenzhen Wang, Engineering Department, Cambridge - United Kingdom



S12.02-P -8

OLIVE OIL PRODUCTION WASTEWATER (OPWW) DISPOSAL: THE EFFECT ON SOIL SORPTIVE ABILITY TOWARDS ORGANIC COMPOUNDS

Yonatan Keren, Bet Dagan - Israel

S12.02-P -9

THE CHANGE OF WATER AND NAPL RETENTION OF SOILS AFTER CATIONIC SURFACTANT PRETREATMENTS

Tunde Csatari, Keszthely - Hungary

S12.02-P -10

TRANSFORMATION AND BOUND RESIDUE FORMATION OF 4-NONYLPHENOL IN SOIL

Rong Ji, Nanjing - China

S12.02-P -11

TRANSFORMATION OF IBUPROFEN INTO BIOGENIC NON-EXTRACTABLE RESIDUES IN SLUDGE AMENDED SOIL

Karolina Nowak, Leipzig - Germany

S12.02-P -12

WASTEWATER FROM OLIVE OIL MILLS IN ISRAEL AND PALESTINE: SHORT AND LONG-TERM EFFECTS ON SOIL PROPERTIES

Benjamin Peikert, Landau - Germany



S12.02-P -1

DISTRIBUTION OF A PROTEAN BIOPOLYMER APPLIED ON AGRICULTURAL DEGRADATED SOILS AS STRUCTURAL CONDITIONER

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Tanneries and leather goods manufacturer problems with the waste disposal lead to new technologies of processing their organic wastes, for being applied in agriculture degraded lands as soil conditioners and biofertilizers. The paper deals with the organic polymers (OPs) resulted from the processing of the leather organic wastes, which have been use to study its distribution in soils and to emphasise its efficiency as a structural conditioner. The researchers have been carry out in the green house (under maize, wheat, sun flower, soya bean), on a wide range of soils with different ecological properties. Having viscosity, for a better application to soil, the OPs were mixed with water in different concentrations: 0.2%, 0.5%, and 0.10%. For precisely observations under microscope, the OPs have been stained with methylene blue. The data showed that the studied soils have favourable ecological properties. The micromorphological study emphasised that in sandy soil the OPs randomly distributed in the upper layer, as a cover of the soil matrix and ambeading all the soil constituents. While in the clayey soil, the OPs penetrate through continuous pores, coating the aggregates with relatively thin coatings. In the case of collapsed aggregates, the distribution of the OPs was similar to the sandy soil. The OPs show to be a good conditioner for the soil structure, reinforcing it architecture, the better concentration being the same (0.5%) for the all studied soils.



S12.02-P -2

EFFECTS OF CARBON BASED NANOPARTICLES ON THE BIOAVAILABILITY OF THE SYNTHETIC 17 β -ETHINYLESTRADIOL (EE2) IN SOIL SOLUTION

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Nanotechnology is a major innovative scientific and economic growth area. To date there is a lack of knowledge about possible adverse effects that may be associated with manufactured nanomaterial in terrestrial environments. Since it is known that on the one hand carbon-based nanoparticles (CNPs) and endocrine disrupting chemicals (EDCs) such as 17 β -ethinylestradiol (EE2) strongly interact in wastewater and that on the other hand CNPs and EDCs are released together via wastewater irrigation to agricultural soils, knowledge of CNP effects on the EDC fate in the soil environment is needed for further risk assessments. Thus, initially the study investigated the interaction between CNPs and EE2 as well as effects of these interactions on the EE2 toxicity and biodegradability in soil solution. For that, the biodegradation of CNP, EE2 or CNP/EE2 by soil microorganisms in solution was investigated using inocula extracted from different test soil samples. Since the hormone was ¹⁴C labelled, the EE2 degradation could be monitored via ¹⁴CO₂-measurements. The microbial activity in the solution system was also monitored measuring the activity of enzymes such as dehydrogenase and peroxidase. It was found that EE2 sorbed up to 30% to CNPs in soil solution, thus EE2/CNPs complexes reduced the free solved EE2. Based on this, the incubation studies demonstrated that these complexes reduced the EE2 biodegradation by up to 40%. Thus, the presence of CNPs resulted in a lower bioavailability of the EDC.



S12.02-P -3

END-O-SLUDG (MARKETABLE SLUDGE DERIVATIVES FROM SUSTAINABLE PROCESSING OF WASTEWATER IN A HIGHLY INTEGRATED TREATMENT PLANT.)

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END-O-SLUDG is a recently funded EU-FP7 project that researches, develops and demonstrates a toolkit of novel processes together with market development for advanced sludge-based products and integration methodologies that can be applied to a range of wastewater treatment plants based on a typical municipal scenario. The aim is to achieve more secure and sustainable sludge treatment and management practices in Europe while reducing pressure on natural resources and reliance on manufactured fertilisers. The concept of END-O-SLUDG is a realistic response in Europe to deal with the rapid rise in sludge production and the need to address the public health, regulations, and the environment in the context of EU climate change mitigation and energy policies by moving toward maximum value recovery and end of waste. The main drivers here are of course reducing carbon dioxide emissions (climate change), improving the security of the land recycling route and the economic opportunities thrown up by changing the technology basis of sludge production and treatment. Rather than build a project around a particular treatment process or processes, we have chosen to concentrate on certain critical unit operations that are at present limiting economic feasibility and which are sufficiently generic to be applicable to a range of wastewater treatment plants. Cognisant of the debate and public sentiment around the use of sewage sludge in agriculture, our project concentrates on developing and delivering marketable agricultural commodities as the end products to suit local condition.



S12.02-P -4

KINETICS OF MODULARLY FUNCTIONALIZED ANATASE NANOPARTICLE ATTACHMENT TO HUMIC ACIDS

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Attachment of engineered nanoparticles to natural organic matter (NOM) is expected to influence their transport and fate in the environment and influence their bioavailability to organisms. Using a novel citric acid derivative, organic ligands were anchored to TiO₂ nanoparticles using azide-terminated polyethylene glycol (PEG) molecules presenting different head groups to solution. The functionalized nanoparticles were characterized by dynamic light scattering, transmission electron microscopy, and infrared and X-ray photoelectron spectroscopy. To examine nanoparticle attachment to humic substances we electrostatically assembled nanoscale films of Elliot soil humic acid on quartz crystal microbalance with dissipation monitoring (QCM-D) and optical waveguide lightmode spectroscopy (OWLS) sensors. We examined nanoparticle attachment over a range of environmentally relevant solution conditions (pH 5-8 and ionic strength = 5-50 mM. Final adsorbed masses, attachment rate constants, attachment efficiencies, and water content (determined through parallel QCM-D and OWLS experiments) were determined.



S12.02-P -5

MICROBIAL POLLUTION OF SOME VEGETABLES IRRIGATED WITH UNTREATED MUNICIPAL WASTEWATER IN HAMEDAN, (IRAN)

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The use of municipal wastewater in agriculture requires a careful monitoring of a range of hygiene parameters. The importance of adequate measures throughout the farm-to-table food chain was emphasized. The aim of this study was to investigate the microbial quality of some raw eaten vegetables irrigated with untreated municipal wastewater. Samples of vegetables including basil, parsley, dill, coriander and signage produced were analyzed for fecal coliforms and Escherichia coli since June to October 2011. Colony forming units (cfu) of E. coli and fecal coliforms on EMBA (eosin methylene blue agar) were counted. The cfu of E. coli on the surface of vegetable's leaves (0.48-1.95 log₁₀ CFU/g) was higher than that inside of the leaves. In this study no E. coli was observed in samples prepared from inside of the leaves of vegetables. Coliform counts were between 1.35-7.12 log₁₀ CFU/g leaves on the surface and 3.03-13.68 log₁₀ CFU/g leaves inside the leaves. The lactose negative counts of coliforms on the surface and in the tissue of the leaves of sampled vegetables were in the range of 0.52 And 6 log₁₀ CFU/g , so vegetables irrigated with untreated waste water had pathogenic microorganisms and represent a risk for consumers regarding foodborne disease.



S12.02-P -6

MOBILE INTEGRATED SYSTEM FOR TREATMENT OF ORGANIC WASTEWATER

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There is an urgent need to process olive mill and winery wastewaters that are unsuitable for treatment by sewage treatment plants. The complexity of these effluents demands the construction of environmentally safe and cost-effective solutions. The main goal of this work was to test a new concept of mobile integrated system for treatment of organic wastewaters. The system consists of fast sedimentation of TSS, up-flow anaerobic sludge blanket bioreactor and a portable vertical flow constructed wetland (VFCW) that reduce pollutant concentrations to permissible levels for irrigation. In the current work we tested the performance of VFCW as a stand alone module. The experiment was conducted with winery effluents that contained 2200 mg l⁻¹ COD, 1.0 mg l⁻¹ NH₄, 12.2 mg l⁻¹ total P, 92 mg l⁻¹ TSS, pH of 4.6, and EC of 2100 μ S cm⁻¹ at a rate of 100 liter per day. The VFCW reduced the COD to 1300 mg l⁻¹, while NH₄, TP and TSS were reduced to 0.1, 0.01, and 4 mg l⁻¹ respectively. The successful reduction of the N, P TSS and EC are very promising while the moderate decrease of COD suggests that currently the VFCW can not work as a stand alone module. We tested the use of dewatered alum as one of the substrate type to reduce P in wastewater. Although the alum has extremely high sorption capacity (> 7000 mg kg⁻¹) it released high level of NH₄⁺ during the effluent transport, which diminished its usefulness.



S12.02-P -7

MODIFIED ZEOLITE FOR SOIL MIX TECHNOLOGY PERMEABLE REACTIVE BARRIERS

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Due to industry use of land and urban activities, a wide range of contaminants are presented in groundwater. Remediation of contaminated groundwater has thus become a controversial issue. As an in-situ permeable treatment, permeable reactive barriers (PRBs) is being considered the most effective and economical technology; one challenge in this technology needed to be addressed is to select effective materials for contaminants removal. This poster presented an innovative material – modified zeolite. Experimental work was concentrated on validation of field trials treatment, laboratory simulated tests and comparison of batch tests results with columns tests. The results of this research will be useful for other PRBs applications, environmental pollution control and water treatment.



S12.02-P -8

OLIVE OIL PRODUCTION WASTEWATER (OPWW) DISPOSAL: THE EFFECT ON SOIL SORPTIVE ABILITY TOWARDS ORGANIC COMPOUNDS

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The olive oil production wastewater (OPWW) is by-product of the three-phase extraction procedure. The organic carbon-rich OPWW could be disposed by the field application; however, it contains toxic components and may involve soil hydrophobization and groundwater pollution. Therefore, understanding of the OPWW impact on key soil properties is of significant agricultural and environmental interest. In this work, the effect of OPWW application on the soil organic carbon (SOC) content, the soil texture, the properties of water-extractable organic matter and the soil ability to interact with organic compounds was examined. The soils affected by the long-term and single OPWW applications were sampled in the olive tree orchards located in the southern Israel, from the 0-3 and 3-25 cm depths. The organic chemicals of interest included atrazine, simazine, diuron, caffeic acid and phenol. The OPWW application may increase the SOC content and concentration of dissolved organic carbon in aqueous soil extracts. The long-term OPWW soil application may result in the two – three-fold increase of the distribution coefficients describing the interactions of organic molecules with the soil (sampled in the upper layer) at the presence of biocide. This increase is more distinct for simazine, diuron and atrazine than for caffeic acid and phenol. There was no relation between the SOC content and the distribution coefficients of organic compounds. However, the distribution coefficients normalized by the SOC content suggest that if SOC controls the interactions of organic chemicals, then, its specific sorptive ability becomes reduced in the result of the OPWW application.



S12.02-P -9

THE CHANGE OF WATER AND NAPL RETENTION OF SOILS AFTER CATIONIC SURFACTANT PRETREATMENTS

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Contamination of soils and groundwater by organic phase liquid (NAPL) pollutants constitutes a major environmental problem worldwide. The released NAPL migrates downward through the subsurface due to gravity forces and is frequently trapped in pores due to the effect of capillary forces. The trapping of NAPL is controlled mainly by the pore geometry of the soil, wettability and interfacial tension. The retained NAPL can persist in the soil for many decades and present a long-term threat to groundwater quality. Nowadays, surfactants (surface active agents) can promote the enhanced removal of NAPL from the subsurface through mobilization and solubilization. In spite of surfactants are widely used in remediation technologies we have only few exact information about how they influence the soil physical properties. However, surfactants may cause change in structure, porosity, retention capacity, permeability etc. of the soils. In our study the effects of cetylpyridinium chloride (a cationic surfactant) on water and NAPL retention of different soil horizons were investigated. The retention measurements were performed using porous plate extractors after various pretreatment procedures. The concentrations of surfactant solutions by pretreatments were chosen using the measured surfactant adsorption isotherms of the soils. To recognize the changing the retention values between soils pretreated with surfactant solutions in different concentration were compared. The effect of soil parameters and surfactant treatment on the fluid retention values was statistically analyzed. Acknowledgement The financial and infrastructural support of the State of Hungary and the European Union in the frame of the TÁMOP-4.2.1/B-09/1/KONV-2010- 0003 project is gratefully acknowledged.



S12.02-P -10

TRANSFORMATION AND BOUND RESIDUE FORMATION OF 4-NONYLPHENOL IN SOIL

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Land application of biosolids bring large amounts of the endocrine disrupting nonylphenol into soil environment, however, the fate of nonylphenol in soil, especially Chinese rice paddy soil, is not clear. Using ¹⁴C-labelled branched isomers of 4-nonylphenol (4-NP), degradation of five 4-NP isomers including four branched 4-NP isomers and the linear 4-NP (4-NP1) in a paddy rice soil was investigated under oxic conditions. The degradation of the 4-NP isomers in the soil was isomer specific, with the half life as follows: 4-NP111 > 4-NP112 > 4-NP65 > 4-NP38 > 4-NP1, which was in agreement with the order of the estrogenic activity of the isomers reported in literature. Mineralization of ¹⁴C-4-NP111 in the soil was slow (5% within 60 days incubation). A less polar metabolite of 4-NP111 was found in active soil after 5 days of incubation as analyzed by autoradiography. Large amounts of 4-NP111 residues were bound to soil humic substances. ¹³C NMR analysis of 4-NP111 residues suggested that the binding was mainly via ester or ether bounding, while HP-¹⁴C-GPC showed preferred binding of 4-NP111 residues to humic molecules with high molecular weights. Incorporation of radioactivity of ¹⁴C-4-NP111 in humin increased over time, amounting to almost 90% of the residual radiolabel located at the end of incubation. Our results showed significance of bound residues of nonylphenol in soil, and further study on nature and stability of the bound residues should be carried out for environmental risks assessment of the bound residues.



S12.02-P -11

**TRANSFORMATION OF IBUPROFEN INTO BIOGENIC NON-EXTRACTABLE RESIDUES IN
SLUDGE AMENDED SOIL**

Nowak Karolina^{*[1]}, Girardi Cristobal^[1], Miltner Anja^[1], Schäffer Andreas^[2], Kästner Matthias^[1]

^[1]UFZ - Helmholtz-Centre for Environmental Research ~ Environmental Biotechnology ~ Leipzig ~ Germany ^[2]RWTH Aachen University ~ Institute for Environmental Research (Biology V) ~ Aachen ~ Germany

Ibuprofen is partially eliminated in wastewater treatment plants and represents one of the most abundant pharmaceutical detected in the biosolids. Application of biosolids in agriculture as fertiliser may introduce this pharmaceutical into soils. Up to date, it is still little known about the fate of ibuprofen in agricultural soils. Available few reports on turnover processes of this pharmaceutical in soil are limited to the general mass balances without any information about the chemical composition of non-extractable residues (NER). NER are generally considered to be composed of parent compounds or primary metabolites with hazardous potential. However, NER may also contain microbial biomass components, for example: fatty acids (FA) and amino acids (AA), which after cell death are stabilised in soil organic matter (SOM) forming biogenic residues. We investigated the biodegradation of ¹³C6-ibuprofen in sludge amended soil over 90 days with particular focus on the extent of biogenic residues formation. We analysed the labelled FA and AA in living and non-living SOM fractions. ¹³C-FA and ¹³C-AA amounts in the living SOM fraction decreased in time course, whereas the ¹³C-FA and ¹³C-AA in the non-living SOM remained surprisingly stable after 58 days. The results showed that at the end, nearly all NER were biogenic and contained only harmless biomass compounds. The presented data thus revealed that land application of biosolids containing readily biodegradable organic contaminants like ibuprofen seems to be an environmentally safe solution for their disposal.



S12.02-P -12

WASTEWATER FROM OLIVE OIL MILLS IN ISRAEL AND PALESTINE: SHORT AND LONG-TERM EFFECTS ON SOIL PROPERTIES

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^[1]Universität of Koblenz-Landau ~ Environmental Sciences; Soil and Environmental Chemistry ~ Landau ~ Germany ^[2]Al Quds University ~ Faculty of Science and Technology ~ Jerusalem ~ Palestinian Territory, Occupied ^[3]Agricultural Research Organization, The Volcani Center ~ Institute of Soil, Water and Environmental Sciences ~ Bet Dagan ~ Israel

Olive orchards play an important role in Israeli and Palestinian agriculture. In the continuous 3-phase extraction process water is added to the pomace. After the decanting process large amounts of olive oil mill wastewater accrue. It is acidic, has a high concentration of organic material and is hardly microbially degradable due to toxic effects of some organic compounds, including polyphenols. Wastewater treatment plants are not able to deal with this wastewater because it negatively affects the microbial processes during the water management. Alternative options for its reuse are rare. This often leads to an uncontrolled disposal of olive oil mill wastewater, which is environmentally risky. We investigated changes in various soils in the West Bank and in Israel after spreading olive oil mill wastewater. In a combined field and lab study we have been analyzing effects of controlled olive oil mill wastewater application under various climatic conditions as well as locations subjected to uncontrolled release of OPWW. The objective is to apply olive oil mill wastewater in a way that soil properties are improved. Contaminated soils contained significantly increased amounts of nutrients including chloride, potassium, organic matter and nitrogen. However, most of the contaminated samples reveal significantly reduced wettability, indicated by high contact angles ($110^\circ \pm 5^\circ$) and long water drop penetration times up to 20 min. This reduced wettability has negative effects on soil quality. It would therefore be promising to minimize the hydrophobizing impacts without losing fertilizing effects of the olive oil mill wastewater.



S12.03-P - BIOGEOCHEMISTRY OF CONTAMINANTS IN WETLAND AND RIVER FLOODPLAIN SOILS

Friday 06 July 2012 from 17:00 to 18:30. Room Poster Areas

S12.03-P -1

A PROBABILISTIC MULTI-COMPARTMENTAL MODEL FOR EVALUATING BIOAVAILABLE CONCENTRATIONS OF METALS IN SOILS AND SEDIMENTS BY DGT

Philippe Ciffroy, Chatou - France

S12.03-P -2

ADVANCEMENT OF A SOIL MICROCOSM TECHNIQUE FOR RESEARCH OF BIOGEOCHEMISTRY OF CONTAMINANTS IN WETLAND SOILS

Jörg Rinklebe, Wuppertal - Germany

S12.03-P -3

BEHAVIOUR OF TRACE METALS IN EUTROPHICATED WETLANDS POLLUTED BY MINE WASTES: ASSAYS IN SIMULATED SOIL PROFILES WITH AND WITHOUT LIMING AND WITH AND WITHOUT VEGETATION

María Nazaret González-Alcaraz, Cartagena - Spain

S12.03-P -4

BIOINDICATING PROPERTIES OF MACROPHYTES FOR MONITORING TRACE ELEMENT-EXPOSURE ALONG THE JALLE RIVER (FRANCE)

Lilian Marchand, Talence - France

S12.03-P -5

COPPER ISOTOPE FRACTIONATION AS A PROXY FOR BIOGEOCHEMICAL PROCESSES IN WETLANDS RECEIVING COPPER-CONTAMINATED RUNOFF FROM AGRICULTURAL CATCHMENT

Izabella Babcsanyi, Strasbourg - France

S12.03-P -6

DYNAMICS OF SOLUBLE NICKEL IN A SERPENTINE SOIL: AN EXPERIMENT FROM REDUCING TO OXIDIZING CONDITIONS

Svetlana Antic-Mladenovic, Belgrade - Serbia



S12.03-P -7

FACTORS AFFECTING PHOSPHORUS RELEASE FROM SEDIMENTS TO WATER

Malorie Renneson, Gembloux - Belgium

S12.03-P -8

LEACHING OF (A, β , γ , D) HCH ISOMERS FROM A CONTAMINATED SOIL THROUGH ALLUVIAL SOIL

Dousset Sylvie, Vandoeuvre-lès-Nancy - France

S12.03-P -9

NATURAL ANARSENIC-IRON COPRECIPITATES: IMPLICATIONS FOR ARSENIC MOBILITY IN THE WATER-SOIL SYSTEM

Maria Martin, Grugliasco - Italy

S12.03-P -10

REDUCED SULFUR MINERALS IN WETLAND SOILS.

Robert Gilkes, Perth - Australia

S12.03-P -11

SOLUBILITY OF FERROUS IRON LIMITS RELEASE OF PHOSPHOROUS IN SUBMERGED SOILS

Fien Amery, Leuven - Belgium

S12.03-P -12

STUDY OF MERCURY ACCUMULATION IN TYPHA DOMINGENSIS (PERS.) IN VALDEAZOGUES RIVER BASIN (ALMADÉN-SPAIN)

Miguel Angel Lominchar, Madrid - Spain



S12.03-P -1

A PROBABILISTIC MULTI-COMPARTMENTAL MODEL FOR EVALUATING BIOAVAILABLE CONCENTRATIONS OF METALS IN SOILS AND SEDIMENTS BY DGT

Ciffroy Philippe^{*[1]}, Yacine Nia^[1], Amélie Caillat^[1], Matthias Grote^[1], Jean-Marie Garnier^[2]

^[1]EDF - R&D Division ~ LNHE ~ Chatou ~ France ^[2]CEREGE, Université Paul Cézanne ~ UMR 6635 CNRS ~ Aix en Provence ~ France

*Information on metal speciation in soils and sediments, in particular at the solid-porewater interface, can be assessed using the diffusive gradients in thin-films technique (DGT). Extensive research has been performed so far on the use of the DIFS (DGT-Induced Fluxes in Soils and Sediments) model to interpret DGT measurements in soils and sediments. The current study identified some areas where the DIFS model has been shown to yield poor results. In particular: (i) many studies of metal accumulation kinetics in DGT exhibit multiple kinetic stages and (ii) several combinations of the two fitted DIFS parameters can yield identical results. To overcome these problems, a model considering two types of particulate binding sites is proposed, instead of the DIFS model which assumed one single particulate pool. A probabilistic approach is proposed to fit experimental data and to determine parametric Probability Distribution Functions (PDFs). The new probabilistic model was tested on twelve different Cd- or Cu contaminated soils and sediments, which differ in pH value, iron oxides and organic matter concentrations. A good fit was obtained for the complete set of data (instead of DIFS-2D) and a range of uncertainty values for each modeling parameter was calculated. The interpretation of parameter PDFs allows one to distinguish between a variety of geochemical behaviors, providing useful information on metal dynamics in soils and sediments. This geochemical model was coupled to a soil-to-root model to simulate metal uptake by plants and experiments were carried out with an immersed plant, *Myriophyllum aquaticum*, to validate model results.*



S12.03-P -2

ADVANCEMENT OF A SOIL MICROCOSM TECHNIQUE FOR RESEARCH OF BIOGEOCHEMISTRY OF CONTAMINANTS IN WETLAND SOILS

Rinklebe Jörg^{*[1]}, Kewei Yu^[2]

^[1]University of Wuppertal ~ D ~ Wuppertal ~ Germany ^[2]Troy University ~ Department of Biological and Environmental Sciences ~ Troy ~ United States

Application of soil microcosm has largely improved our understanding in biogeochemical processes, because the major environmental factors can be independently controlled. Recent advancement to improve the performance of soil microcosm has been made. The modifications include using a different incubation vessel and cap, replacing a magnetic stirrer with an overhead stirrer, providing temperature control for the microcosm, using data logger for continuous measurements of redox potential (EH), pH and temperature, and application of automatic gas analysis. The modifications can be made by any combinations to suit individual's needs and budget. In this presentation, selected results from various recent experiments will be presented. Those results demonstrate that the improved biogeochemical microcosm system is suitable to conduct mechanistically studies aimed to elucidate the release kinetics and dynamics of several trace metals under controlled redox conditions. Mercury, arsenic, their bio-methylated forms as well as other trace metals are in the focus of this presentation. Additionally, factors determining the dynamics of those metals such as redox- (EH) and pH- conditions, dissolved organic carbon (DOC), concentrations of Fe²⁺, NO₃⁻, PO₄³⁻, SO₄²⁻, and soil temperature are determined simultaneously.



S12.03-P -3

BEHAVIOUR OF TRACE METALS IN EUTROPHICATED WETLANDS POLLUTED BY MINE WASTES: ASSAYS IN SIMULATED SOIL PROFILES WITH AND WITHOUT LIMING AND WITH AND WITHOUT VEGETATION

González-Alcaraz María Nazaret^[1], Conesa Héctor Miguel^[1], Álvarez-Rogel José^[1]

^[1]Escuela Técnica Superior de Ingeniería Agronómica. Universidad Politécnica de Cartagena ~ Ciencia y Tecnología Agraria ~ Cartagena ~ Spain

*We evaluated the combined effect of lime (~60% CaCO₃) and presence of *Sarcocornia fruticosa* in the dynamic of Cd, Cu, Mn, Pb and Zn under fluctuating flooding conditions. We worked in simulated soil profiles filled with two types of mine wastes (pH~6.4 and pH~3.1). For each waste 4 treatments were assayed: without lime + without plant; without lime + with plant; with lime + without plant; with lime + with plant. Each profile was put inside a larger container filled with synthetic eutrophic water. The water level in the containers was maintained at 20 cm below soil surface for four weeks and at 45 cm during the following four weeks, repeating this cycle two times. Eh and pH were regularly monitored and pore water samples extracted at 5, 30 y 55 cm depths (A, C1 and C2 horizons). The variations in the water level led to changes in pH and Eh. C1 horizons of vegetated profiles showed alternation of oxic and anoxic conditions. A horizons were always oxic and C2 were anoxic after eight weeks. Liming favoured the drop of Eh which reached a minimum of -250 mV in the lime treatment of the soil with pH~6.4 and *Sarcocornia*. The soil with pH~6.4 showed higher concentrations of metals in pore water than the soil with pH~3.1, and lime addition decreased these concentrations in both soils. The presence of plants facilitated the re-distribution of metals in the soils by pumping water and dissolved metals to the upper part of the profiles.*



S12.03-P -4

BIOINDICATING PROPERTIES OF MACROPHYTES FOR MONITORING TRACE ELEMENT-EXPOSURE ALONG THE JALLE RIVER (FRANCE)

Marchand Lilian*^[1], Mench Michel^[1], Kolbas Aliaksandr^[1], Vystavna Yulija^[2], Huneau Frédérique^[3], Motelika-Heino Mikael^[4]

^[1]UMR BIOGECO INRA 1202 ~ Ecology of Communities ~ Talence ~ France ^[2]National Academy of Municipal Economy Kharkiv ~ Urban Environmental Engineering & Management ~ Kharkiv ~ Ukraine ^[3]Université Bordeaux 1 ~ UMR GHYMAC ~ Talence ~ France ^[4]Université d'Orléans ~ ISTO, UMR6113 CNRS ~ Orléans ~ France

*For a given wetland and sampling time, and accounting for interactions in the sediment between physico-chemical parameters and total and labile element fractions, a relation is expected between macrophyte exposure to trace elements (TE) and the elemental composition of their plant parts. Macrophytes presenting such relation would be bioindicators of TE exposure, and especially of the anthropogenic contamination of the aquatic ecosystem. In this study, macrophytes with various growth strategies such as *Ranunculus acris*, *Phragmites australis*, *Juncus effusus*, *Carex acutiformis*, *Lythrum salicaria*, *Iris pseudacorus*, and *Phalaris arundinacea* were used in a discriminant analysis as a tool for monitoring TE exposure along the Jalle river (SW France). This river collects contaminated water runoff from industrial, agricultural and residential areas as well as treated water from an urban wastewater treatment plant. Four sites were investigated along the river, from the source to the outlet. Trace element concentrations in aerial parts of macrophytes were monitored as we hypothesized they are growth-strategy dependant. Conductivity, pH and total TE concentrations in sediment, freshwater and pore water were determined. Labile TE pool in fresh water and sediment were measured by DGT. This aimed at identifying which macrophyte species could be used as bioindicators of TE exposure in aquatic ecosystems. First results indicated that shoots of *R. acris* are a bioindicator of TE exposure. Other macrophytes stored elements in their below ground plant parts and translocated a few in their aerial parts, independently of TE exposure.*



S12.03-P -5

COPPER ISOTOPE FRACTIONATION AS A PROXY FOR BIOGEOCHEMICAL PROCESSES IN WETLANDS RECEIVING COPPER-CONTAMINATED RUNOFF FROM AGRICULTURAL CATCHMENT

Babcsanyi Izabella*^[1], Granet Mathieu^[1], Chabaux François^[1], Imfeld Gwenael^[2]

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Copper is an essential micronutrient for many organisms but may also be a contaminant in terrestrial and aquatic ecosystems. Little is known about the transfer of copper in soil and aquatic ecosystems receiving copper pollution. Though stormwater wetlands are engineered worldwide to temporarily retain urban and agricultural runoff, knowledge on the transfer of runoff-related copper in wetland systems is scarce. The understanding of processes that control during storm events the mobilisation and the transfer of copper in biogeochemically dynamic ecosystems, such as wetlands, require novel approaches. Here we evaluated, using copper isotope fractionation, the fate and transfer of copper in a stormwater wetland that regularly receive contaminated runoff from a 42 ha vineyard catchment (Rouffach, Alsace, France). Runoff water, suspended solid, sediment, plant and vineyard soil samples were collected monthly through the period of copper application on the vineyard (March to July 2011) for copper quantification and isotopic analysis using MC-ICP-MS. The results show that 80 % of the runoff-related copper was retained within the wetland. The isotopic shift of aqueous copper between the inlet and the outlet of the wetland ranged from 0.08 to 0.53 ± 0.1 ‰. Inflowing copper in runoff was depleted in ^{65}Cu when passing through the wetland, suggesting that copper was retained by both sorption to Al, Fe oxy(hydr)oxides and complexation with insoluble organic matter. Further studies will focus on copper isotope fractionation during elementary processes, such as sorption and precipitation, in order to interpret and decipher the isotope fractionation observed in complex wetland systems.



S12.03-P -6

DYNAMICS OF SOLUBLE NICKEL IN A SERPENTINE SOIL: AN EXPERIMENT FROM REDUCING TO OXIDIZING CONDITIONS

Antic-Mladenovic Svetlana^{*[1]}, Frohne Tina^[2], Stärk Hans-joachim^[3], Wennrich Rainer^[3], Licina Vlado^[1], Rinklebe Jörg^[2]

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^[2]University of Wuppertal ~ Soil- and Groundwater-Management ~ Wuppertal ~ Germany ^[3]Helmholtz Centre for Environmental Research ~ Department of Analytical Chemistry ~ Leipzig ~ Germany

Studies addressing the redox-induced behavior of high geogenic Ni are very scarce. Therefore, we have used a periodically flooded serpentine soil (Serbia) to study the temporal dynamics of high geogenic Ni under pre-definite redox conditions. We have flooded the soil using an automated biogeochemical microcosm system, which allows a control and continuous measurements of EH and pH. Thereafter, we have increased the EH in steps of approximately 100 mV from anaerobic to aerobic conditions. Simultaneously, the concentrations of soluble nickel (Ni), iron (Fe), manganese (Mn), and dissolved organic carbon (DOC) were determined. The EH (corrected to pH 7.0) developed from low to high values (–144 to 476 mV) and correlated with soluble Ni, Fe, Mn and DOC. Soluble Ni (range 166-77 $\mu\text{g L}^{-1}$) was high at low EH and decreased with increasing EH. The DOC showed the same trend, indicating that Ni might attach to DOC. Soluble Fe and Mn concentrations were high at low EH and decreased above 50 and 300 mV, respectively, due to the formation of Fe/Mn (hydr)oxides. Accordingly, Ni immobilization may be attributed to sorption to or co-precipitation with re-oxidized Fe/Mn (hydr)oxides. Temporal pseudo-equilibrium between solution-solid phase Ni was reached at about 200 mV, however, Ni in solution remained high (about 80 $\mu\text{g L}^{-1}$). Nickel concentrations at definite redox windows were in the same order of magnitude as the exchangeable Ni determined by the Tessier's sequential extraction procedure; thus, the procedure might provide a reliable estimation of the potentially mobile Ni under dynamic redox conditions.



S12.03-P -7

FACTORS AFFECTING PHOSPHORUS RELEASE FROM SEDIMENTS TO WATER

Renneson Malorie^[1], Dufey Joseph^[2], Colinet Gilles^[1]

^[1]University of Liege ~ Gembloux Agro-Bio Tech ~ Gembloux ~ Belgium ^[2]Université of Louvain ~ Earth and Life Institute ~ Louvain-la-Neuve ~ Belgium

P transfer from soil to surface waters can be made by runoff or erosion, this last being majority in Wallonia. Many studies have been and many models have been developed to quantify soil transfer by erosion. However, the future of these soil particles is not often known. P release from sediments to water is rarely studied. This study aims (i) to understand the influence of soil P content, temperature or terms of water replacement on P release in water and (ii) to observe the kinetics of P release. Soil was kept in contact with river water in controlled conditions in laboratory. Two loamy soils were tested, corresponding to a low and a high P content. Experiments concern temperature, water replacement (simulation of stagnant water or river) and biological activity. This experiment was conducted during 8 weeks with weekly monitoring of P in water. The monitoring of orthophosphates in water permitted to establish kinetics curve of P release in water. This study showed the importance of temperature and P contents in P release. This process is higher when temperature is high. When P content is low in sediments, P sorption from water can be observed. In this case, the soil acts as a fixation site and not as a source of P. P fractionation also permitted to identify the P sources. Indeed, all these sources have not the same release capacity. In conclusion, this study permitted to establish P release kinetics and analyze factors affecting them.



S12.03-P -8

LEACHING OF (α , β , γ , δ) HCH ISOMERS FROM A CONTAMINATED SOIL THROUGH ALLUVIAL SOIL

Sylvie Dousset^{*[1]}, Cebren Aurélie^[1], Pauline Sidoli^[1], Pierre Faure^[2]

^[1]Lorraine University - CNRS ~ LIMOS ~ Vandoeuvre-lès-Nancy ~ France ^[2]Lorraine University - CNRS ~ G2R ~ Vandoeuvre-lès-Nancy ~ France

In the seventies, after the closing down of a chemical factory producing lindane (γ hexachlorocyclohexane HCH isomer), the insecticide production residues were stored in a former gravel pit, and confined in a tight capsule. This capsule was buried in an alluvial soil above the water table. The objectives of this work were to: 1) assess the leaching of (α , β , γ , δ) HCH isomers through alluvial soil in order to evaluate the risk of contamination of groundwater by these toxic molecules and 2) evaluate the impact of the contamination on bacterial community and biodegradation potential. HCH isomers transport and microbial communities were studied in water saturated and unsaturated conditions. Indeed, contaminated soil (5 cm-thin layer) was placed onto the surface of two undisturbed alluvial soil columns (15 cm diameter x 20 cm length). Effluents were collected once a week in glass bottles during 25 days. At the end of the percolation period, the soil columns were divided into 5 cm-thin sections. α , β , γ and δ HCH isomers were detected in the percolates of saturated soil column; γ and δ HCH isomer were recovered in greater amount (0.25 and 0.31% of the initial amounts, respectively) than α and β isomers (0.13%). On the contrary, α , β and γ isomers were detected in smaller amounts in leachates of unsaturated soil column (0.02 to 0.03% of the initial amounts). Changes in bacterial community structure were assessed using fingerprints (TTGE). Moreover, enrichment and cultivation of HCH-resistant or potentially degrading bacterial isolates were performed.



S12.03-P -9

NATURAL ANARSENIC-IRON COPRECIPITATES: IMPLICATIONS FOR ARSENIC MOBILITY IN THE WATER-SOIL SYSTEM

Martin Maria^{*[1]}, Sordello Fabrizio^[2], Calotescu Laura Gabriela^[1], Barberis Elisabetta^[1], Violante Antonio^[3]

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The arsenic contamination of groundwaters in the Ganges-Meghna-Brahmaputra floodplain is questioning the sustainability of rice cultivation in the area. The formation of iron-arsenic coprecipitates contributes in regulating arsenic fate in paddy fields irrigated with groundwaters containing dissolved arsenic and iron. In these environments, characterized by fluctuating redox conditions, arsenic can be present both as arsenate or arsenite. While sorption-desorption of arsenic on/from iron oxides have been widely studied, arsenic behavior in coprecipitates is less understood, in particular for arsenite. The aim of this study was to evaluate the potential arsenic release from synthetic iron-arsenite coprecipitates under the effect of organic and inorganic ions, at different pH and concentrations, comparing the behavior of the simplified model with that of natural coprecipitates formed in Bangladesh groundwaters. Natural and synthetic coprecipitates were amorphous, with large specific surface area (up to 340 m² g⁻¹). The point of zero charge did not vary with the As content, and was higher for synthetic than for natural materials. In both synthetic and natural coprecipitates arsenic release was below 1% with most tested extractants, except with phosphate (7%) and citrate (4%), the latter being much more effective with natural coprecipitates (up to 42%). Inositol hexaphosphate, a strong competing molecule for arsenic adsorption, was a poor arsenic extractant from coprecipitates. The coprecipitates were relatively stable in most examined conditions. Differences between the natural and synthetic materials were probably linked to the co-presence of different mineral phases and organic matter in the natural ones, these aspects deserving further research.



S12.03-P -10

REDUCED SULFUR MINERALS IN WETLAND SOILS.

Gilkes Robert^[1], Prakongkep Nattaporn^[1]

^[1]university of western australia ~ segs ~ Perth ~ Australia

Very sandy aquic podosols in SW Australia contain several reduced sulfur minerals that are an environmental acidic hazard if the soils dessicate due to drainage or climate change. We show how pyrite, marcasite and elemental sulfur occur in these organic soils and characterise the morphology and chemistry of these minerals using synchrotron and analytical electron optical techniques. Pyrite occurs as submicron-size euhedral crystals and larger framboids. The research also investigated the acid buffering capacity of the soils to enable the prediction of potential acidification of soils and associated groundwaters. Buffering is mostly provided by allophane, kaolin and organic matter.



S12.03-P -11

SOLUBILITY OF FERROUS IRON LIMITS RELEASE OF PHOSPHOROUS IN SUBMERGED SOILS

Amery Fien^{*[1]}, Rakotoson Tovoherly^[2], Smolders Erik^[1]

^[1]KULeuven ~ Earth and Environmental Sciences ~ Leuven ~ Belgium ^[2]Laboratoire de Radio-Isotopes ~ Laboratoire de Radio-Isotopes ~ Antananarivo ~ Madagascar

Phosphorus (P) is the major limiting nutrient for crops grown on highly weathered soils because P is strongly immobilized on the iron (Fe) oxyhydroxides that are abundantly present. Soil flooding in (paddy) rice culture temporarily mobilizes P due to reductive dissolution of P-bearing Fe(III)-minerals. This study was set-up to monitor this P release dynamics in six weathered soils from Madagascar that are P-deficient. Resin-P and isotopically exchangeable P after 50 days incubation were significantly larger in flooded compared to unsaturated soils. This P release upon flooding increased when soil had been amended with organic matter and the P released was positively correlated with the oxalate extractable P concentration in the soil. No or less significant correlations were found with the total or dithionite extractable P concentrations. This suggests that amorphous, oxalate extractable, Fe and Mn oxides are more susceptible to reduction compared to the crystalline ones. Consequently, the P associated with these amorphous oxides can become available during flooding. Available P concentrations in anaerobic soil suspensions increased 4-fold where cation exchangers were added to buffer solution Fe²⁺ released by reductive dissolution of Fe(III) minerals. Our data suggest that release of P upon flooding is either limited by precipitation of P with precipitated Fe(II) minerals and/or by limited reductive dissolution of Fe(III) minerals.



S12.03-P -12

STUDY OF MERCURY ACCUMULATION IN *TYPHA DOMINGENSIS* (PERS.) IN VALDEAZOGUES RIVER BASIN (ALMADÉN-SPAIN)

Lominchar Miguel Angel^[1], Garcia-Ordiales Efren^[2], Bueno Laura^[1], Rodriguez-Alonso Javier^[1], Sierra Maria Jose^[1], Schmid Thomas^[1], Loredó Jorge^[2], Millán Rocio^[1]

^[1]CIEMAT ~ Soil conservation and remediation ~ Madrid ~ Spain ^[2]University of Oviedo ~ Escuela de Minas ~ Oviedo ~ Spain

*The presence of mercury in the ecosystems is a global environmental problem, especially in aquatic systems due to the potential methylation processes in them. Therefore, the need of effective solutions to remove this toxic element is an environmental priority. It is known the capacity of *Typha* sp. to accumulate different heavy metals in its tissues and, therefore it has been used in wetlands and in phytoremediation technologies. Nevertheless, there is a scarce information focus on the interaction between *Thypha* sp. and mercury. The aim of this experimental work is to study the accumulation and distribution of mercury in *Typha domingensis* and to evaluate its possible use for phytoremediation in Valdeazogues River. This river flows through the Almadén mercury mine district (Ciudad Real, Spain) and *Thypha* plants are very common in its riverbanks. The samples include: water, sediments (collected in the river and from the rhizosphere area) and *Typha* plants (root and aerial part). These samples were collected in 10 plots along Valdeazogues River. Water and sediment samples were physicochemical characterized. For all collected samples, mercury concentration was quantified (water, sediment and plants). Furthermore, plant samples were divided in different fractions in order to study the distribution of mercury along them and accumulation patterns, giving the maximum mercury concentration values in the root system.*



S12.04-P - BIOREMEDIATION OF SOILS AND SEDIMENTS CONTAMINATED WITH ORGANIC CHEMICALS: ASSESSING AND OVERCOMING CHEMICAL AND MICROBIOLOGICAL CONSTRAINTS

Monday 02 July 2012 from 17:00 to 18:30. Room Poster Areas

S12.04-P -1

A COMBINED PHYSICAL AND MICROBIOLOGICAL REMEDIATION CONCEPT FOR VCHC CONTAMINATIONS

Wibke Markgraf, Kiel - Germany

S12.04-P -2

A REAL-SCALE SOIL PHYTOREMEDIATION

Cristina Macci, Pisa - Italy

S12.04-P -3

BIODECONTAMINATION OF SEDIMENTS FROM THE ENDOCRINE DISRUPTORS BISPHENOL A AND 4-NONYLPHENOL BY LIGNINOLYTIC FUNGI

Andreina Traversa, Bari - Italy

S12.04-P -4

EFFECT OF A NON-IONIC SURFACTANT (TWEEN 80) ON THE DESORPTION AND BIOAVAILABILITY OF POLYCYCLIC AROMATIC HYDROCARBONS FROM TWO SOILS FROM A TAR OIL-CONTAMINATED FIELD SITE

Katja Heister, Freising-Weihenstephan - Germany

S12.04-P -5

EFFECT OF REVEGETATION WITH NATIVE PLANTS ON SOILS AND SLUDGES POLLUTED BY HEAVY METALS AND POLYCYCLIC AROMATIC HYDROCARBONS

Paola Adamo, Portici (NA) - Italy

S12.04-P -6

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Katrina Potapova, Riga - Latvia



S12.04-P -1

A COMBINED PHYSICAL AND MICROBIOLOGICAL REMEDIATION CONCEPT FOR VCHC CONTAMINATIONS

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In the past, remediation of volatile chlorinated hydrocarbons (VCHC) contaminated soils was performed under saturated conditions with focus on dissolved compounds in the aquifer. Pump-and-treat as well as reactive walls, or natural attenuation are commonly applied in situ remediation systems. Considering soil as a porous medium, a new approach has been done lately by conducting unsaturated leaching experiments on undisturbed structured soil samples of a Reductosol under laboratory conditions. The investigated organic contaminants include derivatives of ethylene (DNAPL), in detail Tetrachlorethylene (Per), Trichlorethylene (Tri), cis-1,2-Dichlorethylene (Cis), and Vinylchloride (VC) or Chlorethylene. Achieved data is used for modelling alternative remediation concepts, focussing soil physical aspects. It is assumed that vertical structured soil samples lead to a larger volume of eluates, which is correlated to higher VCHC concentrations. The exchangeable pore volume is dependent on the texture, pore size distribution, and bulk density. Microbiological activity, which is highest under anaerobic, methanogenic conditions, is mainly influenced by nutrient solutions and their physicochemical properties (surface tension, viscosity): distilled water, blackstrap molasses, and micro emulsion. In general, aim of this research work is, (i) to demonstrate the pore size effect and the accessibility of bacteria to reactive surfaces, which are contaminated, (ii) to show that an unsaturated pore system needs to be considered, if an optimized remediation of VCHC is intended, which is simulated by unsaturated percolation under laboratory conditions.



S12.04-P -2

A REAL-SCALE SOIL PHYTOREMEDIATION

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*In the present investigation, a phytoremediation process with a combination of different plant species (*Populus nigra* (var.italica), *Paulownia tomentosa* and *Cytisus scoparius*) has been proposed at real-scale to bioremediate and functionally recover a soil historically contaminated by heavy metals and organic contaminants. In the attempts to assess both effectiveness and evolution of the remediation system toward a natural soil ecosystem, besides the pollution parameters, also parameters describing the efficiency of the microbiological components (enzyme activities), were investigated. In three years the total content of hydrocarbons and heavy metals in soil decreased with time (50% and 10-30%, respectively), in particular at surface level. The reduction in pollutants was probably the reason of the increase over the time of the β -glucosidase and phosphatase activity, enzymes related to C and P cycles, respectively. However, this trend was obviously due also to the greater availability of substrates. Dehydrogenase activity, widely used as an indicator of overall microbial activity, showed a great variability among sampling points. Moreover, a phytotest carried out with *Lepidium sativum* and *Raphanus sativus*, showed after three years a significant increase in percentage of plant growth, confirming a reduction in soil toxicity and an improvement in soil nutritional state. At the moment the evaluation of the soil protein pattern (SDS-page), are in progress, in order to identify a correlation between the organic contamination and the soil protein expression. Therefore, this biological system seems very promising to perform both decontamination and to functionally recover a polluted soil also at real-scale level.*



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BIODECONTAMINATION OF SEDIMENTS FROM THE ENDOCRINE DISRUPTORS BISPHENOL A AND 4-NONYLPHENOL BY LIGNINOLYTIC FUNGI

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*Bisphenol A (BPA) and 4-nonyphenol (NP) are two xenoestrogens able to disrupt the normal endocrine activity in animals and humans. BPA is used in the production of epoxy resins and polycarbonates, and as a stabilizer for plastics such as polyvinyl chloride, whereas NP is a component of nonylphenol polyethoxilates which are a group of surfactants. Both compounds can contaminate the environment through the discharge or the application in agriculture of wastewaters, sewage sludges and other polluted matrices. Biodecontamination is a technology that utilizes the metabolic potential of microorganisms to remove pollutants in various environmental systems. The potential of three ligninolytic fungi, *Trametes versicolor*, *Stereum hirsutum* and *Pleurotus ostreatus* to remove BPA and NP both at a concentration of 10 mg L⁻¹ from two Apulian sediments from Sassano Lake (SL) and Morelli River (MR) was evaluated. Sediments were contaminated with BPA and NP, inoculated with each fungus separately, except controls (without fungus), and after 7 days BPA and NP residues were extracted and quantified by HPLC analysis with fluorescence detection. The three fungi were able to remove a highly significant BPA and NP amount from both sediments, with the only exception of BPA by *S. hirsutum* from MR. With respect to BPA and NP disappearance in the corresponding controls, the highest removal in SL sediments was produced by *T. versicolor* with 27% and 20% of BPA and NP, respectively, whereas in MR sediments, *P. ostreatus* resulted the most efficient fungus removing 22% and 35% of BPA and NP, respectively.*



S12.04-P -4

EFFECT OF A NON-IONIC SURFACTANT (TWEEN 80) ON THE DESORPTION AND BIOAVAILABILITY OF POLYCYCLIC AROMATIC HYDROCARBONS FROM TWO SOILS FROM A TAR OIL-CONTAMINATED FIELD SITE

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Due to their hydrophobicity, polycyclic aromatic hydrocarbons (PAHs) are difficult to remove from soils. Therefore, surfactants are used to enhance their mobility. We investigated the effect of Tween 80 on desorption and bioavailability of PAHs in laboratory batch experiments. A clayey and a sandy soil from a contaminated site of a former asphalt production plant in Olst, The Netherlands, were placed in dialysis membranes and brought into contact with either water or a 1% Tween solution. At several time intervals, solution samples were retrieved for analyses of pH, electrical conductivity and PAH concentrations. PAH sorption was significantly stronger in the clayey soil. But irrespective of soil type, desorption was more than 20 times higher in the treatments with Tween compared to the treatments with water, indicating the promoting effect of the surfactant on the solubility of these chemicals. Moreover, the surfactant affected the bioavailability of PAHs. Whereas in the treatments with Tween, PAH concentrations in the liquid phase increased over time, PAH concentrations in the treatments with water decreased again after 7 days, pointing to the degradation of these compounds. In the 1% Tween solution, the critical micelle concentration (cmc) was exceeded 720 times. This high cmc could result in toxic effects on the microorganisms, interactions of the surfactant with bacterial cell walls and/or complete enveloping of the PAHs by Tween molecules. Thus, it is concluded that the presence of a surfactant enhances the mobility of PAHs, but at such high cmc, it hinders simultaneously the bioavailability of the chemicals.



S12.04-P -5

EFFECT OF REVEGETATION WITH NATIVE PLANTS ON SOILS AND SLUDGES POLLUTED BY HEAVY METALS AND POLYCYCLIC AROMATIC HYDROCARBONS

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Phytostabilization with native plants can be an efficient, environmentally appropriate and low cost technology for rehabilitation of degraded areas. In this study, the interaction of organic amendment with spontaneous revegetation was investigated on soils polluted by heavy metals (HMs) and polycyclic aromatic hydrocarbons (PAHs) from the Bagnoli brownfield site (southern Italy), actually under remediation by excavation and soil-washing. Polluted soil and the sludge-fraction separated out during the soil-washing process, were left to revegetate naturally in pots, in presence and in absence of acidic sphagnum peat as organic amendment, inside the ILVA plant and in a surrounding naturally vegetated area. Substrates were analyzed before and after four years of plant growth in order to detect, in the rhizosphere, any vegetation-induced change in the substrate properties and contaminants mobility/bioavailability. 57 plant species grew healthy on the studied substrates. Plant diversity was considerably higher in the naturally vegetated area, showing that nearby environment rather than substrate nature affected revegetation. High levels of As, Pb, Sn and Zn were found in substrates, both of natural and antropogenic origin. Despite acidification and increased organic matter content of substrates following plant growth, mobility and bioavailability of HMs did not change significantly, in virtue of their stable association with geochemical phases of iron oxide nature. It cannot be excluded that further development of vegetation increasing the extent of depletion of metal pools by plant uptake could result in a change of metal distribution in soil. The possibility of using the substrates for profitable no-food crops is discussed.



S12.04-P -6

EFFECTS OF CLAY MINERAL COMPOSITION ON THE WATER AND ORGANIC VAPOUR ADSORPTION OF SOILS

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Knowledge of pressure-saturation (P-S) relationships is essential for simulation the fate and transport of nonaqueous phase liquids (NAPL) in subsurface. Besides the common estimation methods an additional opportunity to predict soils oil retention is to create pedotransfer functions (PTFs). It's a common method in three phase soil systems where water retention data are predicted using the easily measurable soil parameters (e.g. organic matter content, texture, bulk density). To create PTFs for the whole pressure-saturation range, the knowledge of how soil and liquid properties affect the various polarity fluid retention capacity of soil next to different leading forces are required. In our research, NAPL and water vapour adsorption of different soils and a mineral mixture series were determined and adsorption isotherms were fitted. The monolayer capacity of soil samples and mineral mixtures with water and NAPL were determined. The BET-surface of the samples was also measured with nitrogen adsorption. Relationships between the solid phase properties (porosity, rate of the micro and macro pores, clay mineral content and type, etc.) and fluid adsorption were examined by statistical analysis (SPSS 13.0). Our results proved differences in soils NAPL retention caused by clay mineral content and mineral composition, as well as the other soil properties. Acknowledgement The financial and infrastructural support of the State of Hungary and the European Union in the frame of the TÁMOP-4.2.1/B-09/1/KONV-2010-0003 project is gratefully acknowledged.



S12.04-P -7

EFFECTS OF COMPOST ADDITION ON PYRENE REMOVAL FROM SOIL VEGETATED WITH THREE SELECTED PLANT SPECIES

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*Phytoremediation has been recognized as an efficient method for eliminating Polycyclic Aromatic Hydrocarbons (PAHs) but this may be limited by the poor soil organic matter content. The addition of organic amendments to soil is expected to improve the treatment efficiency. A pot experiment was conducted to investigate the effect of a coffee by-products compost on the removal of pyrene, as a model PAH, from both an uncultivated soil and soils cultivated with *Medicago sativa* (M.s), *Brassica napus* (B.n) and *Lolium perenne* (L.p). Results showed that the addition of compost to the uncultivated soil enhanced significantly (by 30%) pyrene dissipation compared to a value of 18% in the control soil. The presence of vegetation also significantly enhanced the dissipation of pyrene by 32, 30 and 28% with M.s, B.n and L.p, respectively. Thus, compost addition did not appear to have a significant effect in improving plants phytoremediation capacity, as pyrene concentration in M.s, B.n and L.p amended with compost decreased by 30%, 32% and 33.5%, respectively. In cultivated pots pyrene was undetectable in both shoots and roots of the three species. Thus, disappearance of pyrene might be ascribed to the action of plants roots that stimulate soil microbial biomass and oxygen transport to the rhizosphere facilitating pyrene degradation, or by the adsorption of pyrene to soil organic matter. On the contrary, in uncultivated pots amended with compost, the increase of microbial diversity and activity was suggested as the main process of pyrene disappearance.*



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FLUORESCENCE QUENCHING METHOD FOR DETERMINING PYRENE PARTITION COEFFICIENT TO DISSOLVED ORGANIC MATTER FROM COMPOST

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The equilibrium constants of association of compounds with high fluorescence efficiencies, such as polycyclic aromatic hydrocarbon (PAH), with dissolved organic matter (DOM) can be measured assuming that PAHs do not fluoresce in aqueous solution if associated with DOM. Thus, the PAHs-DOM fraction may be determined from the fractional decrease in fluorescence intensity (FI) upon addition of DOM. In our study fluorescence quenching method has been applied for determining pyrene partition coefficient to DOM from compost. Aliquots of 25 µl of aqueous solution of pyrene were added to five DOM extracts to reach final concentrations of pyrene and DOM, respectively, of 10 µg L⁻¹ and 5-25 mg L⁻¹. The solutions were thoroughly mixed and fluorescence measured at 369 nm (excitation wavelength 271 nm) after 15 min. Fluorescence measurements in each DOM solution in the absence of pyrene and in pyrene solution in the absence of DOM were also recorded (three replicates). The FI values of pyrene in the presence of DOM and in the absence of DOM were used in the Stern-Volmer equation, obtaining a partition coefficient of 2.08×10^5 (l kg⁻¹). This value indicates a very high affinity of pyrene for DOM molecules, probably because their structure is very rich in hydrophobic cavities and/or pseudo-micelles. These results appear important as an additional property of compost, as a potential means in contaminated soils remediation.



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HEALTH RISK ANALYSIS AT THE 7TH ZONE OF THE ENVIRONMENTAL LIABILITY, "EX REFINERIA 18 DE MARZO" IN MEXICO CITY

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Benzene, a constituent of oil is considered the greatest potential carcinogenic and therefore a dangerous compound. Your risk increases when there are spills that the effect of gravity and high mobility in the subsurface infiltrate reaching the phreatic zone to dissolve and contaminate the water. During vertical migration is adsorbed by soil particles. Time begins to play an important role in the release of contaminant retained mainly by volatilization into the atmosphere. During the release to the atmosphere of benzene vapors begin to interact with wildlife, flora and human beings in various ways to these receptors to enter the period of exposure time and increase the risks to health. We analyzed whether the mass of remaining benzene posed a risk. We analyzed the health risk for the area 7 of the environmental liability "ex - refinery March 18" of Mexico City, where for 20 years were no remediation work until the year 2008, which aims to make the site into a recreational park. The results before remediation shows a health risk by 1.2 to 7.2m depth, by 1.2m $1.6977E-07$ and $1.2549E-05$ to 4.8 m, which coincides with the water table of the aquitard and where it reaches the highest level of risk to health. For after the remediation was obtained $4.0767E-07$ to 1.2 m and $3.8581E-07$ to 4.8 m. The results are to know that the mass of benzene before the remediation exceeds the acceptable risk only to the depth of 4.8 the remediation once applied clearly decreased the risk.



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HYDROCARBONS IN WATER AND SEDIMENTS IN THE PERTUSILLO LAKE, VAL D'AGRI, ITALY

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This paper discusses the preliminary results of pollution analyses of the freshwater Lake Pertusillo, an environmental protected area located in the High Agri Valley (Basilicata, southern Italy), where the largest inland oil field of Europe occurs. Soil and water pollution origin and possible solutions are discussed. The lake, located in a national park but very near the Viggiano Oil Refinery, provides waters for human use to Basilicata and Puglia Italian regions. During 2010 and 2011 the lake suffered serious pollution problems: large fish kills (carps) and red algae infestation occurred, but local authorities denied the pollution of Lake Pertusillo. Environmental associations (EHPA and OIPA) decided to analyze waters and lake sediments in 2010 and 2011, while other measurements of soil pollution in the area are foreseen. The main findings indicate a strong pollution, due to both chemical and microbiological contaminants: the latter due to municipal and domestic wastes finding their way directly into the lake. From the chemical point of view, samples of water and sediment showed significant amounts of hydrocarbons, barium (an heavy metal commonly used by oil industry in drilling muds), aluminum, iron and manganese, plus other metals.



S12.04-P -11

ICE GLACIERS AS RESERVOIRS OF XENOBIOTIC DEGRADING STRAINS WITH POTENTIAL APPLICATION IN SOIL BIOREMEDIATION

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Glaciers are extreme environments that recover and preserve for long times many inorganic and organic materials, including bacteria, moulds, algae, pollen, insects, plants, rock debris and chemical pollutants. In particular, in glaciers close to ski resorts, it is possible to find different pollutants at levels significantly higher than background common levels. Two drilling sampling campaigns were conducted in September 2009 and October 2010 in the Glacier Madaccio in the Orthes mountain group, at 3125 m a.s.l., close to summer ski resorts. The first aim of the campaign was to assess the microbial diversity of these environments: culture dependent and culture independent methods were thus applied to analyse the global diversity and isolate culturable strains. Chemical analyses were also conducted, identifying contamination by PAHs and PCBs at ppb levels. A microtiter method was then applied to screen isolates for their ability to degrade phenanthrene and other organic xenobiotics. On the isolates positive to this screening test, further assessments were carried out at different temperatures. Twelve strains were isolated, belonging to different genera such as Pseudomonas, Rhodopseudomonas, Arthrobacter, Polaromonas, Methylobacterium and Janthinobacterium. Some of those are indeed degrading phenanthrene and other pollutants, in some cases even more efficiently at 4°C compared to 20 and 30°C. This paves the way for their possible application, in pure or mixed cultures, in soil bioremediation at cold conditions, for example in cryic soils contaminated by oil spillages.



S12.04-P -12

LIQUID PERMEABILITY OF SOIL IN AQUEOUS AND NON-AQUEOUS SYSTEMS TREATED WITH A CATIONIC SURFACTANT

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Liquid permeability of soil in aqueous and non-aqueous systems treated with a cationic surfactant
In a case of oil pollution one of the main input parameters of transport models is the organic liquid conductivity of soils. Measuring and/or estimating this soil characteristic is indispensable, it can have significant impacts on the results. Often the organic liquid conductivity of a soil is predicted from the measured hydraulic conductivity with Kozeny-Carman equation. In numerous cases hydraulic conductivity itself is estimated from other soil characters with pedotransfer functions. Surfactants are widely used in pesticides, cleansing products, and they are applied during oil spill remediation as well. The impacts of surfactants on soil characteristics are well investigated, but concerning the common effects of these non-aqueous phase liquids (NAPL) and surfactants there not that much information. In our research we measured the liquid permeability of very heterogeneous soil samples (e. g. different clay minerals content, cationic exchange capacity) in aqueous and non-aqueous systems, as well as their air conductivity. After treating the samples with different concentrations of cationic surfactant solutions, thereby making them hydrophobe, we repeated the liquid permeability and air conductivity measurements. With statistical methods we analysed the applicability of the method, the reproducibility of the measurements, the effects of surfactant treatments on permeability data, as well as the predictability of permeability using easily measurable parameters. Acknowledgement The financial and infrastructural support of the State of Hungary and the European Union in the frame of the TÁMOP-4.2.1/B-09/1/KONV-2010- 0003 project is gratefully acknowledged.



S12.04-P -13

MEASURING OF ARYLESTERASE ACTIVITY IN SOILS, AN ENZYME ACTIVITY INVOLVED IN THE DEGRADATION OF ORGANOPHOSPHORUS PESTICIDES

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The large use of organophosphorus pesticides to control a wide range of insect species, has led to the build up of soil total concentration and the potential transfer to the hydrosphere and humans and impacted the soil functions. Microbial-mediated degradation of organophosphorus pesticides in the environment has been considered the main degradative route of pesticides degradation and detoxification, and several microorganisms capable of degrading organophosphates as well as their catabolic pathways have been described. However, while the importance of hydrolases active during the initial degradation of organophosphorus xenobiotics is widely recognised, there is little information on the whole soil degradative potential towards organophosphorus pesticides, mainly due to the lack of sensitive and reliable specific soil enzyme activity assays. We have set up a method to evaluate the arylesterase activity in soils with various characteristics, as this enzyme activity is involved in the degradation of organophosphates. We determined the main soil factors related to the soil arylesterase activity, particularly the response to soil pollution with organophosphates and trace elements. We observed that the soil arylesterase activity is mainly influenced by the organic matter content and soil management, and also strongly inhibited in trace element contaminated soils. The experimental results and the needs to set up new and specific soil enzyme activity assays for evaluating the response of soil microbial communities to xenobiotic contamination and the evaluation of the remediation measures will be discussed.



S12.04-P -14

MYCELIAL NETWORKS ENHANCE PAH-BIOAVAILABILITY IN WATER UNSATURATED ENVIRONMENTS

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*The high hydrophobicity of polycyclic aromatic hydrocarbons (PAH) and absence of continuous water films are main factors limiting the bacterial PAH-degradation in vadose soil. Hence, an efficient mobilization of PAH would help to overcome these limitations by bringing bacteria and contaminants together and increasing PAH-bioavailability. Recent studies revealed that mycelial networks can provide vectors for PAH-translocation in soil, thus acting as 'pipelines' for contaminants. Here, we analysed whether and to which extend these mycelial networks potentially influence the PAH-bioavailability and -biodegradation in water unsaturated environments. Defined agar model systems were built mimicking the vadose zone and fluorene (FLU) was chosen as model PAH. The filamentous soil oomycete *Pythium ultimum* was used as a fast growing, non-FLU-degrading model organism. The amount of FLU translocated by *P. ultimum* across air interspaces was quantified in the absence and in the presence of pollutant degrading bacteria. In the absence of bacteria, up to 1500 ng were translocated within 96 h. In the presence of bacteria only up to 25 ng were detected indicating that FLU was efficiently degraded by bacteria after translocation. To further confirm FLU-bioavailability, we used the whole-cell bioreporter *Burkholderia sartisoli* RP037-mChe which expresses eGFP in response to the FLU flux to the cell. Cells in model systems colonized by *P. ultimum* revealed a significantly higher eGFP-fluorescence compared to controls indicating the presence of hyphae-derived bioavailable FLU. Hence, we propose that mycelial networks have the potential to increase PAH-bioavailability in soil and may be fostered for effective bioremediation of contaminated sites.*



S12.04-P -15

PESTICIDE INTERFERENCES ON THE MICROBIAL COMMUNITY OF AN ORGANIC BIOFILTER USED IN BIODEPURATION OF CONTAMINATED WATER

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Organic residues are largely available in agricultural farms and due to a relatively high organic carbon content and microbial activity, they can be re-used for soil amelioration and/or for bioremediation purposes. The aim of the study was to assess the possible use of a biomixture constituted of pruning residues and straw as a mean to treat pesticide contaminated water. Azoxystrobin, fludioxonil and penconazole are fungicides widely used in agricultural activity. These fungicides affect differently the microbial metabolism and are moderately/very persistent molecules in soil. In a laboratory experience, the organic biomixture was treated with each fungicide and degradation studies were combined with measures of microbiological and biochemical properties to assess half life of fungicide applied as well as their interferences on the metabolic activity of the microbial community of the bio-mixture. During a 120 days of incubation period, organic biomixture was analyzed for fungicide residues, basal respiration (CO₂ evolved per day) and microbial biomass-C content (MBC). Phospholipid fatty acid (PLFAs) profile of the microbial community was also screened. Fludioxonil and penconazole were the most recalcitrant fungicides to degradation in comparison to azoxystrobin. Penconazole has determined the highest depletion of the biochemical parameters by negatively affecting both basal respiration and MBC. This suggest a higher toxicity of penconazole with respect to azoxystrobin and fludioxonil. Significant changes on the PLFA's profile of the microbial community were evidenced at 30 days of the incubation period with most fungal indicators showing a positive response.



S12.04-P -16

PHENANTHRENE ADSORPTION ONTO HYDROPHOBIC MEMBRANES PROMOTES ITS MINERALIZATION BY SOIL BACTERIA AND LEADS TO THE IDENTIFICATION OF NEW PAH-DEGRADERS

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Polycyclic aromatic hydrocarbons (PAHs) are toxic pollutants that contaminate various ecosystems including soils all around the world. Their hydrophobicity make them poorly bioavailable and persistent in soils. Many PAH-degrading bacteria have been isolated, but little is known about soil microorganisms responsible for PAH removal in situ. Here, stable-isotope probing was used to identify such bacteria at an oil-polluted site in Cameroon. As a means to target soil bacteria able to grow on adsorbed PAHs, ¹³C-phenanthrene was coated onto hydrophobic membranes then incubated in soil microcosms. GC/MS monitoring of mineralization rates showed that it was faster in microcosms containing phenanthrene-coated membranes than in those containing spiked soil. After a 7-day incubation period, DNA was extracted from the biofilm that formed on membranes, then subjected to isopycnic centrifugation to isolate ¹³C-labeled DNA. From this fraction, 16S rRNA genes have been PCR amplified and sequenced to identify relevant bacterial taxa likely involved in the degradation of adsorbed PAHs. Main bacterial taxa responsible for removal of adsorbed phenanthrene in tropical soil will be compared to phenanthrene degraders identified by a similar approach in temperate soil.



S12.04-P -17

PHRAGMITES AUSTRALIS (CAV.) TRIN. IN PHYTOREMEDIATION OF HEAVY METAL CONTAMINATED WATER AND SEDIMENTS IN THE SARNO RIVER, ITALY

Bartoli Giovanni^[1], Papa Stefania^{*[1]}, Vitale Alfredo^[1], Fioretto Antonietta^[1]

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A phytoremediation study was carried out on Sarno river (Campania region), that is one of the most polluted river in Italy because of many important tannery and skins factories located along its course and large dumping of untreated agricultural and industrial waste. In aquatic systems, where pollutant inputs are discontinuous and pollutants are quickly diluted, analyses of plant components provide time-integrated information about the quality of the system. Phytoremediation has several advantages and is the most significant one in study of sub-lethal levels of bioaccumulated contaminants within the tissues/components of organisms, which indicate the net amount of pollutants integrated over time. Biomonitoring of pollutants using some plants as accumulator species, accumulate relatively large amounts of certain pollutants, even from much diluted solutions without obvious noxious effects. In this way, the study focused on assessment of heavy metal accumulation in the Phragmites australis (Cav.) Trin., an aquatic macrophyte used as biomonitors, in comparison with water and sediments (abiotic monitors) for phytoremediation. Roots, stems and leaves of this native aquatic plant (biomonitor) along with surface sediments and water, were analyzed, in five sites between the source and delta of Sarno river, for As, Cd, Cr, Cu, Ni, Hg, Pb, V, Zn and Fe contamination. The bioconcentration factor (BCF) of trace metals analysed between different organs and sediments and "Pollution Load Index" (PLI) for each site, were calculated. The data obtained were, also, analyzed with reference to Interim Sediment Quality Guidelines.



S12.04-P -18

PHYTOREMEDIATION OF XENOBIOTICS: AN IN SILICO APPROACH TO STUDY THE GLUTATHIONE S-TRANSFERASE SUPERFAMILY IN SELECTED PLANTS

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The use of plants to reclaim contaminated soils and groundwater, known as phytoremediation, is a promising biotechnological strategy which has gained a lot of attention in the last few years. Plants have evolved sophisticated detoxification systems against the toxic chemicals: following uptake, the compounds are activated so that certain functional groups can conjugate hydrophilic molecules, such as thiols. The resulting conjugates are recognized by the tonoplast transporters and sequestered into the vacuoles. The xenobiotic conjugation with glutathione is mediated by enzymes which belong to the superfamily of glutathione S-transferases (GSTs) catalyzing the nucleophilic attack of the sulphur of glutathione on the electrophilic groups of the cytotoxic substrates therefore playing a crucial role in their degradation. Although a number of plant species are able to accumulate high amounts of heavy metals or to degrade various soil pollutants, their remedial ability can be sharply increased by genetic manipulation. GSTs might represent candidate genes for the development of such transgenic systems involved in pollutants degradation. In the present work we analyzed the comprehensive expression profile of the GSTs in some selected plants such as Brassica species, sweet orange and tobacco by using bioinformatics tools. The protein sequences of the expressed GSTs have been retrieved from UNIGENE, classified and then analyzed in order to assess the evolutionary trend and to predict secondary structure. This approach provides the knowledge of the relationship between gene expression and presence of conserved motifs in the view of future selection of detoxifying GSTs for the genetic transformation studies.



S12.04-P -19

POTENTIAL OF RYGRASS TO REMOVE ENDOCRINE DISRUPTOR COMPOUNDS FROM AQUEOUS SYSTEMS

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Phytoremediation is a promising eco-compatible technique which uses plants to uptake, transform or stabilize pollutants present in sediments, soils and waters. The phytoremediation process can be modulated by organic fractions such as natural organic matter (NOM). On these bases, the aim of this work was to investigate the ability of germinating seeds of ryegrass (*Lolium perenne*) to remove bisphenol A (BPA), linuron (LIN) and 17 α -ethynylestradiol (EE2) from different aqueous systems: (i) bidistilled water (control); (ii) aqueous solution of Suwanne River NOM obtained by the International Humic Substances Society (IHSS) at a concentration of 20 mg L⁻¹; and (iii) two freshwaters collected in Puglia (Italy) from Sassano Lake and Morelli River. The amount of BPA, LIN and EE2 in the medium was determined by high performance liquid chromatography (HPLC) using a diode array detector (DAD) at 210 nm wavelength. Data showed that ryegrass removed 52% of BPA, 4% of LIN and 34% of EE2 from water, 42% of BPA, 1% of LIN and 22% of EE2 from NOM solution, 56% of BPA, 6% of LIN and 48% of EE2 from Sassano Lake water, and 35% of BPA, less than 1% of LIN and 23% of EE2 from Morelli River water. Results obtained suggest that ryegrass is capable to remove more BPA than LIN and EE2 in all media under the conditions studied, and also a lower removal of each compound in the presence of NOM and in the more salted water from Morelli River.



S12.04-P -20

PYOVERDINE INTERACTIONS WITH TRACE ELEMENTS IN SEDIMENT: WHICH PROSPECTS FOR SIDEROPHORE-ASSISTED PHYTOREMEDIATION?

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*Phytoextraction takes time as a result of the low solubility of trace elements in environmental matrices. Improvement can be expected by means of soil bioaugmentation with siderophore-producing micro-organisms. Indeed, siderophores are high-affinity iron chelating compounds secreted by micro-organisms in response to iron limitation in their environment. Since they chelate other metals than iron, siderophores are expected to promote the mobilization and the phytoextraction of trace elements in environmental matrices. Our study aimed at assessing how the mobility and the phytoavailability of two trace elements (Cu and Cd) in sediment were altered by the addition of pyoverdine (Pvd), a common bacterial siderophore. Physico-chemical and spectroscopic investigations were carried out to determine the coordination properties of Pvd towards Fe(III), Cu(II) and Cd(II). The impact of Pvd addition was assessed in a calcareous sediment through the extractability (CaCl₂ 0.005 M), the resupply from the solid phase (DGT technique) and the phytoextraction of trace elements. This study underlined that at pH 7.4 pyoverdine is a powerful chelator for Fe(III) (pM= 26.7) and Cu(II) (pM= 16.0) which competes with exogenous ligands such as EDTA. By contrast, Pvd poorly binds Cd(II) (pM= 6.6). As a result, Pvd addition (250 nmoles g⁻¹ sediment) increased both the extractability of Cu (18-times increase) and the flux of Cu resupply (up to 7 times for shorter exposure) but did not affect those of Cd. Assessing the impact of Pvd addition on trace elements phytoextraction by graminaceous (*Festuca arundinacea*) and non-graminaceous (*Lycopersicon esculentum*) species will provide new insights on siderophore-assisted phytoremediation.*



S12.04-P -21

SOIL IMPROVEMENT BY APPLICATION OF CLINOPTILOLITE IN AN OLIVE OIL MILL WASTE DISPOSAL AREA

Doula Maria^[1], Kavvadias Viktor^[1], Theocharopoulos Sid*^[1], Elaiopoulos Kyriakos^[1]

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In the framework of the LIFE+ project “Strategies to improve and protect soil quality from the disposal of olive oil mills wastes in the Mediterranean-PROSODOL”, clinoptilolite from Greece was used as soil amendment in order to investigate the effectiveness of the material in protecting and improving the quality of soils that accept surface disposal of large Olive Oil Mills Wastes (OOMW) amounts as well as to limit nutrients leaching from degraded soils. For this, clinoptilolite of different particle size (0.0-0.8mm and 0.8-2.5mm) was added to soil at different amounts. The application took place in November 2010 in a pilot area in the island of Crete, South Greece, where untreated OOMW are disposed in evaporation ponds and directly on soil for more than 12 years. Due to the uncontrolled OOMW soil disposal the soil chemical parameters i.e. K, Fe, P, Cu, polyphenols, etc were notably high, and concentrations higher than the recommended phytotoxicity levels were measured. The results obtained until now indicate that the addition of clinoptilolite succeeded to decrease the excess leaching of many inorganic waste’s constituents, such as K, Fe, Cu, etc while at the same time the available concentrations of these constituents were increased. This behavior is typical for natural zeolites and especially clinoptilolite, which are capable to retain large amounts of inorganic constituents and mainly cations, and hold them in their structure.



S12.04-P -22

SOIL INOCULATION WITH SPECIFIC MICROBIAL COMMUNITIES ATTACHED ON CARRIER MATERIAL - CAN THIS BECOME A USEFUL TOOL IN SOIL REMEDIATION?

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Different types of agricultural soils were loaded with ¹⁴C-labelled model chemicals, and subsequently different microbial communities as well as isolated strains were inoculated to enhance the mineralization of such chemicals. Inocula are unknown microbial communities extracted from soils with high degradation capacity. Inocula were introduced in soils by different approaches: (i) soil inocula, (ii) application of isolated strain as well as microbial community via liquid media, (iii) isolated strain as well as microbial community attached to a carrier material. Most of the inoculation experiments were conducted in laboratory but one of these approaches was also tested under real environmental conditions in lysimeters. The inoculation of soils with microbial communities attached on a specific carrier material showed the highest mineralization effectiveness and also the highest sustainability. Microbes attached on these carrier particles preserved their function over a long time period even if the specific microbial substrate was already degraded or at least not detectable any more. Results on isoproturon and 1,2,4-trichlorobenzene as well as the corresponding chemicals` degrading microbial communities and isolated strains will be presented.



S12.04-P -23

SOIL MICROSTRUCTURE AND ADDED ORGANIC MATTER: KEYS FOR CHLORDECON SEQUESTRATION

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The former application of chlordane, a persistent organochlorine pesticide used in French West Indies until 1993, results today in a diffuse pollution in agricultural soils, which are sources of contamination for cultivated roots, tubers, vegetables, terrestrial and marine ecosystems. Chlordane is a very tough and stable molecule, mainly present in solid phase and having a strong affinity with organic matters. To prevent consumers and ecosystems exposure, it is thus necessary to evaluate the factors that influence chlordane migration in the environment. In previous studies, we showed that andosols (containing amorphous clays), even being more polluted than other kind of volcanic soils like nitisols or ferralsols, are surprisingly less contaminant for percolating water and crops. In this research, we study the impacts of clay microstructure of andosols on chlordane retention. We show that allophane aggregates had a greater ability to trap chlordane mainly due to their fractal structure. Their peculiar clay microstructure is thus an important characteristic governing the fate of chlordane. The allophane tortuous structure and the associated low accessibility could explain the low lability of chlordane confined in andosols. Thanks to the microstructure knowledge of the volcanic soils and the large affinity of chlordane for organic matter we modify the soil to crop and soil to water transfer by the addition of organic matter. We show that compost addition modifies the fractal structure of allophane clays favouring the chlordane retention. These results allow us to propose a new strategy in opposition to the complete soil decontamination: chlordane sequestration.



S12.04-P -24

SOILS CONTAMINATED WITH PAH: A LONG TERM NATURAL ATTENUATION ASSESSMENT

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^[1]UdL/INRA ~ Laboratoire Sols et Environnement ~ Vandoeuvre-les-Nancy ~ France ^[2]UdL/CNRS ~ Laboratoire des Interactions Ecotoxicologie, Biodiversité, Ecosystèmes ~ Metz ~ France

Currently the demonstration of the presence of sites contaminated by organic compounds, and the importance of decontamination needs no introduction. Indeed, human activity is generating more and more contaminated soils and polycyclic aromatic hydrocarbons (PAH) are amongst the contaminants most frequently encountered. Although natural attenuation is often depreciated by people because associated with inaction of contaminated land owners, it might represent a valuable alternative to classical treatments such as physico-chemical treatments. Indeed, this technic aims at reducing the concentration of pollutants while minimizing human intervention and therefore costs. A misunderstanding of this method and a small amount of data available does not encourage its development in France. This present work proposes the results obtained during a long-term natural attenuation assessment in real climatic conditions. This study was performed on seventy-two off ground plots filled with contaminated soils from different former industrial sites (coking industry, manufactured gas plants) whose initial concentration of PAH varies between 380 and 2077 mg/kg. The impact diagnosis was made on this device after ten years under natural attenuation. This diagnosis included leached water analysis, soil PAHs concentrations, as well as evaluation of vegetation cover quality and quantity.



S12.04-P -25

TECHNOSOLS TO RECLAIM INDUSTRIAL WASTELANDS: DEPTH DISTRIBUTION OF ABUNDANCE AND ACTIVITY OF N-CYCLING MICROBIAL COMMUNITIES.

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Construction of Technosols through assemblage of treated soil and recycled wastes is an innovative option for the restoration of degraded lands and re-use of industrial wastes. Recent studies have evidenced that Technosols could support soil functions such as primary production but the knowledge about other ecosystemic services, such as nutrient cycling, is limited. In this work, we investigated the abundance and the activity of microbial communities involved in N-cycling in different horizons (0–15, 15–35, 35–70 cm) of two types of Technosols constructed to reclaim an industrial wasteland. The estimation by real-time PCR of the abundances of the different microbial guilds indicated a significant depth effect in both Technosols on the abundances of the total bacterial and crenarchaeal community and of the ammonia-oxidizing and denitrifying communities. Activity measurements revealed higher denitrification than nitrification rates, which were also affected by Technosol depth. Potential denitrification and nitrification were correlated with Technosol physicochemical properties but also with the abundances of the nirS denitrification gene and bacterial amoA gene, respectively. The type of Technosols influenced both the abundance and the activity of the denitrifier community but not the ammonia-oxidizers, which underlines the importance of a better understanding of microbial communities in Technosols to maximize their potential for fulfilling soil ecosystemic functions.



S12.04-P -26

THE QUANTITY OF MICROORGANISMS IN OIL POLLUTION OF THE GRAY-BROWN SOIL OF AZERBAIJAN.

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The vegetation experiments carried out with raw oil (2009-2011) in the clover growing soil, depending on its granulometric composition the total compound of microorganisms breaking down common microorganisms and carbohydrogens were polluted and studied in the artificially contaminated soil. The analysis carried out during the experiments have identified the fact that in comparison with the unpolluted clayey and sandy soil the quantity of microorganisms breaking down common microorganisms and carbohydrogens decreases as filthiness in the oil contaminated soil rises. Thus, the total number of microorganisms in 1 ml of pure clayey soil is 3 mln., while the number of microorganism polluting carbohydrogens is up to 10000. The total number of microorganisms in the low level (0,5 percent) contamination is 2200000, in the 4 % contamination it is up to 900000, while in the highly contaminated soil (8,0 percent) the number is up to 400000. While the number of microorganisms breaking down carbohydrogens is accordingly 10000, 3000 in the 4 % contamination, and up to 2000 in the 8 percent contamination. As the level of contamination in the sandy soil rises, the number of microorganisms breaking up common microorganisms and carbohydrogens decreases twice.



S12.04-P -27

TOLERANCE STRATEGIES AGAINST SOME HEAVY METALS IN FOUR ORNAMENTAL PLANT SPECIES GROWING ON ZINC-MINE TAILING SOIL

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Abstract: Heavy metal pollution from mining activities is one of the current most troublesome environmental problems due agricultural purposes. Metal extraction and enrichment process, produce large amount of wastes and tailings in this area, leading to limitation of plants growth. In this study, we screened ornamental plants of different species in green-space growing on contaminated soil of a large size Zinc-mine. Zinc content in soil was about 3.8 folds of respective permissible limit for plant growth. However, they did not reveal any signs of metal toxicity, consequently they were tolerant. Analysis showed two different strategies in theses species against metal toxicity. Hypericum perforatum, Chaenomeles japonica, Spiraea arguta, accumulated Zn within their leaves particularly in their vacuoles and their floweres antocianin and flavonoides contents did not differe considerably in comparision with control. Among these species, Hypericum perforatum was at top of list of metal accumulators. Zn accumulator plants developed tolerance by vacuole storage of free Zinc, significant elevation in antioxidant enzyme activities, induction in phytochelatins synthesis to restict metal toxicity within their tissues. They also increased organic acids secretion into the siol to immobilize free Zn around roots. On the other hand, Intermedia forsythia species exhibited exclusion of Zn as a rare tolerance mechanism to limit metal absorption. Based on the mass of leaves in annual growth period and Zn accumulation within them, Alestromelia was the main species for remediation porpose of Zn-contaminated soils with lowest Zn toxicity damage parameters. Key words: Zinc toxicity, metal accumulation, ornamental plants, tolerance mechanism.



S12.04-P -28

TROPICAL PEAT SAMPLES: AN ALTERNATIVE SORBENT OF ENDOCRINE DISRUPTOR COMPOUNDS

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Endocrine Disruptor Compounds (EDC) is considering an emergent and dangerous class of contaminants in aquatic systems. They are found at high concentrations in natural waters and the actual wastewater treatment plants can't remove them. On these bases, new low-cost technologies have been studied aiming at improving the removal of these compounds in aquatic environments. Peat due to their high content of organic matter, have been considered a promissory sorbent for removal of both inorganic and organic compounds. Then, the aim of this work was to investigate the ability of tropical peat samples to remove bisphenol A (BPA), estrone (E1), 17 β -estradiol (E2) and 17 α -ethynylestradiol (EE2) from aqueous systems under different conditions. The amount of EDC was determined by gas chromatography - mass spectrometry (GC/MS). Data showed that for all EDC the higher removal was found at pH 6.0. All kinetics experiments have a good fit of pseudo second order kinetics model, with correlation coefficients greater than 0.99. Data showed also a removal of 77% of EE2, 67% of E2, 63% of BPA and 59% of E1 under the conditions studied. These results demonstrate that peat can be a potential sorbent for removal of EDC from the aquatic systems.



S12.04-P -29

**USE OF A MICROBIAL CONSORTIUM FROM A CONTAMINATED SITE ON THE
DEGRADATION OF FUEL OIL**

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^[1]Instituto Superior Técnico ~ Centre for Biological and Chemical Engineering, Dept. of Bioengineering ~ Lisbon ~ Portugal

*Leakage from oil storage tanks at petroleum filling stations and refineries usually enriches the soil microbial community with potential petroleum hydrocarbon (PHCs) degraders. Soil microcosm studies using microbes collected from such sites provide practical tests for in situ bioremediation of oil contaminants. In the present study, microorganisms were screened in soil samples from a site contaminated with petroleum (Petrogal's oil refinery, Sines, Portugal) using enrichment cultures. Three microbial strains were isolated from the soil samples. Two of the strains isolated were identified as *Pseudomonas putida* and *Enterobacter cloacae* using the Sherlock microbial identification system (MIDI Inc., USA). So far, a third degrader remains unidentified (U). This microbial consortium was found able to degrade several PHC compounds e.g. benzene, toluene, ethylbenzene and xylene (BTEX). The strain(s) were subsequently used to inoculate soil microcosms to study the effect of bioaugmentation and biostimulation on degradation of fuel oil. The microcosm experiments covered a three months period, during which microbial growth and substrate consumption rate were monitored. The array of tests used for soil microcosms included: i) bioaugmentation using single strain (BA1: *P. putida*, BA2: *E. cloacae* & BA3: U) and co-culture of strains (BA4); ii) bioaugmentation and biostimulation (BAS1, 2 and 3 with single strains and BAS4 with co-culture) using a nitrogen and a phosphorus source at previously optimized concentrations; iii) control soil without any microbial or chemical additions (B0). A remediation strategy is proposed based on the obtained results.*



S12.04-P -30

VIABILITY OF BACTERIA IMMOBILIZED ONTO CERAMIC BEADS IN SOIL CONTAMINATED BY NITROAROMATICS

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*The coupling of bioaugmentation with phytoremediation has emerged as a promising remediation technology. The use of immobilized cells has been investigated as an alternate technology for environmental applications. The aim of this study was to evaluate the viability of AM-06 consortium immobilized onto ceramic beads in 2-year pilot scale experiment with soil contaminated by nitroaromatics. The impact of pollution, local microflora, rye *Secale cereale*, as well as climatic conditions (July 2010 – September 2011) on the viability of consortium was assessed. Two variants of 72h long immobilization procedure were compared, i.e., (i) ceramic beads were soaked in 48h old culture liquid with cell concentration 8.4×10^8 cfu/ml, (ii) ceramic beads were incubated in a growing bacteria culture (initial concentration 1.1×10^6 cfu/ml), (iii) ceramic beads were incubated in sterile water. After immobilization procedure, ceramic beads were dehydrated at 28 °C for 48h. Comparative evaluation of microbial enzymatic activity (fluoresceine diacetate (FDA) hydrolysis activity, dehydrogenase and urease activity) showed that FDA hydrolysis activity was the most appropriate criterion for assessing the activity of microorganisms under tested conditions. Viability of AM-06 consortium immobilized onto ceramic beads after incubation in soil within the period of July 2010 – September 2011 was demonstrated. Rye *S. cereale* contributed to increasing the microorganisms activity in soil. Further experiments will be focused on the optimization of the use of ceramic beads in soil bioremediation technologies.*



S12.05-P - SPECIATION AND LOSSES OF PHOSPHORUS AND METALS FROM SOILS AND MITIGATION MEASURES

Friday 06 July 2012 from 17:00 to 18:30. Room Poster Areas

S12.05-P -1

ENVIRONMENTAL RISK ASSESSMENT OF NANOMATERIALS: INTERDISCIPLINARY METHOD DEVELOPMENT

Enzo Lombi, Adelaide - Australia

S12.05-P -2

FIELD-FLOW FRACTIONATION TO ASSESS COLLOIDAL COPPER FORMS IN VINEYARD SOIL WATERS

Hind El Hadri, Pau - France

S12.05-P -3

MOBILITY OF SILVER AND SILVER NANOPARTICLES IN SOILS

Martin Hoppe, Hannover - Germany

S12.05-P -4

PHOSPHATE-BEARING FE(III) PRECIPITATES FORMING BY FE(II) OXIDATION IN WATER

Andreas Voegelin, Duebendorf - Switzerland

S12.05-P -5

APPLICATION OF THE PHOSPHOROUS LEACHING MODEL PLEASE AT THE REGIONAL SCALE

Caroline Van Der Salm, Wageningen - Netherlands

S12.05-P -6

ASSESSMENT OF PHOSPHORUS (P) LEACHING LOSSES FROM A LONG-TERM MANURED SANDY SOIL

Jian Liu, Uppsala - Sweden

S12.05-P -7

CARBONATION AGEING OF EAF SLAG: IMPLICATIONS FOR LEACHING BEHAVIOUR

Gorka Gallastegui, Bilbao - Spain



S12.05-P -8

*COLLOID-FACILITATED TRANSPORT OF PHOSPHORUS THROUGH SOIL COLUMNS:
INFLUENCE OF SOIL TEXTURE AND CROPPING SYSTEM.*

Mohsen Morshedizad, Hamadan - Iran, Islamic Republic of

S12.05-P -9

*COMPARISON OF EXTRACTION METHODS FOR PHOSPHORUS (P) AND ITS MAJOR
BINDING COMPONENTS (FE, AL) IN NON-CALCAREOUS SOILS AND SEDIMENTS*

Jan Jirí, Ceske Budejovice - Czech Republic

S12.05-P -10

*COMPETITIVE AND SYNERGISTIC EFFECTS IN PH DEPENDENT PHOSPHATE ADSORPTION
IN SOILS: LCD MODELING*

Liping Weng, Wageningen - Netherlands

S12.05-P -11

*EFFICACY OF PHOSPHORUS BINDING MATERIALS IN REDUCING DISSOLVED
PHOSPHORUS LOSSES IN SURFACE RUNOFF FROM GRASSLANDS*

Mari Rätty, Maaninka - Finland

S12.05-P -12

GROUNDWATER-P CONCENTRATIONS BENEATH DUTCH AGRICULTURAL SOILS

Mostafa Emadi, Wageningen - Netherlands

S12.05-P -13

IRRIGATION PRACTICE AFFECTS SOIL PHOSPHORUS AVAILABILITY

Jim Ippolito, Kimberly, ID - United States

S12.05-P -14

*IS A ZERO P-INPUT COMPATIBLE WITH A SUSTAINABLE AGRICULTURE? LONG-TERM
FIELD EXPERIMENTS IN LOAMY SOILS*

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THE INFLUENCE OF ECO-TOURISM AND FARMING PRACTICES ON THE QUALITY OF EAST MEDITERRANEAN ALTERED WETLAND SOILS AND WATERWAYS

Iggy Litaor, Kyriat Shemona - Israel



S12.05-P -1

ENVIRONMENTAL RISK ASSESSMENT OF NANOMATERIALS: INTERDISCIPLINARY METHOD DEVELOPMENT

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Over the past decade, rapid innovation and commercialisation in the field of nanotechnology has ensured continuous growth in this sector. As a result, an increasing number of manufactured nanomaterials have been incorporated into products and manufacturing processes. This growth has been met with an equivalent increase in concern regarding the safety of manufactured nanoparticles with respect to human and environmental health. In response to this increasing cause for concern, the scientific community has begun investigating the environmental consequences of nanotechnologies. Yet despite efforts on the part of ecotoxicologists, risk assessment of both existing and emerging nanotechnology lags significantly behind commercial developments. This knowledge gap is an issue not only in terms of environmental legislation but also for the sustainability of the industry as public perception plays an important role in the acceptance of new technologies. The growing divergence between risk assessment and commercialisation is underlain by two key factors. Firstly, significant methodological and analytical challenges hinder the meaningful study of nanoparticles in complex environmental media; and secondly, insufficient interdisciplinary collaboration between nanotechnologists and environmental scientists has stymied environmental research in this field. The main aim of this research is to close the gap between innovation in nanotechnology and environmental nanoscience by: a) Designing and producing commercially relevant nanoparticles optimised for environmental risk assessment; b) Developing new methodologies based on isotopic techniques and in situ advanced spectroscopy



S12.05-P -2

FIELD-FLOW FRACTIONATION TO ASSESS COLLOIDAL COPPER FORMS IN VINEYARD SOIL WATERS

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To fight against downy mildew (a plant pathogenic fungus), a copper based-fungicide has been systematically used. This treatment has led to increase the total copper concentration in soil due to its strong immobilisation by soil constituents. However, copper is also susceptible to be transferred to soil solutions and surface waters notably by colloidal transport. Indeed, the colloidal fraction is recognised as playing a key role in biogeochemical cycles of the trace elements (McCarthy, 1989). Particularly, they contribute to the copper diffuse pollution, which presents a risk for water quality and aquatic organisms. Consequently, the characterization of colloidal phase in natural systems represents an important analytical challenge regarding the variety in shape, size and dispersion mechanism of nanoparticles originating from soils. The aim of this study was to characterize colloidal fraction in drain waters sampled in a wine-growing soil and determine the copper distribution on these colloids by hyphenating on-line fractionation with an Asymmetrical Flow Field fractionation (As-FI-FFF) to several complementary detectors like Ultra-violet (UV), light scattering (LS) and atomic mass spectrometry. The results obtained confirm the relevance of such investigation strategy to better understand the copper fate. Indeed, the colloidal phase shows several populations with different nature and size, copper being linked to the more organic fraction. J.F. McCarthy, J.M. Zachara, Subsurface transport of contaminants, Environ. Sci. Technol, 23, 5, 1989



S12.05-P -3

MOBILITY OF SILVER AND SILVER NANOPARTICLES IN SOILS

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The use of silver nanoparticles (AgNP) has increased significantly over the past decade. The pathway of wastewater combines AgNP from different sources, e.g. clothes. High quantities of the redundant AgNP are removed from wastewater into sludges, which can become incorporated into soil upon sludge amendment. We hypothesise that positively charged silver ions (Ag⁺ (aq)) are retained in soils by adsorption processes similar to other trace metals, whereas AgNP, stabilised with nonionic tenside, show different retention mechanisms. For investigating Ag⁺-mobility in soils, batch sorption experiments were conducted at a soil to solution ratio of 1:5 kg L⁻¹. Thirty German top- and subsoils of varying pedogenic properties were treated with different concentrations of Ag⁺ and AgNP, respectively. The retention of Ag⁺ (aq) in the soils could be described by the Freundlich equation. Topsoil A horizons exhibited higher K_f-values compared to subsoil B or C horizons due to their larger organic matter contents. In contrast, the retention of AgNP was best described by a linear distribution coefficient (K_d). At equilibrium, the solution concentration of Ag was much higher compared to the experiments with Ag⁺ (aq) indicating a significantly enhanced mobility of the AgNP compared to Ag⁺ (aq) in the soils under investigation. We conclude that the mobility of the AgNP is mainly controlled by the associated anionic stabiliser, which impairs the sorption of AgNP to the soils. We presume, by reason of linear distribution coefficient, that there are no specific sorption sites for the AgNP used.



S12.05-P -4

PHOSPHATE-BEARING Fe(III) PRECIPITATES FORMING BY Fe(II) OXIDATION IN WATER

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The oxidation of Fe(II) in water leads to the precipitation of nanoparticulate Fe(III)-phases. In terrestrial and aquatic systems, such precipitates may either act as immobilizing sorbents or as colloidal carriers for contaminants and nutrients, depending on their tendency to grow and aggregate to settling particles. We recently showed that amorphous Fe(III)-phosphate with a molar phosphate (P) to Fe ratio of ~0.5 is the first precipitate that forms during Fe(II) oxidation in the presence of dissolved P (at pH 7). At initial dissolved P/Fe ratios below 0.5, initial Fe(III)-phosphate formation is followed by the formation of amorphous to poorly crystalline Fe(III)-(hydr)oxides (depending on the silicate(Si)/Fe ratio in solution). Amorphous Fe(III)-phosphates may also incorporate substantial amounts of Ca via covalent bonding to phosphate or electrostatic attraction to negatively charged P-coordinated Fe(III) oligomers. Electron microscopy data showed that the different amorphous to poorly-crystalline Fe(III)-phases mix in spherical nanoparticles whose size and tendency to coagulate decreases with increasing initial (Si+P)/Fe ratio and decreasing ionic strength. Dissolved species like P, Si, and Ca thus control the colloidal stability as well as the structure of Fe(II) oxidation products. Precipitates with different structure may also vary with respect to their transformation over time and their dissolution kinetics, with important implications for co-transformed trace elements and phosphate in soils.



S12.05-P -5

APPLICATION OF THE PHOSPHOROUS LEACHING MODEL PLEASE AT THE REGIONAL SCALE

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*High soil phosphorus (P) contents in agricultural soils in the Netherlands cause excessive losses of phosphorus to surface waters. Current national manure policies are insufficient to reach water quality standards set by the European Water Framework Directive in many catchments by 2015. Accordingly, additional measures have to be considered at the regional scale to further reduce phosphorous loadings to surface waters. For a cost effective implementation of these measures an instrument to identify critical source areas for phosphorus leaching is indispensable. The identification of critical source areas requires simulations at a high spatial resolution (field scale or smaller). For this reason, a simple model was developed (PLEASE: van der Salm et al., 2011; Schoumans et al., subm.) to calculate phosphorous leaching, in flat areas with shallow groundwater, to surface waters using readily available information like depth of the groundwater table, precipitation surplus, phosphorous status and phosphorus adsorption capacity of the soil. The model was applied to four contrasting catchments. In each catchment 70 sites have been sampled to obtain input data on phosphate binding capacity and P status of the soils. To calculate the P discharge from the catchments the soil input data were interpolated to 25*25 m grids, and P leaching was modeled for each grid. For one of the catchments the impact of different measures to reduce P losses (mining and drainage) has been examined.*



S12.05-P -6

ASSESSMENT OF PHOSPHORUS (P) LEACHING LOSSES FROM A LONG-TERM MANURED SANDY SOIL

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Long-term repeated applications of animal manure at high rates contribute to build-up of soil phosphorus (P) status, which poses a risk of P losses by leaching. However, soil characteristics such as P sorption capacity and degree of P saturation can greatly affect P leaching in certain circumstances. Phosphorus leaching was studied in a long-term experimental field with a sandy soil in southwest Sweden. Field measurements, model simulations, and laboratory lysimeters, were used to assess the risk of P leaching associated with pig slurry applications. The field plots received different P applications resulting in average annual P surpluses of 11-24 kg ha⁻¹ during 1983-2009. Mean annual total-P leaching and total-P concentration measured at a drain depth of 90 cm were in general low, ranging respectively from 0.14 kg ha⁻¹ and 0.06 mg L⁻¹ at the high rate of slurry application to 0.20 kg ha⁻¹ and 0.08 mg L⁻¹ in the mineral P treatment. The simulations with the ICECREAM model confirmed that the abundant P sorption capacity due to considerable Fe, Al, and Ca present in the soil overshadowed the effects of soil P status and fertilization. Laboratory lysimeter studies showed high potential of P leaching from the top-soil due to long-term pig slurry applications even long before the field experiment started. The conclusion is that P sorption capacity of the sub-soil should also be considered, besides soil P status and fertilization, when identifying hotspots and designing P mitigation strategies.



S12.05-P -7

CARBONATION AGEING OF EAF SLAG: IMPLICATIONS FOR LEACHING BEHAVIOUR

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The steel industry generates large amounts of solid waste by-products. Electric arc furnace (EAF) black slag is the major by-product in steelmaking using EAF technology (90% of total slag production). Nearly 900 000 tons of EAF slag are generated each year in the Basque Country (Spain), accounting for 75% of Spain's total output. Recent studies have shown that when in direct contact with soil and atmospheric agents slag may be a source of environmental pollution on a timescale extending over decades. This study focuses on the environmental implications of using EAF black slag for building forest roads. The accurate prediction of the environmental impact in open-air road works remains a serious concern as long-term exposure to weathering factors might have a variable impact on the leaching behaviour of the waste material, and thus pose an environmental threat. Among the different weathering factors (CO₂, moisture, temperature, wetting and drying cycles...), carbonation is expected to have the highest impact. The carbonation ageing process of freshly produced EAF black slag was studied in a laboratory experiment. This slag was ground and sieved to a particle size smaller than 80 μm and exposed to CO₂ in a water-saturated climatic chamber. A leaching test was carried out on the fresh slag, on the lab-carbonated fresh slag and on a naturally carbonated slag used in a 15-year-old forest road. The leaching properties of these samples were assessed in order to predict the environmental impact of aged slag on soil.



S12.05-P -8

**COLLOID-FACILITATED TRANSPORT OF PHOSPHORUS THROUGH SOIL COLUMNS:
INFLUENCE OF SOIL TEXTURE AND CROPPING SYSTEM.**

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Quantification of colloids transport through soils is of great importance for estimating the potential risk of adsorbing phosphorus leaching into water resources. In this research leaching experiments carried-out through intact soil columns under 0 kPa suction using a 20-cm diameter disk infiltrometer. Soil columns collected from watersheds surrounding Zarivar Lake (Kordestan west of Iran) representing two structured clay loam (CL) and loam (L) which had been cropped with either wheat or alfalfa for 20 years. The steady state flow condition established using tap water prior to performing a pulse of (300 mg L⁻¹ of natural colloid) solution on the columns. Colloids, total P, total dissolved P, total reactive P and dissolved reactive P monitored in the leachate samples. Textural variability and management practices caused significant variations in the leaching of colloids and P forms. Breakthrough curves exhibited an early higher concentration of both colloids and P forms indicating the preferential flow effect, in such that their concentration decreased with time and converged at low levels suggesting that soil macropores were blocked and leached were then transported in both soils via matrix flow. Clay loam under alfalfa showed higher colloids and associated P concentration levels comparing with loam under wheat crop production. This was attributed to increased pore connectivity associated with cropping system and soil texture. These results may support the Nutrient Management in reaching to Best Management Practices (BMPs) to improve environmental sustainability of Zarivar Lake.



S12.05-P -9

COMPARISON OF EXTRACTION METHODS FOR PHOSPHORUS (P) AND ITS MAJOR BINDING COMPONENTS (FE, AL) IN NON-CALCAREOUS SOILS AND SEDIMENTS

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The five-step sequential extraction method according to Psenner & Pucsko (1988) (P&P fractionation) frequently used to discern different forms of P was compared with two one-step methods often used for determination of P sorbed by amorphous and poorly crystalline (hydr)oxides, i.e. ascorbate extraction (pH ~7.5) and oxalate extraction (pH ~ 3). The selectivity and efficiency of all extractions were verified using Fe and Al (hydr)oxides of various crystallinity, FeS, pyrite and kaolinite that were enriched with adsorbed phosphate and neutral (pH~6.7) sediment samples. The buffered dithionite (BD) step of P&P fractionation proved to be very effective in separating P bound to redox labile Fe (hydr)oxides from P bound to redox stable Al (hydr)oxides extracted in following NaOH step. BD step was effective in dissolution of Fe (hydr)oxides of every crystallinity while FeS was not dissolved until acid HCl extraction. Non-selective similar behaviour was seen for ascorbate and oxalate methods. They both extracted Fe and Al from poorly crystalline (hydr)oxides together with adsorbed P and also Fe from FeS in a single step. A special combination of methods applied on sediment samples confirmed the bad selectivity of both extractions in systems where P is bound to both Fe and Al (hydr)oxides and with a presence of FeS which can overestimate Fe (hydr)oxides. Results gained from ascorbate and oxalate extractions of natural materials are than impossible to compare with P&P fractionation which is the best tool for the simultaneous determination of various P, Fe and Al forms.



S12.05-P -10

COMPETITIVE AND SYNERGISTIC EFFECTS IN PH DEPENDENT PHOSPHATE ADSORPTION IN SOILS: LCD MODELING

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The pH dependency of soluble phosphate in soil was measured for six agricultural soils over a pH range of 3-10. A mechanistic model, the LCD (Ligand Charge Distribution) model, was used to simulate this change, which considers phosphate adsorption to metal (hydr)oxides in soils under the influence of natural organic matter (NOM) and polyvalent cations (Ca^{2+} , Al^{3+} and Fe^{3+}). For all soils except one, the description in the normal pH range 5-8 is good. For some soils at more extreme pH values (for low P-loading soils at low pH and for high P-loading soils at high pH), the model over predicts soluble P. The calculation shows that adsorption is the major mechanism controlling phosphate solubility in soils, except at high pH in high P-loading soils where precipitation of calcium phosphate may take place. NOM and polyvalent cations have a very strong effect on the concentration level of P. The pattern of pH dependency of soluble P in soils differs greatly from the pH effects on phosphate adsorption to synthetic metal (hydr)oxides in a mono-component system. According to the LCD model, the pH dependency in soil is mainly caused by the synergistic effects of Ca^{2+} adsorption to oxides. Adsorption of Al^{3+} to NOM adsorbed plays an important role only at a $\text{pH} < 4.5$. Presence of NOM coating strongly competes with phosphate for the adsorption and is an important factor to consider in modeling phosphate adsorption in natural samples.



S12.05-P -11

EFFICACY OF PHOSPHORUS BINDING MATERIALS IN REDUCING DISSOLVED PHOSPHORUS LOSSES IN SURFACE RUNOFF FROM GRASSLANDS

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In surface runoff from grasslands, the main part of total phosphorus (P) is generally transported in dissolved form. In Finland, the most important grass production areas are characterized by severe winter conditions, soil frost and snow cover. The amount of surface runoff is highest in springtime during the snow melting period; P loading mainly occurring outside growing season. We tested the potential of biotite (3 t ha⁻¹), gypsum (4 t ha⁻¹), fine lime (3 t ha⁻¹), Phoslock® (0.5 t ha⁻¹) and aluminium, ferrous and ferric sulfates (Al₂(SO₄)₃, FeSO₄, Fe₂(SO₄)₃, 0.5 t ha⁻¹) to reduce dissolved P losses in surface runoff from agricultural grasslands receiving dairy cattle slurry or mineral fertilizer. The materials were spread to the soil surface in early autumn in four replicates, the surface soil layer (0-5 cm) from each plots was lifted at the end of the growing season by a modified turf grass cutter, stored in outside temperature covered with plastic sheets until the beginning of the surface runoff simulation in the non-heated laboratory. Grass mats were covered with snow which was melt by infrared heaters, generating surface runoff, and the collected water was analysed for dissolved and total P. Aluminium and ferric sulfates were very efficient in reducing the dissolved P concentration in runoff even up to 59% and 69%, respectively, also decreasing the extractability of soil P by water or acid ammonium acetate. The other materials did not decrease the soil easily soluble P nor the concentration of dissolved P in surface runoff.



S12.05-P -12

GROUNDWATER-P CONCENTRATIONS BENEATH DUTCH AGRICULTURAL SOILS

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Phosphorus (P) is considered to be the main limiting nutrient in many surface and ground water bodies. P contribution to surface water bodies partly originates from subsurface fluxes, connecting anthropogenic P-leaching to ecological P-enrichment. This study is conducted to increase our understanding of the upper groundwater total phosphorus (UG-TP) status in the Netherlands. The national dataset we used (LMM) comprises over 4200 measurements since 1992 with variations in soil types, groundwater classes and farming types. All analysis of variance were performed on log-transformed data and samples below a limit of detection (LOD) were treated as half LOD allowing useful information from these samples also to be retained. Taking all of the samples from the dataset into account, there appears a statistically significant ($p < 0.01$) decline in mean UGTP concentrations beneath marine-clay > peat > river-clay > loess > sandy soils, respectively. The high UG-TP concentrations beneath marine-clay followed by peat soils may be a more important contributor to surface water phosphorus than previously thought. Farming types and groundwater classes did not have a uniform impact in different soil types on UG-TP concentrations. UG-TP concentration in arable farming of sandy soil was significantly lowest ($p < 0.01$) compared with other farming types but in marine-clay the differences were not significant. The mean UG-TP concentrations in deeper groundwater levels (dry soils) are lower than shallower groundwater levels (wet soils) beneath sandy and marine-clay soils. The national time-series of annual mean UG-TP concentration shows no decreasing significant trend in the past two decades for any of the main soil types.



S12.05-P -13

IRRIGATION PRACTICE AFFECTS SOIL PHOSPHORUS AVAILABILITY

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Water flowing in irrigation furrows detaches and transports soil particles and subsequently nutrients such as phosphorus (P). To reduce the risk of erosion and offsite P transport, producers in south-central Idaho have been converting from furrow to sprinkler irrigation. We completed research on soil P dynamics in furrow versus sprinkler irrigated soils from four paired-fields in the region. Surface soils (0-5 cm) were obtained from fields in September following barley harvest. Furrow irrigated soils contained 38 mg kg⁻¹ (on average) of plant-available P as compared to 20 mg kg⁻¹ under sprinkler irrigation. These results are important as 20 mg kg⁻¹ extractable P can be construed as the point where soil P is considered low to medium in soil testing. These soils were also analyzed using a sequential extraction technique to discern inorganic and organic P pools. Soils under sprinkler irrigation contained lower concentrations of inorganic P in soluble/Al-bound/Fe-bound and occluded phases, in the moderately labile and non-labile organic fractions, and in the amorphous Fe phases. Phosphorus concentrations in all other soil phases were similar between the two irrigation practices. Findings suggest that P use efficiency may be greater under sprinkler versus furrow irrigation.



S12.05-P -14

IS A ZERO P-INPUT COMPATIBLE WITH A SUSTAINABLE AGRICULTURE? LONG-TERM FIELD EXPERIMENTS IN LOAMY SOILS

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Being an essential element for plant growth, P generates eutrophication issue in surface waters and groundwater. To reduce P transfers by leaching, runoff or erosion, a diminution of P inputs in agriculture is advised. However, is such a management measure compatible with yield maintaining? To answer to this question and show in which forms P inputs are fixed in the soil, long-term experimental plots can be interesting tools. We observed the effect of 3 doses of P on yields and P contents in loamy soil thanks to study of experimental plots installed 4 decades ago by the Walloon Agricultural Research Centre. Different P indicators (degree of P saturation, total P, inorganic P, available P and water-soluble P) were measured. All indicators are coherent with P management and correlated with yields. It is likely that the results would be different for a shorter experiment. P management left also a mark on yields. Meanly, zero P-input engenders a decrease of yield of 7%, while a double input increases yield of 2% in comparison to plots with an input corresponding to crop export. So, financially, the zero P-input option does not seem profitable in the long-term. Lastly, analysis of deeper horizons showed the lack of leaching in these soils, even in plots with double inputs. Indeed, soil P contents in depth were similar in these plots than those with no P-inputs or soils under forest cover.



S12.05-P -15

LONG TERM EFFECTS OF MINING SOIL PHOSPHOROUS BY ZERO P APPLICATION

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High soil P contents in agricultural soils cause excessive leaching of P to surface waters. The current policy aims at reducing P application rates towards balancing P inputs and P removal with crops. Due to the high P content in the soil, such plans are mostly insufficient to reach surface water quality goals of the EU Water Framework Directive in the forthcoming decade and, hence, additional measures to reduce P loading to surface water are necessary. Zero P application leads to a rapid reduction in soluble P and readily available soil P in the upper soil layers. Long term field data on the effects of mining are scarce. In 1990 a long term experiment was started on arable land on a sandy soil and in 2002 an experiment started on four grasslands sites with different texture. At all sites a rapid reduction in readily available soil P pools was found. At arable land the amount of water extractable P declined by 12-15 mg P₂O₅ l⁻¹ in 20 years, reaching the same level of water extractable P as initially (before 1970) available on these soils. On grassland the amount of water extractable P declined by 10-19 mg P₂O₅ l⁻¹ in the upper 30 cm of the soil in 8 years. In the peat and clay soils, the strongest decline was found in the upper 10 cm where most of the P had accumulated. In the sandy soils the P content declined in all soil layers up to 30 cm depth.



S12.05-P -16

MANAGING PHOSPHORUS LEACHING ON SANDY MEDITERRANEAN SOILS TO MEET AGRONOMIC AND ENVIRONMENTAL TARGETS

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Rising cost, insecure supply and environmental impact of phosphorus fertilisers suggest the need to improve their efficiency. Our aims were to assess (1) how P used by grains grown on sandy soils across the Mediterranean-type region of Western Australia (WA) met agronomic and environmental targets and (2) management interventions required to meet these targets. This analysis was based on data from the literature, growers' surveys and unpublished data. The P balance efficiency (PBE) of grains is 48% (% P applied recovered in grains). On-going build-up of available P (Colwell P) led to over 80% of 109,000 soil samples examined exceeding critical Colwell P values for near maximum crop production (CV). Agronomic efficiency (yield gains with P application compared with the control) close to zero in these soils is not offset by high PBE. Currently over 95% of these 109,000 soil samples exceed Australian and New Zealand's environmental targets for dissolved reactive P (DRP) concentration and risk of P leaching. Adopting maintenance P supply only partially alleviates this risk as targets for DRP are still exceeded when these sandy soils are maintained close to their CV. These soils have low PBI (typically<70), which results in high P leaching risk at their CV. A management option to allow these soils to meet agronomic and environmental targets is to increase PBI. This can be achieved by applying (1) or delving clay which is commonly practised in WA and (2) P retentive mining residues rich in iron and aluminium oxides.



S12.05-P -17

PHOSPHORUS BIOCYCLING IN WET/DRY INCUBATED SOILS SUBJECTED TO A DIFFERENT FERTILIZATION HISTORY FOR ASSESSING THE RISK OF LEACHING

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Drying/rewetting (DRW) cycles are known to affect soil fertility increasing organic matter turnover and nutrient release. Soil microorganisms are particularly susceptible to DRW stresses and may be killed by soil drying and rapid rewetting. Moreover, fertilization significantly affects soil microbial biomass and enzyme activity. However effects of DRW on phosphorus cycling and on its availability are partly unknown and limit the complete understanding of the risk of P losses from over-fertilizer soils. In this work we studied the effect of compost or mineral P application in long term balanced and unbalanced fertilized systems to assess the dynamics of P in incubated soils subjected to repeated DRW cycles. Soils were collected from an ongoing long-term fertilizer management platform (Torino, NW Italy), comparing agrosystems subjected to low N and K application and no P fertilization for 15 years with traditional ones fertilised with high levels of N and P, both divided in three subplots and treated with i) compost, ii) mineral fertilizer and iii) control. The soils were subjected to four DRW cycles and compared with another set maintained at constant moisture. Weakly the soils were analyzed for their soluble, total and microbial P forms. Soluble P increased especially in the mineral and compost fertilized soils after the 3th DRW cycle following microbial P decay. This was more enhanced in the soils receiving high amounts of fertilizers. From these findings we conclude that the risk of P losses may be further enhanced by DRW cycles and compost addition



S12.05-P -18

PHOSPHORUS DISTRIBUTION IN THE PROFILES OF THREE ITALIAN SOILS AFTER LONG-TERM MINERAL AND MANURE APPLICATIONS

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In areas of intensive agriculture continuous applications of mineral and organic fertilizers can lead to an accumulation of phosphorus (P) in the soils and progressive saturation of their sorption capacities, increasing the risk of P losses to aquatic ecosystems. The long-term evolution (44 years) of soil P forms has been studied in a factorial experiment combining three soils (sandy, clay and a peaty) with three types of fertilization (no fertilizer, farmyard manure and mineral fertilizer). The P distribution across the calcium P (PCa), iron P (PFe), iron + aluminium P (PFe+Al) forms, and the effect of treatments on P availability (oxalate extractable-P, Mehlich-3-P, Olsen-P, water extractable-P) were determined along the 1-m depth profile. In comparison with the control, manure application significantly increased the levels of all P forms with the largest increase occurring in available P (e.g. Mehlich-3-P). A unique change point was identified for Olsen-P (54 mg kg⁻¹) in clay and peaty while a different concentration was observed for Mehlich-3-P in clay (10 mg kg⁻¹) and peaty soils (170 mg kg⁻¹). Change point was not identified in sandy soils. Long-term manure applications increased the movement of P along the soil profiles and could represent a risk to the environment if not properly managed.



S12.05-P -19

PHOSPHORUS LEACHING FROM A CLAY AND SANDY SOIL SUPPLIED WITH MANURE AND MINERAL FERTILIZER

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Phosphorus (P) leaching from agricultural fields contributes to eutrophication of adjacent water bodies. The complexity among factors controlling P leaching losses requires careful consideration in designing effective mitigation strategies. We studied P leaching (both total-P and dissolved reactive P) from lysimeters filled with clay or sandy topsoil before and after addition of 30 kg P ha⁻¹ in the laboratory. The clay lysimeters were collected from a field with separately tile-drained plots and the results were compared with data from that field. The topsoils were treated with different sources of P (pig slurry or mineral P), which were either surface applied or incorporated into the soil. The initial total-P concentrations in lysimeter leachate were lower from the clay soil (0.13 mg L⁻¹) than from the sandy soil (0.21 mg L⁻¹), but in the clay soil they increased considerably after slurry application, to 1.39 mg L⁻¹ for incorporated slurry and 2.76 mg L⁻¹ for surface-applied slurry. The field study on the clay soil confirmed that surface-applied slurry increases P leaching under certain conditions. Critical events in the crop rotation were application in autumn on the soil surface, after cereals or on grass/clover, while spring application did not increase P leaching. Thus time of application and incorporation of slurry after application may be important for reducing P losses from clay soils.



S12.05-P -20

PHOSPHORUS LOAD FROM GRASSLANDS TO INLAND WATERS IN CENTRAL FINLAND

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Grasslands constitute approximately third of the cultivated area in Finland, corresponding to more than 620 000 hectare. For grasslands, P loading values are largely based on studies performed in the experimental fields, and hence there are uncertainties when applying these results to the larger scale. In this study, we estimate the level of annual P load from grasslands by monitoring water quality and discharge in five streams in the small agricultural catchment (about 3 km²) in central Finland, including various types of land uses, however, the portion of grass is substantial in this area. Main part of total P originating from grasslands is transported in dissolved rather than particulate form in surface runoff. Therefore the samples are taken using an automated programmable sampler, and the water samples are analysed for e.g. the concentrations of total P, dissolved P, total suspended solids, dissolved organic carbon, total nitrogen (N), ammonium-N and nitrate-N. The discharge is constantly monitored with ultrasonic doppler instruments or through a water level measurement with pressure probes and V-notched weirs. According to the one year (2010-11) preliminary results, after winter runoff started already at the beginning of April under snow cover; peaking highly during the snowmelt period. The critical period for P losses when most of P transport from the catchment also occurred, may last only 3-4 weeks during high flow period in spring. Because of large hydrological variation between years, the reliable estimates of annual loading are only achieved by long-term monitoring and frequent sampling.



S12.05-P -21

PREDICTING PHOSPHORUS LOSSES WITH THE MODEL PLEASE IN THE ACID SANDY REGION OF FLANDERS

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Intensification of agriculture, with concentration of intensive livestock breeding and intensive horticultural cropping systems in certain areas in Western Europe, has resulted in excessive fertilization both with mineral fertilizers and organic manures especially between the 1970's and 1990's. This has resulted also in excessive P build-up in specific areas, and especially acid sandy soils are prone to P leaching. According to Van der Zee et al., an acid sandy soil is considered P saturated when the phosphate saturation degree (PSD) is > 25% (or when the P concentration in the shallow groundwater is > 0.1 mg o-P l⁻¹). Between 1995 and 1997 an intensive sampling campaign was launched to make an inventory of the PSD of acid sandy soils in Flanders.. This was used as a basis for enforcing strict P fertilization rules on P saturated soils. In 2009 and 2010, we revisited a number of locations, part of which were P saturated fields with severe P fertilizer restrictions, and part of which were not P saturated at the time of the first survey. To investigate if the restrictions were effective and to have an cost effective instrument to evaluate the PSD status of the acid sandy soils in Flanders, the PLEASE model was applied. The PLEASE model is developed in the Netherlands and has proven to be a efficient instrument in identifying critical fields/areas for P leaching.



S12.05-P -22

THE EFFECT OF VARIOUS FERTILIZING STRATEGIES ON SOIL ORGANIC MATTER, SOIL P FRACTIONS AND P LEACHING POTENTIAL IN FLANDERS AND THE NETHERLANDS

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Nutrient leaching caused by over-fertilization has led the Flemish and Dutch governments to regulate fertilizer and manure applications. Restrictions on the N and P supply have decreased nutrient leaching somewhat, but nutrient losses are still substantial. Further restrictions on fertilizer dosing are needed to protect the environment from eutrophication. In Flanders, the total organic carbon content of agricultural soils has declined over the last 20 years. Further restrictions on manure application may lead to an even faster decrease in organic carbon content of the soil. The objective of this research is to study the effects of different types of organic fertilizers on the P fractions of the soil, the P leaching, and the soil organic matter (SOM) content. Which soil management strategies allow for reducing P losses from agricultural fields while maintaining the SOM at an acceptable level? This research is based upon 3 long-term field trials and a percolation experiment. In these field trials, several types of organic fertilizers are compared to each other and to a mineral fertilizer. The evolution in the soil organic C and P fractions is followed by measuring the total organic carbon content, hot water extractable C and P, P_{org}, P(CaCl₂) and the ammonium-lactate extractable P. In addition, soil samples are taken and placed into glass fiber filters under constant suction, above which water is continuously added via a peristaltic pump. The sampled percolation water is measured at regular intervals for concentrations of total P, total dissolved P, orthophosphate, and total dissolved organic carbon.



S12.05-P -23

THE EUTROPHICATION POTENTIAL OF PHOSPHORUS IN AGRICULTURAL SOILS OF THE CZECH REPUBLIC

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In the past 20 years, there has been an increasing tendency to decrease industrial fertilizer dosage in Czech agriculture, which results in higher P export from the fields compared to P input in most agricultural areas. Due to intensification methods prevalent in agricultural practice today, a high percentage of arable land has become highly susceptible to erosion. The aim of our study is to assess the contribution of soil erosion particles to the eutrophication of freshwater ecosystems throughout the Czech Republic. For this purpose, 60 different agricultural soils, representative of the entire area of the Czech Republic, were collected as a part of a regular monitoring program carried out by the Central Institute for Supervising and Testing in Agriculture. In these samples, phosphorus sorption/desorption properties were experimentally determined. Chemical fractionation of phosphorus, iron, and aluminium was subsequently performed to determine the main binding partners in each soil type. As there is currently very little or no information on the contribution that phosphorus bound to erosion particles makes to eutrophication, these results will allow for considerable improvement of our ability to estimate the importance of different phosphorus sources, and consequently model and accurately predict the behavior of freshwater ecosystems.



S12.05-P -24

THE IMPACT OF PH ON PHOSPHORUS SORPTION IN PHOSPHORUS-RICH SANDY SOILS

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The phosphorus binding in soil is closely dependent on the soil's richness in phosphorus. In the case of arable soils their high level of phosphorus abundance is reached quite fast due to a necessity to satisfy the plants' nutritive needs alongside low efficiency of phosphorus fertilization. This creates a high risk of the phosphorus leaching from soil and the occurrence of the eutrophication problem, particularly in the neighbourhood of sandy soils. The aim of the paper is to analyse the impact of different soil pH on the process of phosphorus sorption in the phosphorus-rich sandy arable soils. The research was conducted on four soil profiles located in the Dalkowskie Hills (western Poland). The basic chemical, chemical-physical and physical properties were investigated in the soil samples. Phosphorus sorptive capacity and phosphorus saturation degree were assessed on the basis of the amount of ammonium oxalate extractable Al, Fe and P. Then the process of sorption of different phosphorus doses in all soil horizons was conducted. The phosphorus sorption process was carried out in different pH which was modified in laboratory conditions. The process was analysed on the basis of Langmuir and Freundlich equations.



S12.05-P -25

THE INFLUENCE OF ECO-TOURISM AND FARMING PRACTICES ON THE QUALITY OF EAST MEDITERRANEAN ALTERED WETLAND SOILS AND WATERWAYS

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Agmon Hula in Northern Israel is a small (1.1 km²) artificial lake that was constructed in 1994 in the formally swampy area that was drained in the 1950s. Following the establishment of the Agmon huge flocks of *Grus grus* (> 50,000) have adapted this area for wintering. To minimize crop damage the farming authority has began planned feeding in an area adjacent to the Agmon. The objective of this study was to evaluate the influence of this feeding on the P status of these altered wetland soils and waterways. We installed a series of wells at two depths (40- & 90 cm) between two major waterways and monitored the hydraulic heads and collected samples for elemental analyses. We collected sediments from the waterways and conducted sequential P extraction. We found significant increase in groundwater SRP (> 0.5 mg l⁻¹) in 2010 compared with the period prior to the feeding (SRP ~ 0.05 mg l⁻¹). We found significant decrease in Fe(II), Ca, and SO₄ concentrations in the shallow groundwater in 2010 (15-, 100-, and 20 mg l⁻¹ respectively) compared with the period prior to the feeding (60, 700, 200 mg l⁻¹ respectively). A shift in P fractionation from inorganic P before the feeding to organic P and significant increase in total P (~ 4000 mg P kg⁻¹) was observed. On the basis of hydraulic head monitoring we concluded that about 0.3 to 0.8 ton of P has been removed by plant harvesting with little impact on waterways.



S12.06-P - OPPORTUNITIES AND CHALLENGES IN MINE SITE REHABILITATION

Friday 06 July 2012 from 17:00 to 18:30. Room Poster Areas

S12.06-P -1

ARSENIC CONTAMINATED SOILS FROM THE SIERRA MINERA OF LA UNIÓN

Clémence Bes, Murcia - Spain

S12.06-P -2

BIOAVAILABLE PB REDUCTION IN CONTAMINATED SOIL AMENDED BY ANIMAL MANURE COMPOSTS

Masahiko Katoh, Gifu - Japan

S12.06-P -3

CADMIUM AND LEAD SORPTION CAPACITY IN SOME PLYGORSKITIC SOILS IN ISFAHAN PROVINCE

Mohammad Hassan Salehi, Shahrekord - Iran, Islamic Republic of

S12.06-P -4

CHANGES IN THE MICROBIOLOGICAL PROPERTIES OF SOIL POLLUTED WITH RED MUD

Gábor Csitári, Keszthely - Hungary

S12.06-P -5

CONTRIBUTION TO THE STUDY OF SOIL-TECNOSOL EQUILIBRIUM IN THE CU MINE OF TOURO (GALICIA, NW SPAIN)

Jose Ramon Verde Vilanova, Santiago de Compostela - Spain

S12.06-P -6

DEVELOPMENT OF REMEDIATION GUIDELINES FOR CONTAMINATED SITES BASED ON THE RESULTS OF THE EU-PROJECT UMBRELLA

Andreas Baumgarten, Vienna - Austria

S12.06-P -7

DEVELOPMENT OF REMEDIATION GUIDELINES FOR CONTAMINATED SITES BASED ON THE RESULTS OF THE EU-PROJECT UMBRELLA

Andreas Baumgarten, Vienna - Austria



S12.06-P -8

EFFECT OF NATIVE PLANT SPECIES ON PYRITIC MINE SOILS.

Rebeca Manzano, Madrid - Spain

S12.06-P -9

EFFECTS OF PH AND SOLUBLE ORGANIC MATTER PROVIDED BY ORGANIC AMENDMENTS ON HEAVY METAL MOBILITY IN MINE SOILS

Javier Pérez-Esteban, Madrid - Spain

S12.06-P -10

ENVIRONMENTAL GRADIENTS AND COLONIZATION PATTERNS OF PIONEER VEGETATION IN MINE TAILINGS LOCATED AT SOUTHEAST SPAIN

Héctor Miguel Conesa-Alcaraz, Cartagena - Spain

S12.06-P -11

ESTIMATING SOIL WATER AND BUFFER PROPERTIES OF MINE SPOILS IN NORTHEASTERN GERMANY FOR SOIL FERTILITY CLASSIFICATION

Thomas Heinkele, Finsterwalde - Germany

S12.06-P -12

EVALUATION OF BIOLOGICAL SOIL QUALITY (QBS-AR) INDEX FROM SPOLIC TECHNOSOLS IN AN ABANDONED MINE AREA IN NE ITALY: 50 YEARS OF BIOLOGICAL REHABILITATION OPPORTUNITY

Andrea Ferrarini, Venice - Italy

S12.06-P -13

EVALUATION OF THE PHYTOSTABILISATION EFFICIENCY IN A TRACE ELEMENTS POLLUTED SOIL USING SOIL MICROBIAL PARAMETERS

Tania Pardo, Murcia - Spain

S12.06-P -14

FIRST DATA ON PEDOGENESIS AND EVOLUTION OF PLANT COVER ON CONTAMINATED SUBSTRATA COLONIZED BY TWO ENDEMIC METALLOPHYTES FROM THE MINING AREAS OF SW-SARDINIA

Mauro Casti, Iglesias - Italy



S12.06-P -15

IMPACT OF PAST MINING ACTIVITY ON THE QUALITY OF SOIL IN THE HIGH MOULOUYA VALLEY (MOROCCO)

Pietro Iavazzo, Napoli - Italy

S12.06-P -16

METHANOTROPHIC ACTIVITY OF THE COALBED ROCKS FROM UPPER SILESIAN COAL BASIN

Anna Pytlak, Lublin - Poland

S12.06-P -17

MOBILITY OF TOXIC METALS FROM CALCAREOUS MINE TAILINGS IN COMPOST AMENDED MESOCOSMS

Maria De Nobili, Udine - Italy

S12.06-P -18

PHYTOMINING OF NICKEL IN SERPENTINE SOILS OF ALBANIA

Aida Bani, Tirana - Albania

S12.06-P -19

POTENTIAL USE OF SORGHUM BICOLOR AND CARTHAMUS TINCTORIUS IN PHYTOREMEDIATION OF NI, PB AND ZN

Ziad Al Chami, Valenzano - Italy

S12.06-P -20

SOIL-PLANT INTERACTIONS AT THE ABANDONED SÃO DOMINGOS MINE (IBERIAN PYRITE BELT, PORTUGAL)

Paula Alvarenga, Beja - Portugal

S12.06-P -21

SULFATE RELEASE FROM COAL OVERBURDEN TREATED WITH LIME IN A LONG TERM LEACHING EXPERIMENT

Luiz Fernando Spinelli Pinto, Pelotas - Brazil

S12.06-P -22

SUSTAINABLE TAILINGS TREATMENT, REMEDIATION AND REVEGETATION: A REAL-WORLD LONGITUDINAL STUDY OF THE KING RIVER "TAILINGS BEACH" COMPARING VIROMINE TECHNOLOGY TO A STANDARD APPLICATION AND DOING NOTHING

Lee Fergusson, Coomera Waters - Australia



S12.06-P -23

TAILINGS COVER SYSTEM USING A SOLIDIFIED LAYER AND ITS FIELD PERFORMANCE

Joo Sung Ahn, Daejeon - Korea, Republic of

S12.06-P -24

THE EFFECT OF TWO EARTHWORM SPECIES ON PB, ZN, CD AND CU BIOACCESSIBILITY AND MICROBIAL ACTIVITY IN SOIL AFTER ITS REMEDIATION WITH STABILIZATION

Metka Udovic, Ljubljana - Slovenia

S12.06-P -25

THE GREENLAND PROJECT: GENTLE REMEDIATION OF TRACE ELEMENT CONTAMINATED LA

Markus Puschenreiter, Tulln - Austria

S12.06-P -26

THE POTENTIAL OF CISTUS LADANIFER L. IN THE RESTORATION OF MINE TAILINGS AT RIOTINTO (SW SPAIN)

M^a Dolores Mingorance, Granada - Spain

S12.06-P -27

THE ROLE OF HYDROLOGICAL PROPERTIES AND THEIR EFFECTS ON GEOCHEMICAL PROCESSES FOR ESTABLISHING ROOT ZONES IN MINE WASTES

Thomas Baumgartl, Brisbane - Australia

S12.06-P -28

TRANSPORT OF COPPER, CADMIUM AND NICKEL IN MINE SOILS AMENDED WITH MUSSEL SHELL RESIDUES

Marcos Paradelo, Ourense - Spain

S12.06-P -29

URANIUM AND DECAY PRODUCTS IN SOME SOILS IN THE VICINITY OF FORMER URANIUM MINING SITES

Lauret Pourcelot, St Paul lez Durance - France

S12.06-P -30

USE OF BIODIESEL BYPRODUCT AS NUTRIENTS SOURCE FOR IRON-MINE TAILING RECLAMATION

Ana Sevilla Perea, Armilla - Spain



S12.06-P -31

USE OF PGPB TO ENHANCE MICROBIAL FUNCTIONAL AND GENETIC DIVERSITY IN MINING SOILS: A PRELIMINARY STUDY WITHIN THE UMBRELLA PROJECT

Sara Marinari, Viterbo - Italy



S12.06-P -1

ARSENIC CONTAMINATED SOILS FROM THE SIERRA MINERA OF LA UNIÓN

Bes Clémence^[1], Martínez-Fernández Domingo^[1], Clemente Rafael^[1], Bernal Pilar^[1]

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Two sites within an abandoned mining area were surveyed for their potential high levels of As. Six soils originating from these 2 sites were sampled. Total and available As and metals were measured as well as pH, electrical conductivity, and C and N concentrations. Accumulation in the aerial part of plants and soil phytotoxicity were also assessed. For all the soils, C and N concentrations were very low while As and heavy metals were extremely high. Soils from 'El Descargador' (D) were very acidic (pH<3.5) whereas those from 'El Gorguel' (G) presented almost neutral pH and slightly higher C concentrations. The electrical conductivity was very elevated for some soils (>15 dS m⁻¹). Regarding trace element concentrations, there were clear differences between the two sites, with high Cu and As in site D soils (maximum 1357 and 1161 mg kg⁻¹, respectively) and lower concentrations in G soils (maximum 192 and 525 mg kg⁻¹, respectively). There were also differences in available concentrations, G soils showing higher available As than D soils. In a pot assay, beans were only able to grow in the two soils with the highest pH and OM content and with the lowest total and available concentrations of metals. However, only the most acidic soil with very high electrical conductivity, total and available concentrations of metals impacted negatively on watercress germination. Accumulation of As in the aerial parts of the plants surveyed varied among species, concentrations found falling within the range 0.1-78 mg kg⁻¹ for all species and soils.



S12.06-P -2

BIOAVAILABLE PB REDUCTION IN CONTAMINATED SOIL AMENDED BY ANIMAL MANURE COMPOSTS

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It has been known that an animal manure compost was useful for reducing heavy metal bioavailability. This might be attributed to the reactions that lead heavy metal forms to change to insoluble phases. The mechanisms of heavy metal immobilization using the composts, however, were poorly understood. The purpose of the study was to evaluate Pb bioavailability and Pb speciation in contaminated soil amended composts which have the different chemical properties such as P content. A cattle (C), a swine (S), and a poultry (P) composts, which have 7, 25, 17 mg g⁻¹ of P contents respectively, were added to Pb-contaminated soil at a rate of 3%w/w, and soils amended were incubated for 12 weeks. 0.1 M CaCl₂ extraction was performed for each soil sample to extract bioavailable Pb. Pb speciation was characterized using sequential extraction (five step) procedure: exchangeable, bound to carbonates, bound to Fe/Mn oxides, bound to organic matter, and residual fractions. CaCl₂-extractable Pb in C-amended soil was stable and reduced to 10 mg kg⁻¹ lower than in non-amended soil. Differences of CaCl₂-extractable Pb in between S-, P- amended soil and non-amended soil peaked on 4 weeks (40 mg kg⁻¹) , and then decreased around 10mg kg⁻¹ on 12 weeks. In C-amended soil, Pb associated with carbonates was reduced and Pb associated organic matter was increased than in non-amended soil, while residual fraction in S- and P-amended soil increased than in non-amended soil. This study suggested that S- and P-composts were effective in the remediation of Pb-contaminated soil.



S12.06-P -3

CADMIUM AND LEAD SORPTION CAPACITY IN SOME PLYGORSKITIC SOILS IN ISFAHAN PROVINCE

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One of the main aims of soil surveys is to find suitable locations for industrial sewage or wastewaters. This research was carried out to study the sorption of lead (Pb) and cadmium (Cd) at surface and sub-surface horizons of palygorskitic soils in eastern Isfahan province. Physical, chemical and mineralogical properties of the selected soils were measured. Sorption characteristics of Pb and Cd were estimated from sorption isotherms using Langmuir, Ferundlich and linear equations. Ferundlich and linear adsorption isotherms and Ferundlich, Langmuir and linear adsorption isotherms were able to describe the lead adsorption and cadmium adsorption, respectively. Ferundlich isotherm showed higher R^2 for both of the elements. Parameter n in Ferundlich equation for Pb and Cd was in the range of 0.22-1.52 and 1.95-4.61 respectively. Distribution coefficient (K_F) for Pb and Cd was in the range of 2679-114815 and 353-1369 Lkg⁻¹ respectively. Maximum sorption of cadmium (b) was in the range of 1250-2000 mgkg⁻¹. The constant related to binding energy (k) was in the range of 0.30-2.50 Lmg⁻¹ for cadmium. In linear model, distribution coefficient (K_d) for Pb and Cd was in the range of 4188-64605 and 33-678 Lkg⁻¹, respectively. Correlation coefficients between sorption isotherms parameters and soil physico-chemical properties showed that calcium carbonate equivalent, organic mater, cation exchange capacity and clay percentage are the most important soil properties for Pb and Cd sorption. Lead sorption was higher than cadmium in the soils of the area. Palygorskite-containing soils of the area have a high capacity for lead and cadmium adsorption.



S12.06-P -4

CHANGES IN THE MICROBIOLOGICAL PROPERTIES OF SOIL POLLUTED WITH RED MUD

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At the 4th Oct 2010 through the broken wall of a red sludge deposit in the area of Ajka (Hungary) a huge amount of red sludge flooded the closed areas. The red sludge is a highly alkaline toxic substance containing heavy metals, one of the waste products of alumina processing. To determine the harmful effects of the contamination and for the recovery of soils column experiment were set up with red sludge. The investigated soil was collected from the polluted site so it was representative to the area. Layers of the soil column were packed similarly to the original soil genetic horizons with identical bulk density and gravel content. The diameter of the soil columns was 11 cm and their lengths were 100 cm. We set the experiments in three replicates and determined the soil biological, physical and chemical parameters after 30, 60 and 120 days of incubation. We measured two biological parameters, the soil microbial biomass (with chloroform fumigation extraction method) and the enzyme activities among the hydrolysis of fluorescein diacetate. Basic soil properties such as the quantity and quality of soil organic matter, cation exchange capacity, pH, aggregate stability, particle size distribution were measured, respectively. The effects of red sludge on the microbial biomass and activity were characterised in the different soil layers. The correlation between the soil physical, chemical and biological parameters was investigated as well.



S12.06-P -5

CONTRIBUTION TO THE STUDY OF SOIL-TECNOSOL EQUILIBRIUM IN THE CU MINE OF TOURO (GALICIA, NW SPAIN)

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In the mine of Cu-sulfide of Touro (Galicia, NW Spain), the hyperacid and hyperoxidant cuts and dumps, have been subjected to recovering processes adding Tecnosoils "tailor made" and with properties similar to alu-andic and sil-andic soils. Acidity neutralization and immobilization of Al, Fe forms and other metals, decrease of oxidation rate of exposed sulfurs, sulphates adsorption, input of nutrients, and creation of systems which carry out soil functions. Analysis of twenty-five soils, with determination of physicochemical properties of soils and equilibrium dissolution, as well as the observation of developed life forms, allows us to conclude that these objectives have been reached. As a results, the addition of Tecnosoils: i) increase the acid neutralization capacity and provide alkali to initial mining soils, which contribute to the decrease the acidification (pH: 8-10 in surface horizons, and 8-9 in subsurface horizons); ii) increase the sulphate retention capacity, so decreasing strongly its concentration in runoff water and their electric conductivity; iii) increase the flocculated organic matter forms, with presence of recalcitrant, humificated and easily oxidate forms, which influence positively in O₂ diffusion, water retention, change capacity and contaminant fixation; iv) provide essential nutrients, specially P, N, Ca⁺², Mg⁺² and K⁺, contributing to rebuilding the biogeochemical cycles and trophic chain of systems; v) contribute to decrease Eh (values 0.4 V), increasing pH, modifying of stable S species and carrying the equilibrium conditions to the stability of the sulphates and hydrosilated forms of Al and Fe, reducing strongly sulphur oxidation rate and potential production of acidity.



S12.06-P -6

DEVELOPMENT OF REMEDIATION GUIDELINES FOR CONTAMINATED SITES BASED ON THE RESULTS OF THE EU-PROJECT UMBRELLA

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The overall goal of the EU-financed project UMBRELLA (<http://www.umbrella.uni-jena.de>) is to use micro-organisms to develop cost-efficient and sustainable methods for soil remediation on heavy metal contaminated sites throughout Europe. UMBRELLA uses an integrated scientific approach, including different institutions from several European countries concerning microbiology, botany, and (hydro)geochemistry. All were centred on studying the microbial influence on metal biogeochemical cycles and their use in environmental protection. A uniform definition of metal loads which necessitate action for remediation is still lacking. In particular in national soil and water guidelines, total contents rather than bio-available contents are the basis for decisions about remediation actions. From an ecological and eco-toxicological point of view, this is not overall supported by scientific data. The differences in geogenic metal contents in soils have led to problems with determination of relevant limits. Hence, the inclusion of governmental agencies as partner will allow to develop feasible guidelines that can be proposed to the EU to develop a combinatory guideline including both soil and water protection issues. Thus, one outcome of UMBRELLA is a set of new phytoremediation techniques of metal contaminated soils. Based on these methods, bioremediation guidelines which focus both on soil and water protection, are developed. Those guidelines contain best practice rules for remediation in different scales based on methods and results of the project work-packages (microbiology, botany, (hydro)geochemistry) and individual laws and regulations of the European UMBRELLA partner countries.



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EFFECT OF NATIVE PLANT SPECIES ON PYRITIC MINE SOILS.

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Mining activities have promoted pollutants to emerge, contributing to increase trace element concentration in soils. The use of native plant species on soils contaminated with trace elements is focused in decreasing contaminants' bioavailability and lixiviation, improving soil quality and promoting the establishment of a vegetative cover. Containers of 140x60x40 cm were used, filled with a mixture of control soil plus material proceeding from an arsenopyrite mining dump in NW Madrid, Spain (80:20 w/w). One-year old plants of Salix atrocinerea and Cytisus scoparius were planted in different containers, each one in combination with seeds of Lupinus albus cv. Marta. A control without plant was also included. Irrigation by sprinklers was set up, and the experiment lasted fourteen months. Pseudototal and available arsenic and metals concentrations in soils and leachates were analyzed along the assay, as well as enzymatic activity at the end of the experiment. Trace element concentrations in plants were also analysed. In the early stages of the experiment, the available arsenic concentration was lower in the treatment with plants than without them. This trend maintains till the final sampling in the treatment with S. atrocinerea but not for the metals (Cd, Cu, Zn and Mn). Cd, Cu and As concentrations in the leachates exceeded the maximum concentration allowed for drinking water. S. atrocinerea concentrated larger Cd amounts in fronds than the rest of species, maintaining its capacity during the assay. No symptoms of toxicity were observed in plants, but they were not able to reduce trace element availability.



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EFFECTS OF PH AND SOLUBLE ORGANIC MATTER PROVIDED BY ORGANIC AMENDMENTS ON HEAVY METAL MOBILITY IN MINE SOILS

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The incorporation of organic amendments to mine soils can improve its physical and chemical properties and affect the mobility and bioavailability of heavy metals. The aim of this work was to study the effect of soil pH and soluble organic matter content modified by the application of organic amendments on metal mobility. Two organic amendments (pine bark compost and a mixture of sheep and horse manure compost) were applied to metal contaminated soils collected from two mining areas near Madrid (Spain). Soil solutions were obtained using 0.005 M CaCl₂ adjusted to different pHs. Extractable metal concentrations (Cu and Zn) and soluble organic carbon content were measured in the extracts. The NICA-Donnan model was used with the experimental data to predict metal speciation in soil solution and metal binding by soluble organic matter. Results showed that the application of organic amendments modified soil pH and increased the soluble organic matter content. Cu presents a high affinity to organic matter. The application of manure amendment reduced Cu desorption due to its higher pH and degree of humification. Conversely, pine bark amendment increased Cu mobility. A higher soluble organic carbon content promoted Cu desorption in soil because the formation of soluble complexes, especially at high pH. Most of extractable Cu was linked to organic species. On the other hand, extractable Zn was strongly affected by pH and this metal was mainly presented in soil solution as free cation. The addition of manure amendment reduced Zn mobility due to its high pH.



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ENVIRONMENTAL GRADIENTS AND COLONIZATION PATTERNS OF PIONEER VEGETATION IN MINE TAILINGS LOCATED AT SOUTHEAST SPAIN

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The presence of mining wastes in semiarid areas of Southeast Spain is considered an important environmental concern due to the risk of metal transfer to the biota and human population. The revegetation or phytostabilization of these areas has been proposed as an effective measure to avoid soil erosion and thus the spread of pollutants via wind or run-off water. In order to achieve the establishment of a suitable vegetation cover, these techniques must involve a complete understanding of different abiotic (topography, climate, edaphic properties, economic resources) and biotic (locally adapted plant species, plant stress factors) parameters. This integrated approach to the revegetation of polluted areas has been recently incorporated into phytoremediation schemes and, defined as phytomanagement, is being successfully applied in the restoration of metal- polluted sites around the world. In this work we describe the environmental gradients related to the colonization of pioneer vegetation in mine tailings located at Southeast Spain. For this purpose we performed a transec/plot sampling design and a characterization of some edaphic properties and ecology of the existing plant communities. Our initial hypothesis, is that pioneer vegetation, which grows in situ in mine tailings, may promote the colonization of non-metal tolerant plant species through facilitation. The occurrence of a self sustaining plant cover at long term with low human intervention and the potential benefits or constraints of soil conditioners are discussed.



S12.06-P -11

**ESTIMATING SOIL WATER AND BUFFER PROPERTIES OF MINE SPOILS IN
NORTHEASTERN GERMANY FOR SOIL FERTILITY CLASSIFICATION**

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Due to low annual precipitation, a severe negative water balance during the vegetation period and a predominance of sandy mine spoils the reestablishment of fertile landscapes for agriculture or forestry on former mined land in the Lusatian mining district of Northeastern Germany is a major challenge. To enable a fertility classification of mine soils, the knowledge of mine soils capacity for storage of water and nutrients is of outstanding importance. We examined several pedotransfer functions to estimate soil water (effective field capacity) and buffering (CEC, exchangeable cations) properties of mine soils by comparing laboratory results and estimated values of almost 1000 sampled mine soil horizons of about 300 typical mine soil profiles. Most of the pedotransferfunctions tested do not consider some specific properties of mine soils, e.g. very high bulk densities, finely distributed lignitic materials, adequately. However, the pedotransferfunction according to „ROSETTA“ and the German Soil Mapping and Classification Handbook estimate the effective field capacity of the tested mine soil reliably. For estimating buffer properties, the pedotransfer function according to the German Soil Mapping and Classification Handbokk, after adjusting to specific mine soil properties, came out to be well applicable. The tested pedotransfer functions allow a reliable classification of the mine soils of the Northeastern German lignite mining districts into four soil hydrological and five buffering classes. This classification is based on parameters (grain size classes, pH-values, content of organic materials) which can be measured or estimated very simply by field work.



S12.06-P -12

**EVALUATION OF BIOLOGICAL SOIL QUALITY (QBS-AR) INDEX FROM SPOLIC
TECHNOSOLS IN AN ABANDONED MINE AREA IN NE ITALY: 50 YEARS OF BIOLOGICAL
REHABILITATION OPPORTUNITY**

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Heavy metal contamination of soils from mining activities is one of the major environmental problems in many parts of the world. The aim of this work was to investigate the relationship between soil metal pollution and microarthropod community structure using QBS-ar method. Humus samples were collected from 6 sites (4 grasslands and 2 forests) in an abandoned mixed sulphides mining area in Northeast Italy during spring 2011. The vegetation cover was constituted of mixed forests (*Abies alba* Mill., *Picea abies* (L.) H. Karst., 1881, *Fagus sylvatica* L. and *Ostrya carpinifolia* Scop.), with clearances where herbaceous and shrubby vegetation prevails over the arboreal one. Results showed significant differences in QBS-ar values between forest (141.0 ± 29.7) and grassland (94.8 ± 28) mine sites. It was possible to identify the class of soil biological quality (range between 3 and 6). QBS-ar values appeared to decrease significantly ($p < 0.05$ ANOVA) with respect to soil pollution by heavy metals (Cr, Cu, Pb, Zn and Fe). Moreover, the formation of humus seems to be dependent on both the type and amount of leaf litter and the contamination of soil matrix. Humus forms varied from Dysmoder to Amphimus to the more developed humus forms, Oligomull. In this context, we hypothesized that 50 years of biological rehabilitation could improve the microarthropods biodiversity (evenness and richness), driving the humus development to a better soil ecosystem functional stability. The application of QBS-ar index assumed to be a useful tool of monitoring surface mine reclamation process.



S12.06-P -13

**EVALUATION OF THE PHYTOSTABILISATION EFFICIENCY IN A TRACE ELEMENTS
POLLUTED SOIL USING SOIL MICROBIAL PARAMETERS**

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*The intense mining activity in La Unión-Cartagena (Murcia, SE Spain) has given rise to highly contaminated soils with very unfavourable conditions, most of them without a vegetal cover to protect from erosion. A two-year field phytostabilisation experiment was carried out in a mine spoil soil contaminated with trace elements (pH 6.2; Zn 9686; Pb 10188; Cu 193; Cd 19; As 664 mg kg⁻¹). Three amendments were applied: olive mill-waste compost (60 t ha⁻¹), pig slurry (60 m³ ha⁻¹) and hydrated lime (2.3 t ha⁻¹); and a native halophytic shrub (*Atriplex halimus* L.) was planted, leaving subplots without plants. In order to evaluate the efficiency of the phytostabilisation process for soil remediation, plant growth, soil pH, trace elements availability and microbial parameters with potential as indicators of soil health were analysed at the end of the experiment. The amendments did not substantially modify metal availability in the soil and both organic amendments stimulated the growth of *A. halimus*. Compost amended soils with plants showed the highest microbial biomass (CB, NB), enzyme activities (mainly dehydrogenase activity and β -glucosidase) and overall catalytic activity (FDA), increasing catabolic potential (AWCD) and functional diversity (S, H') of the heterotrophic cultivable soil bacterial communities (Biolog Ecoplates). Although both organic amendments improved plant growth, compost in combination with *A. halimus* stimulated soil microbial communities, increasing their biomass, activity and functional diversity. Therefore, under semi-arid conditions, the use of *A. halimus* and compost can be a good phytostabilisation strategy to improve soil health in heavy metal-contaminated soils.*



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FIRST DATA ON PEDOGENESIS AND EVOLUTION OF PLANT COVER ON CONTAMINATED SUBSTRATA COLONIZED BY TWO ENDEMIC METALLOPHYTES FROM THE MINING AREAS OF SW-SARDINIA

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*The plant-soil interactions of two endemic plants from SW-Sardinia have been investigated. The studied species, *Linum muelleri* Moris and *Genista sulcitana* Vals., can be considered as metallophytes, due to their high metal-tolerance. Both are threatened and *L. muelleri* is included as priority species in the Annex II of the Habitats Directive. *L. muelleri* is a calcicolous chamaephyte rarely higher than 0.6m, whilst *G. sulcitana* is a nanophanerophyte up to 1.5m high, growing exclusively on siliceous acid substrata. Both can grow in the crevices of rocky walls or in different types of garrigues and maquis. The plant communities in which these species grow have been analyzed by the phytosociological method. In order to investigate the soil properties, in every recorded site, plants and soils have been sampled. The soils, taken in correspondence of the rhizosphere, were analyzed to determine: skeleton, texture, pH, conductivity, CEC, exchange complex, CaCO₃, assimilable phosphorous, C, N, S, organic matter and the total and bioavailable content in As, Cd, Cr, Cu, Ni, Pb and Zn. Soil characteristics have been correlated with the plant communities features. The content of metals in soils vary depending on the successional vegetational stages, being lower in the formations with high cover values. Concerning *L. muelleri*, organic matter and skeleton are correlated with the different plant communities, whilst *G. sulcitana* can form close formations on pebbly mining dumps with very low contents in organic matter and exchange complex. Both species show the ability to uptake toxic elements, in particular Cd, Pb and Zn.*



S12.06-P -15

IMPACT OF PAST MINING ACTIVITY ON THE QUALITY OF SOIL IN THE HIGH MOULOUYA VALLEY (MOROCCO)

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Physical and chemical properties and total content of potentially harmful elements (PHEs) in tailings and soils were studied from the High Moulouya Valley (Morocco) in order to assess the impact of the past mining activity on their quality and to lay the foundations of a potential reclamation of the area. Samples, collected inside and outside the mine sites of Zeïda, Mibladen and Aouli, were alkaline, due to the limestone environment, and contained Pb and Zn as main metallic contaminants showing clay fraction highly enriched in metal contaminants. Chemical extractions coupled with quantitative XRPD were also used to define the forms of Pb and Zn in samples in order to provide baseline data required to assess metal mobility/bioavailability. Pollution levels were highest within the Mibladen mining site and soil pollution was mainly restricted to the areas where activities of metal concentration were carried out. At the time of study, all soils and tailings were in advanced stage of spontaneous herbaceous and arbustive revegetation. It is concluded that in the High Moulouya Valley the processes governing PHEs transfer from the element-rich sites to the nearby environment are strongly influenced by the alkaline conditions and the low solubility of Pb and Zn mineral phases reducing metal mobility from the mining waste impoundments by dissolution. The transfer by wind and water erosion of metal-enriched fine waste particles is likely to be a much more important vector for metal dispersion. In this perspective, natural and oriented revegetation could represent a low-cost and possible permanent solution.



S12.06-P -16

METHANOTROPHIC ACTIVITY OF THE COALBED ROCKS FROM UPPER SILESIA COAL BASIN

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Coal serves as primary fuel in many countries, including Poland. One of the effects of coal mining is excavation of a waste rock. The mass of the waste rocks is nearly half mass of the coal produced. Piles of the waste material disturb countryside and pose a threat of a spontaneous heating and acidic leachate production. The most intensive development of hard coal mining in Poland occurs in Upper Silesian Coal Basin (USCB). Reuse of mine wastes produced in this area include geo- and hydrotechnical applications. However the supply of rock exceeds demand of the industry, so there is a necessity to find a new application. Usage of the coal waste material as a landfill cover was suggested and discussed for the rocks originating from Lublin Coal Basin (LCB), which are inhabited by methanotrophic bacteria. USCB rocks are also inhabited by methanotrophs and therefore could be applied as a landfill sealing. The research carried on rocks from Borynia (BR), Budryk (BK), Jas-Mos (JM) and Krupinski (KR) coal mines showed biological methane oxidation of the rocks growing along with CH₄ concentration up to 10% v/v with the highest value of 2,2 $\mu\text{m CH}_4 \text{ g}^{-1} \text{ day}^{-1}$ in BK. Methane oxidation of the sample JM was the highest at 20% CH₄ v/v, however only at the level of 0,2 $\mu\text{m CH}_4 \text{ g}^{-1} \text{ day}^{-1}$. The application of USCB rocks on landfills could help to reduce methane emission to the atmosphere and reduce the amount of the rock collected in the dumping areas.



S12.06-P -17

**MOBILITY OF TOXIC METALS FROM CALCAREOUS MINE TAILINGS IN COMPOST
AMENDED MESOCOSMS**

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The elevate acid neutralization capacity of dolomite and other sedimentary carbonate rocks contained in the mine tailings of the Raibl mine (Cave del Predil, Italy), a dismissed zinc mine situated in the Julian section of the Southern Limestone Alps range, has so far minimized leaching of toxic metals from abandoned mill tailing deposits. However, their reclamation by amendment with compost, as well as the natural reclamation of a boundary strip situated near a wooded zone, may increase mobilization risks. The effect of compost addition was studied by collecting leacheates from model constructed profiles (mesocosms) incubated for 100 days at 25 °C, under a simulated rainfall regime that mimicked the average precipitation patter of the summer months. A single layer profile of tailings was compared with a single profile of compost amended tailings and with a two layer profile: the 10 cm top layer made by compost amended tailings and the 10 cm bottom layer made of native tailings. Significantly more Zn and Tl leached from the composite profile while Pb and As were more mobile in the amended tailings (single profile). The lower horizon of native tailings was able to drastically reduce metals leaching from the top horizon. This different behaviour is coherent with a fundamental role of DOC in the mobilization of Pb and As and with its much lower influence on that Zn and Tl. Mobilization of Zn and Tl was governed by S oxidation and to a lesser extent by carbonates.



S12.06-P -18

PHYTOMINING OF NICKEL IN SERPENTINE SOILS OF ALBANIA

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*There are large areas of ultramafic soils in Albania that are currently being used for agriculture with low productivity. These areas could sometimes be suitable for phytomining provided that Ni availability is high and soil deep enough. This is why we started investigating (field experiment) the performance of a low-cost phytoextraction with limited agronomic actions adapted to the Albanian context. We have been studying several soil management practices which may affect the efficiency of Ni phytoextraction in native covers of *A. murale* on 18-m² plots in natural conditions. In soil fertility management studies, we have tried different regime of fertilisation. We found that NPK application significantly increased shoot biomass yield, without reducing shoot Ni concentration. In weed control practices we have used the anti-monocots herbicide (FocusTM ultra) to allow for the full development of *A. murale*. We have carried out a number of field and laboratory trials to define the optimal harvest time. In this five-year experiment, the biomass yields in fertilised and herbicide treated plots have progressively improved: 2.6-3.7-6.0-4.6-9 t ha⁻¹. So have phytoextracted Ni: 22.56-29.5-69-55-104.9 kg ha⁻¹. Such crop management practice studies have improved phytoextraction efficiency. When fertilization and harvest conditions were optimized, herbicide control proved little efficiency. Extensive phytomining on such sites could be promising in the Albanian context by domesticating already installed natural populations with fertilization and possibly no herbicide treatment.*



S12.06-P -19

POTENTIAL USE OF SORGHUM BICOLOR AND CARTHAMUS TINCTORIUS IN PHYTOREMEDIATION OF NI, PB AND ZN

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Growing global population coupled with increased demands for food and fuel is driving demand for clean, renewable and alternatives to petroleum based fuels. The production of biomass fuel crops on degraded or contaminated land has several advantages as a means of site remediation combined with bioenergy production. In this contest, two energy crops, *S. bicolor* and *C. tinctorius* were grown hydroponically to assess their potential use in phytoremediation of Ni, Pb and Zn and biomass production. The experiment was carried out in a growth chamber using half strength Hoagland's solution as control and 5 concentrations for Ni, Pb and Zn (between 5 and 100 mg/l). Main growth parameters were determined and shoots and roots were analyzed for their metals contents. Results showed that the plants were able to uptake Ni, Pb and Zn. Furthermore, roots accumulated more metals than shoots. Ni seems more toxic than Zn and Pb. In fact, both species were unable to grow at Ni concentration above 10 mg/l. High toxicity symptoms and biomass reduction were observed at concentrations of Pb and Zn above 25 mg/l for both species. *S. bicolor* was more efficient than *C. tinctorius* in metal uptake, whereas metals toxicity ranked as follows: Ni > Zn > Pb. Due to the high biomass production and the relatively high shoot concentration of metal, *S. bicolor* could be successfully used in phytoremediation applications in marginal soils with moderately heavy metal contamination. However, results obtained through the hydroponic experiment need to be confirmed by field experiment.



S12.06-P -20

SOIL-PLANT INTERACTIONS AT THE ABANDONED SÃO DOMINGOS MINE (IBERIAN PYRITE BELT, PORTUGAL)

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*The São Domingos mine, located in SE Portugal, is one of a number of volcanogenic massive sulphide deposits within the Iberian Pyrite Belt, which extends from Spain along the south region of Portugal. The mine was extensively exploited from 1857 to 1966, when the production was discontinued. During all that time, pyrite and sulphides of several trace elements became exposed to the air and were responsible for the pollution observed in soils, superficial water and sediments. This study aims to assess the impact on soil and plants (*Cistus ladanifer* and *Erica andevalensis*), considering: (i) soil general physicochemical characterization; (ii) soil pseudo-total and bioavailable trace element quantification, obtained by chemical extractions; (iii) plant trace element content; and (iv) soil enzymatic activities. In the mine area, the soils were generally acid, poor in organic matter and in plant nutrients. Pseudo-total As, Cu, Pb and Zn concentrations were very high, and the same was true for their CaCl₂ 0.01 M extractable fractions. As a consequence of the soil poor physicochemical characteristics, the enzymatic activities measured (dehydrogenase, α -glucosidase, cellulase, protease, urease, and acid-phosphatase) were very low. Soil-plant interactions for *Cistus ladanifer* and *Erica andevalensis*, the most abundant plants in the mine area, were discussed. Results evidenced the possibility of using those plants in the phytostabilization of soils from sulphide mines.*



S12.06-P -21

SULFATE RELEASE FROM COAL OVERBURDEN TREATED WITH LIME IN A LONG TERM LEACHING EXPERIMENT

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This study aimed the study of the sulfate release from the overburden material of coal mine soils treated with different lime doses. The experiment was conducted in the laboratory in leaching columns, with four lime doses (0, 1/2, 1 and 2 times the estimated dose), with coal overburden and this mixed with 50% soil. The overburden and soil materials used were from Candiota Coal Mine, Rio Grande do Sul State, Brazil. The leachings were made with distilled water for seven years, totaling 260 leachings. pH and electrical conductivity (EC) were measured in all leacheates, sulfate were determined in 17 leacheates. The concentration of sulfate present in each leacheate was estimated by correlation with the EC. It was observed that only the double dose was able to maintain the pH above the zero dose during the whole experiment, reaching 4.5 in the overburden and 5.5 in the overburden + soil, against 3.0 to 3.5 in the other treatments. The EC gradually decreased, in cycles related to year seasons, inversely proportional to the lime doses in the beginning, with the half and full dose reaching the zero dose as the leacheates acidified. The rate of the sulfate release decreased with time, with the estimate of the sulfate release corresponding to 70 to 80% of the sulfate present in the initial material. The estimated number of leachings needed to release all the sulfate varies from 200 in the beginning to 550 in the last period, with longer estimates to the overburden.



S12.06-P -22

SUSTAINABLE TAILINGS TREATMENT, REMEDIATION AND REVEGETATION: A REAL-WORLD LONGITUDINAL STUDY OF THE KING RIVER "TAILINGS BEACH" COMPARING VIROMINE TECHNOLOGY TO A STANDARD APPLICATION AND DOING NOTHING

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The King River is considered the most polluted river in Australia; Reversing the damaging effects of the dumped tailings is technically and operationally impossible over any time frame, Its formation and current characteristics are very similar to many other mine sites around the world eg. the "tailings beach" formed in the Bahia de Portmán, near Murcia in Spain, which was formed when cadmium, cyanide, lead and zinc contaminated mine tailings were discharged into the Mediterranean. There are also similarities with the heavy metal contaminated soil at the Zinco site in Cartagena, Spain, which has been successfully treated using ViroMine Technology. The purpose of this paper is to present the findings of a tailings treatment and remediation program conducted at the King River by independent researchers. Parameters measured in the program included pH, Total Actual Acidity (TAA) and Total Potential Acidity (TPA), As, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Se, Zn, and vegetative cover density and type over a twelve-month period. The findings over the life of the study will be discussed including the comparability of Virotec's Terra B reagent versus lime for vegetative cover and the potential reuse of the treated acid mine drainage as process water



S12.06-P -23

TAILINGS COVER SYSTEM USING A SOLIDIFIED LAYER AND ITS FIELD PERFORMANCE

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A cover system for mine tailings with a solidified layer (called an engineered hardpan) was developed in this study to reduce water infiltration, acid generation and sulfide oxidation. Hydrated lime and waterglass were used to produce calcium silicate, which can serve as a binder when constructing a hardpan layer. The compressive strength of each solidified/stabilized material was found to be sufficient in the lab, and the amounts of heavy metals were significantly reduced in chemical leaching tests. Various characteristics of tailings may affect the layer's mechanical strength early on, but a long curing period is capable of compensating for these effects. Heavy metals were stabilized as carbonate-bound phases and sulfide minerals were surrounded by calcium silicate matrix, thereby preventing further reaction. To evaluate the field performance of the system, a hardpan layer was installed on top of tailings on a pilot scale. Leachate with high salt content was generated in the tailings layer in the early stages of monitoring, but after approximately 6 months, the objective was achieved as the hardpan layer gradually stabilized. Notably, during the heavy rainfall season of the later monitoring stage, water infiltration was continuously prevented by the system. It is reasonable to apply the system to the tailings with high risk (strong acid and high sulfide contents) considering strong alkaline properties of binders and site-specific field conditions.



S12.06-P -24

THE EFFECT OF TWO EARTHWORM SPECIES ON PB, ZN, CD AND CU BIOACCESSIBILITY AND MICROBIAL ACTIVITY IN SOIL AFTER ITS REMEDIATION WITH STABILIZATION

Udovic Metka^{*[1]}, Tica Dragana^[1], Lestan Domen^[1]

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The remediation with stabilization of soils polluted with potentially toxic metals (PTMs) implies reducing the bioavailability of PTMs, improving thus the functionality of soil. The stabilized soil is exposed to various abiotic and biotic environmental factors in time, which can affect the remedial effect. Among the biotic environmental factors, earthworms were found to significantly alter the biological, physical and chemical properties of soil with their activity. In the present study we observed the changes of PTM bioaccessibility and soil microbial activity in stabilized soil exposed to two earthworm species, Lumbricus terrestris and Dendrobaena veneta, used as model environmental biotic soil factors. Stabilization of industrially polluted soil (Arnoldstein, Austria) with 5% (w/w) of Slovakite and with 5% (w/w) of apatite resulted in significantly reduced PTM bioaccessibility, as assessed with selected one-step extraction tests and with a six-step sequential extraction. The remediation also reduced the environmental stress for soil microbial populations, mirrored in the reduced β -glucosidase activity in soil. In general, both earthworm species increased Pb, Zn, Cd and Cu bioaccessibility, decreasing thus the remediation efficacy. The two species had different effect on soil enzymatic activity, which can be attributed to species-specific microbial populations in earthworm gut acting on the ingested soil. It is important to consider the long-term fate of remediated soil, since its characteristic can change in time. The observed parameters should be however carefully selected, since the results of different chemical extractions may give contradictory results and test organisms are subjected to interspecific differences, as shown in this study.



S12.06-P -25

**THE GREENLAND PROJECT: GENTLE REMEDIATION OF TRACE ELEMENT
CONTAMINATED LA**

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Gentle remediation options (GRO) include various and in general plant-based approaches to remediate trace element contaminated soils at low cost and without significant negative effects for the environment. Although GRO comprise very innovative and efficient technologies, they are still not widely used as practical site solution due to several reasons of hindrance. Greenland will solve the remaining problems and make GRO ready for practical application. Contamination of soils with trace elements (TE) is worldwide still one of the major environmental problems. Conventional technologies for soil remediation are usually very expensive and may negatively affect or destroy soil structure and functions. Gentle soil remediation options (GRO), however, comprise environmentally friendly technologies that have little or no negative impact on the soil. The main technologies are phytoextraction, in situ immobilization and assisted phytostabilization. Although major progress has been achieved on the lab scale, success stories obtained on the field are still limited, in particular for phytoextraction. Also, the issue of valorization of the potentially contaminated plant biomass has insufficiently been addressed so far. Furthermore, further development is needed regarding the adequate determination of endpoints of GRO. Finally, the application of GRO as practical site solution may be hindered by legal frameworks and by insufficient knowledge of the decision makers. Therefore, an EU-FP7 (KBBE-2010-4) has been launched on January 1 2011 to address these issues and to make GRO ready for use as practical site solution.



S12.06-P -26

THE POTENTIAL OF CISTUS LADANIFER L. IN THE RESTORATION OF MINE TAILINGS AT RIOTINTO (SW SPAIN)

Mingorance M^a Dolores^{*[1]}, Baldés Benito^[2], Bargagli Roberto^[3], Monaci Fabrizio^[3], Guzmán Ignacio^[1], Rossini Sabina^[2]

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The Iberian Pyrite Belt is the largest metallic sulfide deposits in the world and the most mining and smelting activities occurred in the Rio Tinto district (SW Spain). For centuries this region has undergone environmental contamination. Despite extreme environmental conditions for vegetation colonization and survival, patches of vegetation grow on Riotinto mine tailings. Cistus is a rather common genus in the area with different species. In this study we evaluated the phytostabilization potential of C. ladanifer for implementing a self-sustaining vegetative cover in Riotinto mining district. The results showed that mining soils where the species grows are very acidic ($4.1 < \text{pH} < 5.0$), with low availability of water and micronutrients and concentrations of potentially toxic elements such as As, Cd, Cu and Pb well above regional guidelines for soils. Cistus ladanifer did not accumulate these elements since the ratio between their concentrations in leaves and soil was always < 1 . Very high concentrations of As, Cu, Ni and Pb were detected in the outer tissues of roots. Although the elemental composition of leaves was in the normal range for plants for almost elements, significant amounts of Cd, Mn, Ni and Zn were translocated to the aerial parts, and in leaf concentrations of Cd, Ni and Mn reached levels higher than controls and that are not considered normal for plants. Cistus ladanifer seems to tolerate the metal accumulation, it seems capable to adapt to these extreme conditions, and reproduce at self-sustaining levels to maintain a vegetative cover in Riotinto mine tailings.



S12.06-P -27

THE ROLE OF HYDROLOGICAL PROPERTIES AND THEIR EFFECTS ON GEOCHEMICAL PROCESSES FOR ESTABLISHING ROOT ZONES IN MINE WASTES

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The establishment of a stable landform is one of the primary objectives in mined land rehabilitation. The vegetation establishment and site-specific productivity can be used as primary indicators for assessing the success of rehabilitation. Substrates or soils used for the re-construction of such a landform often lack in suitable properties necessary to successfully grow vegetation. The exposure of non-weathered substrates to the natural elements and an increase of a reactive surface area as a result of mechanical processing of the geological material, initiates sudden and intensive geochemical reactions causing dissolution and precipitation of minerals. The intensity of these reactions is closely linked to the access of water and air to the reactive surfaces, which can be influenced by amending materials. Successful rehabilitation has to consider the extent and the kinetics of those weathering processes with the objective to be able to influence or to control them, in order to accelerate the development of the engineered soil matrix and horizons into “near” natural soil systems. Based on examples from case studies, the requirements to produce a suitable root zone for plant growth and the role additional measures play to improve such initial soil developments will be shown. It will be pointed out that amendments can alter the pore system of a substrate and hence influence the velocity of geochemical reactions and hydrochemical stabilisation. The differences in the intensity of reactions feeds back to the level of success of creating a suitable root zone for plant growth.



S12.06-P -28

TRANSPORT OF COPPER, CADMIUM AND NICKEL IN MINE SOILS AMENDED WITH MUSSEL SHELL RESIDUES

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The use of mussel shell residue (MS) from shellfish industry as an amendment in mine soils was studied regarding its ability to retain metals. A set of transport experiments were performed in 60 mm length x 10 mm internal diameter columns packed with mixtures of mine soil and MS (0, 12 and 48 t ha⁻¹). An 8 hours pulse of 2.5 mM of Cu, Cd or Ni as their nitrate salt was applied upwards with a flow rate of 2 mL h⁻¹. The retention of metals was poor in the mine soil without MS (39% of Cu, 28% of Cd, and 11% of Ni). Meanwhile, the addition of MS increased sharply the retention of metals. The mixture with 12 t ha⁻¹ showed a sorption capacity of 93% of Cu, 89% of Cd, and 80% of Ni of the total applied, and with the highest dose no measurable concentrations of any of the metals was detected in the column outlet. The pH measured in the outlet fractions increased with the MS dose from 3.5 to 7.5, indicating that precipitation processes could govern the retention of the metals in the columns with the highest MS dose. In addition, metal retention profiles for 48 t ha⁻¹ exhibited larger amounts of metal in the first centimetres suggesting the high efficiency of the process. These results revealed the suitability of mussel shell residues in the immobilization of metals and could be a candidate material in remediation of contaminated soils.



S12.06-P -29

URANIUM AND DECAY PRODUCTS IN SOME SOILS IN THE VICINITY OF FORMER URANIUM MINING SITES

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Some of the soils located downstream from former uranium mining sites can accumulate large amount of uranium (^{238}U and ^{235}U), decay products (^{230}Th , ^{226}Ra , ^{210}Pb , etc...) and heavy metals (such as Pb, Cd, etc...) presumably due to the releases after mining. Today the main risk arises from the enhancement of the dose rate recorded at those sites. The activity of uranium and thorium daughters was determined by low level gamma spectrometry in some river bank soils taken downstream former uranium mining sites, where high dose rate was monitored using a portable NaI-detector. The goal of the present study is mainly to quantify the excess of uranium and decay products occurring in the soils of the river bank. To this aim, the activities of uranium and daughters (coarsely between 1,000 and 10,000 Bq.kg⁻¹) are first compared with those recorded at reference sites, where no accumulation of the releases is assumed (coarsely between 10 and 100 Bq.kg⁻¹). The activities of uranium and daughters are also compared with those of thorium and decay products, which are supposed to reflect the baseline of the natural radioactivity. Lastly the activity ratios of the ^{238}U and ^{235}U decay daughters allow us to quantify the excess of radionuclides. Indeed, whereas the uranium decay products are generally close to the secular equilibrium in the soils (activity ratios close to unity), strong disequilibria are observed in the bank river soils. The enrichment of uranium and decay products are ranked as $^{238}\text{U} > ^{230}\text{Th} > ^{226}\text{Ra} > ^{210}\text{Pb}$.



S12.06-P -30

USE OF BIODIESEL BYPRODUCT AS NUTRIENTS SOURCE FOR IRON-MINE TAILING RECLAMATION

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Biodiesel as an alternative fuel has attracted increasing interest worldwide in recent years. During the biodiesel production process, glycerol is a primary by-product which is impure and of low economic value. Purification of this crude to obtain glycerol for use in food, pharmaceutical, or cosmetic industries provides an alternative for its disposal. This process produces a waste rich in C and minerals with potential use to improve quality of a degraded soil from an iron-mine tailing. The waste (DRS) from vegetal oil biodiesel production was provided by a Spanish company. The DRS was mixed with distilled water at a ratio of 2:1 (w/v) to reduce the viscosity before addition to an iron-mine tailing. The DRS solution was applied at 10% (w/w), alone or in combination with sewage sludge (stabilized and composted). The mixtures received an incubation step at 40% of soil field capacity followed by a drying step after which they were incubated again. Nutrient mineralization and microbial biomass were evaluated periodically. An increase in organic P mineralization rate but a drastic decrease in soluble ammonia was observed in soils amended with DRS compared to the non-amended soil. Biological activity of the DRS amended soil does not decrease during the drying step as occurs with the organic amendments due probably to the enhanced water retention of soil. These preliminary results support waste glycerol as potential soil amendment to supply mainly P and enhance soil biological activity.



S12.06-P -31

USE OF PGPB TO ENHANCE MICROBIAL FUNCTIONAL AND GENETIC DIVERSITY IN MINING SOILS: A PRELIMINARY STUDY WITHIN THE UMBRELLA PROJECT

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The soils of abandoned mining areas, characterized by high heavy metals content and often mobility, represent a significant problem all over Europe. It is urgent to choose sustainable methods for their remediation aimed to avoid heavy metals diffusion in the environment and uptake into the food chain. Bioaugmentation, which corresponds to the inoculation of appropriate bacteria in soil, can improve phytoremediation processes in polluted areas. The best candidates for bioaugmentation are Plant Growth-Promoting Bacteria (PGPB) that favour the plants' growth and are resistant to the metal concentrations in the environment. This study was carried out under the EC 7FP UMBRELLA project and aimed to evaluate the efficiency of bioaugmentation for enhancing the phytoremediation potential, through the enlargement of the functional and genetic microbial diversity in a heavy metals polluted soil. For this purpose a pot experiment was carried out by inoculating four strains of PGPB, isolated from the test site of Ingurtosu (Italy), in a soil collected from the test site of Ronneburg (Germany). Ten weeks later, an improvement of microbial activity and functional diversity was measured in the inoculated soil by MicroResp and enzyme activities, and furthermore the biodiversity Richness Index obtained by DGGE data, showed an evident increase of genetic diversity, while the physiological profiling at community level, measured by Biolog system did not reveal a significant difference between inoculated and uninoculated pots. In conclusion, bioaugmentation produced a positive effect on functional and genetic microbial diversity, which may lead to the improvement of a phytoremediation process.



S12.07-P - POTENTIALLY HARMFUL ELEMENTS IN SOILS

Tuesday 03 July 2012 from 17:00 to 18:30. Room Poster Areas

S12.07-P -1

THE INFLUENCE OF POLLUTED SOIL IN THE UPTAKE OF ARSENIC AND OTHER TOXIC METALS BY SOME GREEN AND RED VEGETABLES

Alberto De Diego, Leioa - Spain

S12.07-P -2

EFFECTS OF MYCORRHIZA AND SALICYLIC ACID ON GROWTH, CADMIUM CONTENT AND UPTAKE OF CORN (ZEA MAYS L.) SEEDLINGS IN CADMIUM CONTAMINATED MEDIA

Füsün Gülser, Van - Turkey

S12.07-P -3

EFFECT OF THE ORGANIC AMENDMENTS ON THE ECODYNAMICS OF TRACE METALS IN POLYCONTAMINATED ALKALINE TECHNO-SOIL

Nour Hattab, Orleans - France

S12.07-P -4

A COMPARISON OF BA, CU, NI, PB, V AND ZN CONCENTRATIONS DETERMINED BY AQUA REGIA AND XRF ANALYSES IN SOILS OF A MEDITERRANEAN REGION, CATALONIA, SPAIN.

Jaume Bech, Barcelona - Spain

S12.07-P -5

AN EVALUATION OF THE MEDALUS ESA INDEX (ENVIRONMENTAL SENSITIVITY TO LAND DEGRADATION), IN MURCIA REGION, SE SPAIN.

Carmen Perez- Sirvent, Murcia - Spain

S12.07-P -6

ARSENIC BIOACCESSIBILITY FACTOR AND RISK ASSOCIATED WITH CONTAMINATED SOIL INGESTION

Carmen Perez- Sirvent, Murcia - Spain

S12.07-P -7

ARSENIC CONTENT IN SOILS SUBJECTED TO ANTHROPIC POLLUTION

Silvia Rita Stazi, Viterbo - Italy



S12.07-P -8

ASSESSMENT OF HEAVY METALS POLLUTION IN SULPHIDE MINE AFFECTED-SOILS OF MADRID, CENTRAL SPAIN

Lorena Recio-Vázquez, Madrid - Spain

S12.07-P -9

ASSESSMENT OF THE PHYTOREMEDIATION POTENTIAL OF CANOLA (*BRASSICA NAPUS* L.) AND VETIVER (*VETIVERIA ZIZANIOIDES* L.) FOR TOXIC ELEMENTS

Claudia Zoani, Roma - Italy

S12.07-P -10

ASSIMILATION OF CADMIUM AND LEAD BY CORIANDER CULTIVATED IN AN ARGILLACEOUS BRAZILIAN SOIL

Madson De Godoi Pereira, Salvador - Brazil

S12.07-P -11

AVAILABILITY OF BA, CR, CU, NI AND ZN IN TROPICAL SOILS SUBJECTED TO THE ADDITION OF SEWAGE SLUDGE

Larissa Macedo Dos Santos, Pato Branco - Brazil

S12.07-P -12

BACKGROUND LEVELS OF POTENTIALLY HARMFUL ELEMENTS IN TERRACED AGROECOSYSTEMS OF NE ITALY: GEOGENIC VS ANTHROPOGENIC ENRICHMENT

Claudio Bini, Venice - Italy

S12.07-P -13

BIOINDICATORS IN ASSESSMENT OF SEDIMENT QUALITY

Sonja Gvozdenac, Novi Sad - Serbia

S12.07-P -14

CADMIUM ACCUMULATION IN PLANT AND SOIL FOLLOWING NINE YEARS OF PAPER MILL BIOSOLIDS AND LIMING MATERIALS APPLICATION

Antoine Karam, Quebec - Canada

S12.07-P -15

CAN COMPOST AND TRICHODERMA ENHANCE GIANT REED PHYTOEXTRACTION EFFICIENCY? RESULTS FROM A TWO YEAR OPEN FIELD EXPERIMENT

Nunzio Fiorentino, Portici - Italy



S12.07-P -16

CAN EARLY STAGES CONCENTRATIONS BE USEFULL TOOLS TO ENHANCE THE PREDICTION OF TRACE METAL UPTAKE BY VEGETABLES GROWN ON CONTAMINATED SOILS?

Gilles Colinet, Gembloux - Belgium

S12.07-P -17

CHEMISTRY OF VANADIUM IN SOIL- THE UNDERLYING BASIS FOR RISK ASSESSMENT

Inka Reijonen, Helsinki - Finland

S12.07-P -18

COLLOIDAL TRANSPORT OF URANIUM IN SOIL STUDIED BY BOTH STATIC AND DYNAMIC LIXIVIATION IN LABORATORY BATCH AND COLUMN SYSTEMS

Stephanie Harguindeguy, Pau - France

S12.07-P -19

COLUMN LEACHING TESTS ON SOILS CONTAINING LESS INVESTIGATED ORGANIC POLLUTANTS

Ute Kalbe, Berlin - Germany

S12.07-P -20

CONCENTRATIONS AND DISTRIBUTIONS OF CU, CR, NI AND PB IN SOILS OF THE PRELITORAL RANGE, SECTOR SENTMENAT (CATALONIA, SPAIN).

Jaume Bech, Barcelona - Spain

S12.07-P -21

CONCENTRATIONS OF CE, GA, MO, RB, SN, Y AND ZR IN SOILS OF CENTRAL CATALONIA, SPAIN

Jaume Bech, Barcelona - Spain

S12.07-P -22

CONDITIONS FOR GROWTH OF FOREST VEGETATION ON EMBANKMENTS AFTER COAL MINING

Jaume Bech, Barcelona - Spain

S12.07-P -23

COPPER FRACTION ACCUMULATION IN SANDY SOILS, CULTIVATED WITH VINES AND WITH HISTORY OF CUPRIC FUNGICIDE APPLICATION IN THE SOUTH REGION OF BRAZIL

Gustavo Brunetto, Florianópolis - Brazil



S12.07-P -24

DISTRIBUTION OF HEAVY METALS IN RICE FARMING SOILS OF A COASTAL WETLAND (L'ALBUFERA DE VALENCIA, SPAIN)

Vicente Andreu, Valencia - Spain

S12.07-P -25

EFFECT OF LIMING ON THE DISTRIBUTION OF MANGANESE AND MANGANESE UPTAKE BY MAIZE GROWN IN A COARSE TEXTURED SOIL

Antoine Karam, Quebec - Canada

S12.07-P -26

EFFECT OF TIN OXIDE (SNO₂) NANOPARTICLES ON SOIL ORGANISMS (MICROBIAL BIOMASS, LUMBRICUS RUBELLUS)

Serena Carbone, Bologna - Italy

S12.07-P -27

ESTIMATION OF POTENTIAL POLLUTION IN SOIL AROUND A CLOSED INDUSTRIAL AND URBAN WASTE DUMP SITE IN HERNANI (BASQUE COUNTRY, NORTH OF SPAIN)

Alberto De Diego, Leioa - Spain

S12.07-P -28

EVALUATING A SOIL QUALITY STANDARD FOR CD IN AGRICULTURAL MEDITERRANEAN SOILS UNDER A NON-ACCUMULATOR CROP.

Luis Recatalá Boix, Moncada (Valencia) - Spain

S12.07-P -29

EVALUATION OF THALLIUM TOXICITY WITH PLANT BIOASSAYS AND BIOCHEMICAL TESTS

Laura Crippa, Milano - Italy

S12.07-P -30

EXPERIENCE OF THE REMEDIATION OF SOILS POLLUTED BY HEAVY METALS IN IRRIGATION DISTRICT IN SOUTHERN GEORGIA

Besik Kalandadze, Tbilisi - Georgia

S12.07-P -31

FIELD EVALUATION OF ONE CU-RESISTANT TOBACCO VARIANT AND ITS PARENTAL LINES FOR COPPER PHYTOEXTRACTION AT A WOOD PRESERVATION SITE.

Michel Mench, Talence - France



S12.07-P -32

FRAMEWORK TRANSFORMATION OF FAU TYPE ZEOLITE IN HIGH ALKALINITY

Leen Van Tendeloo, Leuven - Belgium

S12.07-P -33

GEOCHEMISTRY ANALYSIS OF RARE EARTH ELEMENTS OF SOUTHERN ITALY SOILS

Ilaria Guagliardi, Rende (CS) - Italy

S12.07-P -34

HEAVY METAL ADSORPTION IN SALT-AFFECTED LAKE SEDIMENTS AT FEHÉR-LAKE, SZEGED, HUNGARY

Gábor Bozsó, Szeged - Hungary

S12.07-P -35

HEAVY METAL CONTENT IN CULTIVATED SOILS OF UPPER RIO NEGRO VALLEY (PATAGONIA, ARGENTINA)

Jaume Bech, Barcelona - Spain

S12.07-P -36

INCREASING THE KNOWLEDGE ON THE TRANSFERENCE OF ZN TO AN ACCUMULATOR CROP (LACTUCA SATIVA L.) IN REPRESENTATIVE MEDITERRANEAN SOILS

Luis Recatalá Boix, Moncada (Valencia) - Spain

S12.07-P -37

INFLUENCE OF SOIL PROPERTIES ON POTENTIALLY HARMFUL ELEMENTS (PHES)

Ilaria Guagliardi, Rende (CS) - Italy

S12.07-P -38

MECHANOCHEMICAL IMMOBILIZATION OF COPPER BY DIOCTAHEDRAL AND TRIOCTAHEDRAL SMECTITES

Maria D.r. Pizzigallo, Bari - Italy

S12.07-P -39

MERCURY ACCUMULATION IN SOILS AND CROPS IN A MINING REGION OF SAN JOAQUÍN, QUERETARO, MÉXICO.

Sara Solís-Valdez, Querétaro - Mexico



S12.07-P -40

METHODOLOGY FOR ASSESSING ENVIRONMENTAL HAZARDS RESULTING FROM GEOCHEMICAL ANOMALIES OF TOXIC ELEMENTS IN SOILS OF THE IBERIAN MASSIF (SW SPAIN)-

Isabel Gonzalez, Sevilla - Spain

S12.07-P -41

MODEL OF PROPOSED TREATMENT FOR IN SITU REMEDIATION IN PORTMAN BAY

Carmen Perez- Sirvent, Murcia - Spain

S12.07-P -42

NICKEL PRESENCE IN OLIVE OIL MILL WASTE DISPOSAL AREAS

Sid Theocharopoulos, Athens - Greece

S12.07-P -43

NITRATE LEACHING AND NITROGEN TRANSFORMATIONS ON A SAND LOAM SOIL UNDER DIFFERENT FORMS OF NITROGEN AND SULPHUR APPLICATION

Safaa Mahmoud, Giza - Egypt

S12.07-P -44

PB TOXICITY VALUES FOR A NON-ACCUMULATOR CROP IN REPRESENTATIVE AGRICULTURAL MEDITERRANEAN SOILS.

Luis Recatalá Boix, Moncada (Valencia) - Spain

S12.07-P -45

PHES CONTAMINATION FROM A MINING SITE IN NE ITALY: ASSESSMENT OF METAL ACCUMULATION AND TOXICITY IN WILLOW

Mohammad Wahsha, Venice - Italy

S12.07-P -46

PHES INDUCE ADVERSE EFFECTS ON WILD PLANTS GROWING ON MINE WASTE. PRELIMINARY RESULTS ON DANDELION (TARAXACUM OFFICINALE WEBER) FROM VALLE IMPERINA (ITALY).

Claudio Bini, Venice - Italy

S12.07-P -47

PHOSPHORUS FRACTIONS IN VINEYARD SOILS IN THE SOUTH REGION OF BRAZIL

Jucinei José Comin, Florianópolis - Brazil



S12.07-P -48

POTENTIAL USE OF BAMBOOS AS BIOFILTERS IN BELGRADE

Ljubinko Jovanovic, Belgrade - Serbia

S12.07-P -49

*PRELIMINARY STUDY ABOUT MERCURY THERMAL DESORPTION ON SOILS FROM
ALMADÉN DISTRICT AREA*

Maria Jose Sierra, Madrid - Spain

S12.07-P -50

*THE INFLUENCE OF INTERFERING IONS IN SOIL ON CHELATE-ASSISTED
PHYTOEXTRACTION OF COPPER*

Tijana Zeremski, Novi Sad - Serbia

S12.07-P -51

*TO INVESTIGATE THE VARIATION OF HEAVY METALS CONCENTRATION IN DEPOSITS OF
ZAYANDERUD RIVER BED*

Ali Izadi Ghorveh, Esfahan - Iran, Islamic Republic of

S12.07-P -52

*TRACE ELEMENTS ACCUMULATION AND TRANSLOCATION IN CISTUS LADANIFER L.
GROWING IN PORTUGUESE IBERIAN PYRITE BELT MINE AREAS*

Erika S. Santos, Loulé - Portugal

S12.07-P -53

*TRANSFER OF CD, CU AND ZN FROM SOIL INTO FOOD CROPS IN THE MASHAVERA
VALLEY, GEORGIA*

Levan Navrozashvili, Giessen - Germany

S12.07-P -54

*USING LIBS TO INVESTIGATE ELEMENTAL CONTENT IN PLANTS AND COMPOSTS DURING
SOIL REMEDIATION PROCESSES*

Claudio Zacccone, Foggia - Italy

S12.07-P -55

*VALIDATION OF BATCH TESTS FOR THE EXAMINATION OF LEACHING BEHAVIOUR OF
ORGANIC POLLUTANTS FROM CONTAMINATED SOILS*

Wolfgang Berger, Berlin - Germany



S12.07-P -56

VICIA FABA RESPONSES TO LEAD POLLUTION AND ROLE OF METAL SPECIATION

Muhammad Shahid, Vehari - Pakistan

S12.07-P -57

ZEOLITES AS SORPTION SINK FOR $^{137}\text{Cs}^+$ IN ULTRA-ALKALINE CONDITIONS

Eric Breynaert, Leuven - Belgium



S12.07-P -1

THE INFLUENCE OF POLLUTED SOIL IN THE UPTAKE OF ARSENIC AND OTHER TOXIC METALS BY SOME GREEN AND RED VEGETABLES

Trebolazabal Josu^[1], Rodriguez-Iruretagoiena Azibar^[1], Maguregi Maite^[1], Morillas Hector^[1], Fdez-ortiz De Vallejuelo Silvia^[1], De Diego Alberto^{*[1]}, Madariaga Juan Manuel^[1]

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The past and current metal and steel industry in the Basque Country, together with related mining activities, have produced an important metal impact in soils, affecting their present and future uses. In this work, soil and five orchard crops (tomatoes, raspberry, pepper, chard and artichoke) were collected in a potentially polluted farm, close to a former Pb-Zn mining area, to measure As, Cd, Co, Cr, Cu, Ni, Pb and Zn concentrations. Analyses were performed by both acid digestion/ICP-MS and XRF mapping. The Basque Indicative Values for Assessment (VIE) establish the risk acceptance limits for different soil uses. According to this scale, As and Cd show concentrations in the soil samples which indicates no risk for human health. Cr and Ni are in the slight risk level, while Co, Cu, Pb and Zn are in the moderate one. None of the metals investigated are in the high or very high risk level. The arsenic content in the five orchard crops were below (< 0.45 mg/kg) the As concentration in soil (20.4 mg/kg). Arsenic bioaccumulation ($c_{veg}/c_{soil} \cdot 100$) in crops was negligible for tomato whilst the maximum was obtained for artichoke (2.2%). Other metals showed similar trends, with bioaccumulations of 0.72% for Cr, 2.1% Ni, 0.71% Pb and 5.8% Zn in chard, and 14.1% for Cu in tomato. Bioaccumulation of Cd was significantly higher, from 32.5% in raspberry to 142.5% in artichoke, being negligible in tomato. Acknowledgements This work has been financially supported by Basque Government through ETORTEK BERRILUR 3 project (ref. IE09-242).



S12.07-P -2

EFFECTS OF MYCORRHIZA AND SALICYLIC ACID ON GROWTH, CADMIUM CONTENT AND UPTAKE OF CORN (ZEA MAYS L.) SEEDLINGS IN CADMIUM CONTAMINATED MEDIA

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The objectives of this study were to determine the effects of mycorrhiza and salicylic acid (SA) applications on plant growth, cadmium content and uptake of corn (Zea mays L.) seedlings grown in cadmium contaminated media. Three different doses of salicylic acid (0- 0.05-0.10 mmol) were treated into 2 kg soil with and without mycorrhiza application. Mycorrhiza and SA applications significantly increased plant length, fresh and dry weights, and decreased Cd contents and uptakes of corn seedlings. The lowest plant length (26.63 cm), fresh (3.74 g) and dry weight (1.63 g) means were obtained in the control treatment without mycorrhiza and SA applications. While the highest plant length (56.17 cm) and fresh weight (21.46 g) means were obtained in 0.10 mmol SA treatment without mycorrhiza application, the highest dry weight mean (5.70 g) was determined in 0.10 mmol SA treatment with mycorrhiza application. While the highest Cd content (3.37 ppm) and uptake (5.95 ppm) of the seedlings were determined in the control, the lowest Cd content (0.307 ppm) and uptake (1.48 ppm) were in 0.1 mmol SA and 0.05 mmol SA treatments with mycorrhiza applications, respectively. As a result, mycorrhiza and SA applications had positive effects on corn seedlings growth in Cd contaminated media.



S12.07-P -3

EFFECT OF THE ORGANIC AMENDMENTS ON THE ECODYNAMICS OF TRACE METALS IN POLYCONTAMINATED ALKALINE TECHNO-SOIL

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Trace metals are major contaminants in soils resulting from domestic, agricultural activities and industrial (Adriano, 2001). The methodological guide of the French Geological Survey (BRGM) establishes the uncompleted knowledge on trace elements (TE) in soils, particularly Cu, Cr, Zn and As (Laperche et al, 2003). In the present report, the ecodynamics of As, Cr, Cu and Zn were studied in phytomanaged soils contaminated with high concentration of trace elements from a steel smelter site (techno-soil ;St-Etienne; FRANCE). This techno-soil is managed with natural attenuation: organic compost (MO or MIATE), 'rameal' chipped wood (BRF). This study aims at obtaining data on the concentration and speciation of trace elements (TE) in the water-soil-plant system and on the soil reaction mechanisms for the TE. Biotests (dwarf beans) were carried out on soil sampled from the site with 80 % of the soil water saturation capacity to investigate the effects of the soil treatments on soil ecotoxicity, studying metal trace speciation with two different techniques: Rhizon samplers and DGT (assessment of the Diffusive Gradients in Thin-films technique). This experimental set-up was applied for two years to monitor the effect of amendments on the mobility and the availability of the TE in the soil solution. Our results showed that the organic matter added to soil and specially the MIATE, increased the concentrations of dissolved Cu and Zn and decreased that of Zn in the solution of soil while the Cr and Cu were non-labile in this soil.



S12.07-P -4

A COMPARISON OF BA, CU, NI PB, V AND ZN CONCENTRATIONS DETERMINED BY AQUA REGIA AND XRF ANALYSES IN SOILS OF A MEDITERRANEAN REGION, CATALONIA, SPAIN.

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The objectives of this study were (1) to determine by means of X-ray fluorescence (XRF) the barium (Ba), copper (Cu), nickel (Ni), lead (Pb), vanadium (V), and zinc (Zn) content in 27 soil plots (54 samples, two different layers: 0-10 and 10-20 cm) from Manresa, NE Spain, (2) to examine whether there was a significant relationship between aqua regia extractable and XRF analysed metal levels. The median potentially harmful element concentrations (mg kg⁻¹) were Ba 562 (range 147-954), Cu 21.5 (range 7-61), Ni 26 (range 13-39), Pb 23 (range 11-61), V 74.5 (range 38-121) and Zn 70 (range 28-137). Element concentrations for these soils were lower than the values published for European Union Soils and the World. The element-specific relationships between the XRF and aqua regia methods were highly significant for Cu, Ni, Pb and Zn.



S12.07-P -5

AN EVALUATION OF THE MEDALUS ESA INDEX (ENVIRONMENTAL SENSITIVITY TO LAND DEGRADATION), IN MURCIA REGION, SE SPAIN.

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Most of arid and semi-arid Mediterranean areas are affected by land degradation and desertification due to interaction of a set of natural (bio-physical) and anthropogenic factors having different temporal and spatial variability. In order to properly understand this phenomenon, it is important to identify and describe their main driving forces and the sensitivity of the lands. To this respect, the concept of environmental sensitivity was established in order to identify areas prone to land degradation on the basis of their environmental characteristics. An environmentally sensitive area to degradation (ESA) could be considered as a spatially delimited area in which some key aspects related to its sustainability are unbalanced and not sustainable for a particular environment. An assessment of the sensitivity to land degradation have been carried out in Murcia Region, SE Spain, by means of a modelling approach developed in the European Commission funded MEDALUS project (Mediterranean Desertification and Land Use) which identifies such areas on the basis of an index (ESA index) that incorporates data on environmental quality (climate, vegetation, soil) as well as anthropogenic factors (management). The Soil Quality Index indicates that most of territory is of low quality (50%) and only 0.9% showed high quality. The rest of samples showed moderate quality. ESAI results showed that 19% of samples are included in C2 subclass and affected by a critical desertification risk, 78% in C3 subclass, critical and 3% included in F3, fragile desertification risk.



S12.07-P -6

ARSENIC BIOACCESSIBILITY FACTOR AND RISK ASSOCIATED WITH CONTAMINATED SOIL INGESTION

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Arsenic is a carcinogenic metalloid and therefore should be borne in mind in studies of the risks associated with the possible accidental ingestion of soil in areas with a high level of this element. In this work, the concentrations of bioavailable As in the soils with mining-influenced, in SE Spain are determined. The risk posed by the accidental ingestion is studied in two soil fractions (<2mm and <250µm), taking into consideration the possible uses of the soils (residential/agricultural) and possible receptors (adults and/or children). The properties and mineralogical composition of the samples (26 soil samples in total) are taken into account. The results obtained in this work showed that the use of the traditional CDI (M2) for the characterization of the present risk may overestimate the risk existing in the zone, leading to a problem in the management of contaminated soils. The importance of considering the amount of bioaccessible As in the <250 µm fraction before permitting the soils to be used for residential purposes, as beaches or for agriculture near temporary watercourses or imposing restrictions is pointed out.



S12.07-P -7

ARSENIC CONTENT IN SOILS SUBJECTED TO ANTHROPIC POLLUTION

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Trace amounts of arsenic (As) are present in the pedosphere, lithosphere, hydrosphere, atmosphere and in plant and animal tissues. As is mainly inherited from soil parent materials, but it can also accumulate in soils due to inputs through human activities. As may be present in different chemical forms and in different soil compartments: thus reliable methods to measure its concentration and bioavailability are necessary. Furthermore, in relation to its mobility and availability, As may have deleterious effects on soil microbial community and functions as microbes are key players in many ecosystem processes. Aim of the present study was to: 1) test different analytical methods to determine total As content in soils; 2) perform a sequential chemical extraction of soil in order to evaluate As bioavailability and the amount of As associated with different soil fractions (Wenzel et al. 2001); 3) determine the effect of different levels of As contamination on soil microbial biomass, its metabolic activities and functional diversity assessed using enzyme activities representative of C, P and S cycles 4) study changes in total microbial community structure by analyzing the ester-linked phospholipid fatty acid (PLFA) composition of the soil. Soils were sampled within an area originally occupied by the gold mine of Pestarena (VB province, Northern Italy) where the extractory activity was definitely stopped in 1960. Key words : arsenic, metal pollution, sequential extraction, microbial functional diversity, PLFA, soil enzymes



S12.07-P -8

ASSESSMENT OF HEAVY METALS POLLUTION IN SULPHIDE MINE AFFECTED-SOILS OF MADRID, CENTRAL SPAIN

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The uncontrolled extraction of mineral resources is considered one of the major anthropogenic sources of soil pollution. In Spain, exploitation of metallic mineral deposits and its subsequent abandonment in last decades has lead to significant environmental hazard for natural systems. In this research, potentially contaminated soils surrounding an old chalcopyrite mine district in Madrid (Central Spain) have been studied. The focus is to assess the degree of pollution by heavy metals and other trace elements as a consequence of the extraction and treatment of sulphides for several centuries. For this purpose, 15 soil samples were collected considering the distance to the source of pollution and the soil depth. The soil heavy metals speciation was determined using the BCR sequential extraction procedure (Community Bureau of Reference, European Commission) and analysed by ICP-MS for 14 elements. The total contents of these elements have been calculated as the sum of the four BCR fractions. The results showed heavy metals concentrations decreasing with the distance from the source of pollution. The highest amounts of these elements (mg·kg⁻¹) were found at sites close to livestock pastures (As 80±2; Cu 1679±13; Cd 5.5±0.1; Co 867±12). These values exceed the allowed limits of the local environmental regulation. Moreover, the amounts (mg·kg⁻¹) of some trace elements associated with the bioavailable fraction of the soil are high (Cu 419±5; Cd 3.6±0.1), suggesting that further research is needed for a better evaluation of the potential risk of contamination dispersion and the consequences of this process on the whole ecosystem.



S12.07-P -9

ASSESSMENT OF THE PHYTOREMEDIATION POTENTIAL OF CANOLA (*BRASSICA NAPUS* L.) AND VETIVER (*VETIVERIA ZIZANIOIDES* L.) FOR TOXIC ELEMENTS

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*Phytoremediation permits to contain or remove contaminants in soils by using pollutant-accumulating plants that can immobilize or extract and translocate them to the harvestable parts. We report about a study carried out for assessing the phytoremediation potential of canola (*Brassica Napus* L.) and vetiver (*Vetiveria Zizanioides* L.) in soils contaminated by toxic elements, in the framework of a pot-experiment. The plants were grown in soils sampled in a contaminated area, using two different agricultural conditions: with and without phosphatic fertilization. With the aim to consider all the input and output of toxic elements, not only soils and vegetable tissues, but also the irrigation waters (or rainwater), the added fertilizers and the percolation waters were analyzed. Main physical-chemical properties of soils were determined; the total contents of toxic elements before and after the plant growing were compared. As concerns canola and vetiver plants, the toxic element contents were determined in the different tissues apart. Moreover, considering that the total elemental content in soils is insufficient – in respect to the bioavailable fractions – to explain their translocation from soils to plants, soils were submitted to selective extraction procedures for obtaining information about the mobile (or mobilizable) fractions of toxic elements. In this way, it was possible to determine the Translocation Factor (TF) of each toxic element in the two plant species in the two different agricultural conditions and to evaluate the Bioconcentration Factors (BF), in respect not only to the elemental total contents in soils, but also to the bioavailable fractions.*



S12.07-P -10

ASSIMILATION OF CADMIUM AND LEAD BY CORIANDER CULTIVATED IN AN ARGILLACEOUS BRAZILIAN SOIL

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This work evaluated the transfer of cadmium and lead from a typical Brazilian argillaceous soil (Chromic luvisol) to coriander (Coriandrum sativum). For this purpose, plastic vessels were filled with 3 kg of soil previously contaminated with different levels of Cd (625–2,500 mg kg⁻¹) and/or Pb (1,250–5,000 mg kg⁻¹). In a next step, all of the vessels (40, including 3 controls) were transferred to greenhouses where coriander seeds were planted. After 45 days under humidity control, the plant tissues were collected and dried at 60 °C in a stove for 72 h. After that, samples were crushed, sieved (0.053 mm), and stored in polyethylene bottles. The next step comprised acidic digestion in a microwave oven (high pressure) using 14 mol L⁻¹ HNO₃ and 30% (m/v) H₂O₂. Finally, the digested samples were analysed by flame atomic absorption spectrometry in order to obtain the total contents of cadmium and lead. The results showed 100% mortality for all levels of contamination with cadmium and with cadmium and lead together. Nevertheless, coriander grown in soil containing only lead did not die regardless of the level of contamination, and the maximum concentration was 146.3 ± 11.6 mg kg⁻¹, corresponding to less than 3% of the initial lead mass (at the 5,000 mg kg⁻¹ level). Thus, cadmium was identified as the phytotoxic element for coriander due to its smaller charge density and reduced affinity with clays (ca. 12%, m/m) contained in Chromic luvisol.



S12.07-P -11

AVAILABILITY OF BA, CR, CU, NI AND ZN IN TROPICAL SOILS SUBJECTED TO THE ADDITION OF SEWAGE SLUDGE

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Considering the agronomic importance of the provision of agricultural sewage sludge, and its growing concerning environmental point of view, in this work it was evaluated the availability of Ba, Cr, Cu, Ni and Zn in two tropical soils, Typic Eutrorthox and Typic Haplorthox, subjected to the addition of sewage sludge for 11 consecutive years. Sequential extraction, and a methodology for determining the availability of elements potentially toxic in soils subjected to the addition of sewage sludge from the assessment of humic fractions, fulvic acid 1, fulvic acid 2, humic acid and humin + mineral obtained during the chemical fractionation of soil organic matter was proposed. Availability studies presented significant amount of Cr, Cu, Ni and Zn bounded to the Mn and Fe oxides and residual fractions, suggesting the low availability of these elements in the evaluated conditions. The chemical fractionation of soil organic matter showed results confirming the high concentration of potentially toxic elements in the oxides in the Typic Eutrorthox soil and in the humic acid in the Typic Haplorthox soil. Although the sewage sludge added to soil increase the levels of potentially toxic elements, these are present in the most stable fractions of soil. In other words, less available or less mobile.



S12.07-P -12

BACKGROUND LEVELS OF POTENTIALLY HARMFUL ELEMENTS IN TERRACED AGROECOSYSTEMS OF NE ITALY: GEOGENIC VS ANTHROPOGENIC ENRICHMENT

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One of the most important man-induced land transformations since many centuries is the terraced landform, an agricultural technique that characterizes many agroecosystems all over the world. The main objective of the present study is to ascertain the concentration of trace elements in such terraced agroecosystems, and in the conterminous areas not affected by terracing. Land use change, indeed, may alter the soil chemical composition, introducing PHEs in the environment. Six different terraced landforms were selected; totally, 35 representative soil profiles were opened and sampled. Specific analyses of 15 potentially harmful trace elements (Sb, As, Be, Cd, Co, Cr, Hg, Ni, Pb, Cu, Se, Sn, Tl, V, Zn) were carried out in the laboratory by ICP-MS after digestion with HF and HClO₄. The soils investigated present generally low contents of trace elements, which are related to the nature of parent material. The recorded background levels of PHEs, therefore, are of geogenic origin. The extreme parts of the territory investigated, however, present significant concentrations of some metals. In particular, Cu, Pb and Zn contents in surface horizon suggest an anthropogenic enrichment. The human contribution could be due to past mine activities, and metals could have been vehicled southward through riverine and/or wind transport. Moreover, Sn shows amounts overall above the permitted threshold. In some cases it is not possible to assess if the presence, or the concentration level, of a metal could be related to natural sources or to recent, or past, human activities.



S12.07-P -13

BIOINDICATORS IN ASSESSMENT OF SEDIMENT QUALITY

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*Periodical maintenance of irrigation systems provides large amounts of dredged sediment that are used in agriculture. However, sediment often contains toxic and persistent substances (pesticides, heavy metal and organic pollutants) and presents the risk for cultivated plants. Thus it is necessary to evaluate its quality, detect and characterize contamination and determine pollutants bioavailability for plants. The aim of this work was to assess the quality of sediment (pore water-PW) from Great backa (GBC) and Aleksandrovacki canal (AC), that are regarded as the most risky watercourses in region, but are intensively used in agriculture. Heavy metal content was determined according to EPA 7000B, and biological effects were evaluated using germination, root elongation and shoot growth of white mustard (*Sinapis alba* L.) (ISTA Regulations book, 2011). Distilled water was control variant. Chemical analysis showed that sediment from GBC was contaminated with Cu²⁺, and from AK with Cu²⁺, Cr³⁺ and Ni²⁺. PW from GBC and AK did not affect seed germination (88%, 78.8%) that was at the same level of significance with control (83.2%). PW from GBC significantly inhibited root elongation and stimulated shoot growth, while PW from AC highly significantly stimulated both, root elongation and shoot growth, compared to control. Results indicate at good potential of white mustard in detection of higher Cu²⁺, Cr³⁺, and Ni²⁺ content in sediment, and higher sensitivity of morphological parameters (root elongation and shoot growth) compared to germination, that was not a valid indicator of higher levels of mentioned heavy metals.*



S12.07-P -14

CADMIUM ACCUMULATION IN PLANT AND SOIL FOLLOWING NINE YEARS OF PAPER MILL BIOSOLIDS AND LIMING MATERIALS APPLICATION

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*Residues from pulp and paper Kraft mills contain crop nutrients but also trace metals that can harm the environment when applied in large amounts to agricultural land. This study investigated the effects of repeated application over nine years of paper mill biosolids (PB) and liming materials on accumulation of several metals especially Cd in plant and soil. The study was conducted (2000-2008) in eastern Canada on a loamy soil. The PB treatments (0, 30, 60, and 90 Mg wet/ha) were surface hand-applied around 4 to 5 wk after crop seeding. Liming materials (calcitic lime [CL], lime mud [LM], wood ash [WA]) were applied at a rate of 3 Mg wet/ha along with 30 Mg wet PB/ha. Soil samples were collected on the 0-30 cm depth at corn (*Zea mays* L.) harvest on October 2008, and analyzed for Cd concentration using different methods. Repeated annual application of PB resulted in increase of plant Cd concentration varying between 3.6 with the control to 6.2 µg/kg DM with the highest PB application (90 Mg wet/ha). Alkaline residuals, however, decreased Cd availability that could be attributed to soil pH increase. The percentage of Cd recovery in plants was about 4% when PB was applied. Results of this study indicated that PB and liming materials, when applied at the provincial regulation for land application, have a limited impact on Cd availability.*



S12.07-P -15

CAN COMPOST AND TRICHODERMA ENHANCE GIANT REED PHYTOEXTRACTION EFFICIENCY? RESULTS FROM A TWO YEAR OPEN FIELD EXPERIMENT

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*A large part of agricultural polluted sites in the Campania region (southern Italy) is characterized by a PTEs content slightly higher than the Italian legal threshold (2 mg kg⁻¹). These contamination levels make phytoextraction a suitable reclamation strategy, but the lack of open field experiments is still a limiting factor for a realistic evaluation of this technique. For this reason a two year field plot experiment was carried out on a Cd contaminated soil, with the aim to assess the effectiveness of assisted phytoextraction with Giant reed (*Arundo donax* L.). Fertilization with MSW Compost was made to increase N and Cd availability to plants, while *Trichoderma* inoculation of rhizomes was made to enhance root uptake efficiency. The two management strategies were factorial combined resulting in 4 treatments: not inoculated and not fertilized (NT-NC); inoculated and not fertilized (T-NC); not inoculated and fertilized (NT-C) and inoculated and fertilized (T-C). The experimental scheme was a randomized complete block design with 3 replicates. Above biomass production and Cd uptake were positively affected by both factors in the two years. Compost fertilization significantly increased Cd availability as assessed by EDTA-extraction in the first year while *Trichoderma* reduced Cd availability in the second year. These results highlighted the positive effect of compost fertilization on Cd biological availability and uptake. Though estimated reclamation time was too high (20-30 years) as compared to other techniques, the industrial demand of Giant reed biomass for energy and polymers production could compensate this gap ensuring adequate income for farmers.*



S12.07-P -16

CAN EARLY STAGES CONCENTRATIONS BE USEFULL TOOLS TO ENHANCE THE PREDICTION OF TRACE METAL UPTAKE BY VEGETABLES GROWN ON CONTAMINATED SOILS?

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*Quality of vegetables cropped on soils rich in metallic trace elements is of major concern. Numerous empirical models (based on soil characteristics, chemical extractions, or even uptake by ray grass) have been developed in years to predict the soil-plant transfer of metal pollutants. Still, these models are not fully satisfying for predicting trace metal concentrations in a given vegetable. In our study, we investigate the relevance of using the concentrations of pollutants at the first stages of vegetables growth to determine their concentrations at maturity. Eight soils of kitchen gardens contaminated by atmospheric fallout from metalliferous-ore treatment activities have been sampled. They were sown with head lettuce (*Lactuca Sativa Capitata* L., cv Appia) and green bean (*Phaseolus vulgaris*, cv Argus), then cultivated in greenhouse for 2 months. Four replicates were made for each sol/vegetable/stage combination. Lettuces were harvested at 2-4; 5-7; 8-10 leaves; head initiation; and maturity stages. Green beans were harvested at 2; 4 leaves; flowering, and maturity stages. Total concentrations in Cd, Cu, Ni, Pb and Zn were measured in soils and vegetables. Besides, pedological characteristics (pH_{water}, pH_{KCl}, organic carbon, clay content) and bioavailable (EDTA extraction) and soluble (CaCl₂ 0.01M extraction) trace elements concentrations in soils were also measured. Statistical correlations followed by multiple regressions were performed to estimate the final concentrations of metallic trace elements in lettuces and green beans from soil characteristics. Then we estimated the accuracy gained in the prediction when taking the concentrations measured at the different growth stages into account.*



S12.07-P -17

CHEMISTRY OF VANADIUM IN SOIL- THE UNDERLYING BASIS FOR RISK ASSESSMENT

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The main object of this study was to unravel the environmental and ecological risks related to the chemical reactions of vanadium (V) in the soil. This transition metal is a redox-sensitive element existing in multiple oxidation states. However, in the environmental solutions there are only two stable oxidation states, +IV and +V, from which +V is often considered more toxic. The effect of oxidation state and soil pH on the bioavailability, mobility and ecotoxicity of V was studied with two test soils: 1) field soil with relatively high soil organic matter (OM) content and 2) coarse mineral soil without SOM. The trial was completed with a systematic incubation test (variable soil pH values), water extraction (mQ-water, 1:50 dw/V) and sequential extraction (0.25 M KCl, 0.1 M KH₂/K₂HPO₄, 0.1 M NaOH, 0.25 M H₂SO₄, 1:10 dw/V). Soil analyses were combined with an endogenic earthworm ecotoxicity test. Fresh soil samples (60 % of water holding capacity, 4 mm sieving) were incubated (3-12 weeks, +22°C) separately with V(+V) (added as NaVO₃) and V(+IV) (added as VOSO₄). Solubility, potential mobility and ecotoxicity increased in the soil samples with higher pH values. Also, toxicity of V was greater in the mineral subsoil than in the surface soil containing OM. This was attributable to OM able to act as reductant of V(+V) and adsorbent for V(+IV). The difference in the toxicity of V(+IV) and V(+V) was not clear, especially at higher pHs. It seems that the soil properties are crucial factors dictating the ecotoxicity of V.



S12.07-P -18

COLLOIDAL TRANSPORT OF URANIUM IN SOIL STUDIED BY BOTH STATIC AND DYNAMIC LIXIVIATION IN LABORATORY BATCH AND COLUMN SYSTEMS

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Use of the naturally-occurring actinide uranium in the nuclear industry may result in local increases of uranium concentration in soils. Soil water under oxic or suboxic conditions, where U(VI) is present, may carry high concentrations of uranium. Uranium retention occurs on various soil minerals, but colloids (species from 1 nm to 1 µm according to IUPAC [1]) are ubiquitous in the environment and are likely to act as rapid vehicles that enhance the transport of uranium through soil toward groundwater. To study the uranium mobility in a site of environmental interest and focus on the role of colloidal phase, an original analytical approach was used. Thus, experiences were jointly carried out by batch and column using two different soil horizons from the same site (an organic soil, and a chalky deeper horizons). Rain water infiltration in soil was simulated using synthetic rain water. The influence of ionic strength and of the leaching solution on the lixiviation of colloids were then investigated. In order to reach the uranium distribution between aqueous and colloidal phases the leachate either after batch or percolation throughout the soil column was analyzed using flow field-flow fractionation FI-FFF coupled to multi-detection (ultraviolet (UV), multi laser light scattering (MALLS) and atomic mass spectrometry (ICP-MS)). Complementary, this analytical approach allows the distribution in size, diffusion capability, chemical composition of the soil and the colloids associated to uranium be also determined. [1] IUPAC, "Compendium of chemical terminology". Blackwell Scientific 2nd edition, 1997.



S12.07-P -19

COLUMN LEACHING TESTS ON SOILS CONTAINING LESS INVESTIGATED ORGANIC POLLUTANTS

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Leaching tests are fundamental tools for the assessment of groundwater impact by contaminated soils. In comparison to batch tests, column tests enable basic characterization of leaching behaviour of soils and provide a release pattern similar to field conditions. With the amendment of the German Ordinance on Soil Protection and Contaminated Sites a new standardized column test procedure (DIN 19528) will be established among others as a tool for source term determination and subsequent seepage prognosis. This standard is currently validated for a variety of inorganic substances but in case of organic pollutants only for PAH (Polycyclic Aromatic Hydrocarbons). Other frequently occurring pollutants such as TPH (Total Petroleum Hydrocarbons) have not been addressed so far. Additionally further less investigated organic pollutants will come into consideration in the framework of new German regulations. This contribution is dedicated to the question if soil materials contaminated with such pollutants can be investigated by column tests. Column test results based on soils contaminated with TPH, PFT (Perfluorinated Surfactants) and the biocide tebuconazole will be demonstrated. Furthermore it was tested if materials of the column test device are appropriate considering interaction with the soil and water under investigation (e.g. sorption/desorption). Keywords: leaching, column test, contaminated soil, organic pollutants



S12.07-P -20

CONCENTRATIONS AND DISTRIBUTIONS OF CU, CR, NI AND PB IN SOILS OF THE PRELITORAL RANGE, SECTOR SENTMENAT (CATALONIA, SPAIN).

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Concentrations and distributions of four elements – Cu, Cr, Ni and Pb – in 28 Sentmenat soil profiles (117 soil samples) were investigated. The soils were classified as Alfisols, Entisols, Inceptisols. Background data ranges were estimated with the box plot [median \pm 2 median absolute deviation (MAD)] procedure as follows: Cu: 1.3 – 13.7 mg kg⁻¹, Cr: 1.5- 11.5 mg kg⁻¹, Ni: 0-18.1 mg kg⁻¹ and Pb: 20.2 – 49.4 mg kg⁻¹. Element concentrations for these soils were lower than the published values for Granada soils and for agricultural soils from Piedmont, Italy. Cr, Cu and Pb concentrations were correlated with clay content and Ni was negative correlated with pH. Element distributions in soils reflected parent materials and pedogenic factor determining variation between and within soil profiles. Generally, metal contents decreased in the order of Alfisols > Entisols > Inceptisols and A > B > C horizons. Copper and Pb were concentrated in A horizons where OM had accumulated.



S12.07-P -21

CONCENTRATIONS OF CE, GA, MO, RB, SN, Y AND ZR IN SOILS OF CENTRAL CATALONIA, SPAIN

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The aims of this study were to determine the total contents (XRF) of cerium (Ce), gallium (Ga), molybdenum (Mo), rubidium (Rb), tin (Sn), yttrium (Y) and zirconium (Zr) in soils from the Bages area, Central Catalonia, NE Spain, and to establish the relationships between heavy metals and some soil properties. The study area occupies 485.6 km² and 54 samples from 27 soil plots were examined. The median concentrations (mg kg⁻¹) obtained were Ce 55 (range 27-78 mg kg⁻¹), Ga 14 (7-21 mg kg⁻¹), Rb 86.5 (25-140 mg kg⁻¹), Y 20 (12-27 mg kg⁻¹), and Zr 145 (88-239 mg kg⁻¹). Fifty-three samples were reported as having less than the 3 mg kg⁻¹ limit of quantification for molybdenum and fifty samples were reported as having less than the 4 mg kg⁻¹ limit of quantification for tin. Data about this element are scarce. Element concentrations for these soils were similar than the published values for the Nidda catchment in Hesse (Central Germany). In terms of soil properties, the results of this study suggest that, in Bages soils, both trace element adsorption and retention are influenced by several properties such as clay minerals, carbonates and pH. Almost all element contents were positively correlated with clay content and negatively correlated with carbonates. Ce, Ga, Rb, Y show significant correlation between them suggesting common origin.



S12.07-P -22

CONDITIONS FOR GROWTH OF FOREST VEGETATION ON EMBANKMENTS AFTER COAL MINING

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The problem of reclamation of disturbed lands after mining is becoming more important issue. The soil formation processes of the substrates of coal mining in the region of East Maritsa basin, Bulgaria, are mainly related to the successful development of forest vegetation used for reclamation of the embankments. The region of Maritsa coal field is characterized by a continental climate with strong Mediterranean influence. The morphological profile of this deposit consists mainly of clay, sand, and lignite with Pliocene age and thickness deposited on the Paleozoic and Triassic rock substrate. The terrain is hilly, with rounded shapes, with a slope of 20-25° and expressed erosion process. Three experimental sites were chosen ("Trojanovo 1", "Trojanovo 3" and "Trojanovo North") and the substrates were analyzed. The analyzed substrates are geological materials exported from deep layers and deposited on the surface, aligned and without normal morphological structure. The purpose of this study was to propose a technology for the biological remediation, which will be implemented after termination of mining. To achieve this goal a detailed characterization of the water-physical and chemical parameters of soil substrates was made, as well as recommendations for improving their properties for their use in biological reclamation were elaborated. As a result of this study and the results obtained recommendations for the potential of the embankments after coal mining were summarized with focus on the appropriate tree and shrub species, different schemes were proposed and rules for bioremediation of damaged sites were listed.



S12.07-P -23

COPPER FRACTION ACCUMULATION IN SANDY SOILS, CULTIVATED WITH VINES AND WITH HISTORY OF CUPRIC FUNGICIDE APPLICATION IN THE SOUTH REGION OF BRAZIL

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The cultivated grapevines in Sandy soils in the South region of Brazil are normally submitted to the cupric fungicides application for fungi disease control what can cause Copper accumulation in the soils and the increase of its bio-availability. The objective of this study was to diagnose Cu levels in Sandy soils cultivated with grapevines and with cupric fungicide application history. In October of 2009, in Haplic Acrisol (arenic) soil samples in the layer of 0-10 e 10-20 cm were collected in 19 vineyards and in a natural field area, in the city of Santana do Livramento, South region of Brazil. In the soils collected were determined the levels of Cu extracted by EDTA (CuEDTA) and pseudo-total (CuEPA) (EPA method). All vineyards presented levels of CuEDTA and CuEPA, in the layers of 0-10 and 10-20 cm, higher than the natural field areas, being the higher levels found in the vineyards with larger period of cultivation (such as the ones of 30 years of cultivation). In these layer levels, the CuEDTA were higher than the CuEPA, also in the layer of 10-20 cm, showing the Cu percolation in the soil profile, probably because of the station saturation in higher affinity of the reactivated particles found in the surface layer of the soils, what can potentiate sub-surface water contamination.



S12.07-P -24

**DISTRIBUTION OF HEAVY METALS IN RICE FARMING SOILS OF A COASTAL WETLAND
(L'ALBUFERA DE VALENCIA, SPAIN)**

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One of the most important zones on rice production in Europe is located in Valencia (Spain), in particular in the coastal wetland of L'Albufera. In this rice area, 18 sampling zones were selected to determine the degree of heavy metals incidence in soils. Total concentrations of Cd, Co, Cr, Cu, Ni, Pb, and Zn were evaluated. Their distribution in the surficial and sub-surficial horizons was determined together with the temporal variability of metals concentrations during 1991-2009. Results show that the highest metal concentrations correspond to Zn, Cr and Cu. However, all metals have levels below the limits established by legislation, except for Cr that exceeds them in several zones showing a maximum of 254.93 ppm. In general, heavy metals showed an accumulation in soil surface, except for Co that has their highest values in the AB horizon. Soil salinity and related cations, mainly Na and K, are the main parameters that control the behavior of metals in these soils. Co, Cr, Pb and Zn contents are the parameters more influenced by this. This could be due to climate changes toward a high aridity, which could affect the concentration of salts and the marine intrusion in this area. Cu and Zn also show strong relationships with the available phosphorous levels. Through the study of the temporal evolution of these metals, a general decrease of their concentrations in the subsurface horizons was observed, except for the case of Cr.



S12.07-P -25

EFFECT OF LIMING ON THE DISTRIBUTION OF MANGANESE AND MANGANESE UPTAKE BY MAIZE GROWN IN A COARSE TEXTURED SOIL

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Although materials containing calcium (Ca) and magnesium (Mg) may mitigate manganese (Mn) phytoavailability and toxicity, a high concentration of calcium or magnesium carbonates in the soil or irrigation water is likely to make Mn deficiency of crops more severe. The aim of this study was to assess the effect of dolomitic limestone on the distribution of Mn in soil fractions and the uptake of Mn in the different parts of maize. Maize was grown in 40-cm high and 15-cm diameter columns filled with Morin series loamy sand for 90 days under greenhouse conditions. The average amount of exchangeable + carbonate fraction represented less than 5% of total Mn. Most Mn was in the oxide fraction (53 to 61%). Exchangeable soil Mn (MnEXCH) was the most significantly affected by liming. Mn-EXCH was negatively correlated with soil Ca-EXCH and Mg-EXCH (0.5 M BaCl₂-TEA, pH 8.2), soil pH-water and concentrations of Ca and Mg in stems, leaves, flowers, ears and roots. On average, total Mn uptake by shoots was 3.2-fold higher than Mn uptake by roots. Liming soil to pH 6.4 maximized shoot biomass yield while reducing extractable Mn fractions /(Ca-EXCH + Mg-EXCH) ratio to 0.09 in the 0-10 cm soil layer. Tissue Mn concentrations ranged from 30 to 95 mg/kg in stems and from 113 to 266 mg/kg in leaves, well below the critical toxicity limit of 400-500 mg/kg dry weight for most agricultural crops, whatever soil pH and the level of exchangeable Mn.



S12.07-P -26

EFFECT OF TIN OXIDE (SnO₂) NANOPARTICLES ON SOIL ORGANISMS (MICROBIAL BIOMASS, LUMBRICUS RUBELLUS)

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Tin compound is a major industrial metal and nowadays SnO₂ nanoparticles (NPs) are used for their conductive properties by modern industry in different consumer products. However manufacture, use and potential release of this material have preceded the evaluation of the environmental risks. The aim of this work was to evaluate if SnO₂ engineered nanoparticles have acute effect for short time on soil microbial biomass and Lumbricus rubellus. Two experiments were carried out: the first a Cambisol has been exposed at 500 mg Sn-SnO₂/kg and the second a "Technologic soil" with earthworms at 50 and 500 mg Sn-SnO₂/kg. The biological assays show an increment of C and N biomass, but did not differ significantly from that in the control group. The presence of SnO₂ is clearly detected in soil by Environmental Scanning Electro Microscopy (ESEM) coupled by Energy Dispersive Spectroscopy (EDS). The NPs chemical composition appears unaltered, while the size can be modified by NPs aggregation. The preliminary results of physicochemical analysis of both soils have showed a solubility of the SnO₂ NPs in aqua regia, but not in EDTA and DTPA. The detection of Sn in water at the equilibrium (after 16 hours shaking) can be due to weak link between the NPs and soil natural colloids. For this case the NPs are found in water phase. The analysis by ESEM-EDS have shown that SnO₂ may penetrate into the earthworms through intestine, but they have no acute toxic effect. The NPs ingestion is confirmed by analysis of earthworms dejections.



S12.07-P -27

ESTIMATION OF POTENTIAL POLLUTION IN SOIL AROUND A CLOSED INDUSTRIAL AND URBAN WASTE DUMP SITE IN HERNANI (BASQUE COUNTRY, NORTH OF SPAIN)

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Waste dumping sites could be secondary sources of pollution, leading to environmental degradation of the ecosystem and is possible that poses a great risk to public health. Such an example is a dump located at the site near Hernani (Basque Country) that was closed in 1990, after over 20 years of accumulation of urban and industrial residues. The aim of this work was the analysis of metallic pollutants existing currently in the soils around the studied dump and in sediments of the creek crossing the dumping area. Elemental concentrations were measured "in situ" by a portable XRF device. The mineralogical composition of the soils and sediments was analyzed by a hand-held InnoRaman spectrometer, the spectra indicated the presence of hematite, quartz and rutile in the control soils, while the soils around the dump and the sediments shown appreciable amounts of calcite. The pH in the control soil was around 4.4-4.8 while the soils around the dump shown values from 8.4 near the dump till 5.8 at 50 meters down the dump. Moderate heavy metals concentrations on the surrounding area were found around the dump, especially down to the site, showing a decreasing gradient for most of the analyzed metals. This suggest that, at the beginning, calcite was added in order to stabilize the metals; but with time this calcite has been partially neutralized or removed downwards the dump, starting a metal mobilization process. Acknowledgements This work has been financially supported by Basque Government through ETORTEK BERRILUR 3 project (ref. IE10-273).



S12.07-P -28

EVALUATING A SOIL QUALITY STANDARD FOR CD IN AGRICULTURAL MEDITERRANEAN SOILS UNDER A NON-ACCUMULATOR CROP.

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*According to the Spanish Royal Decree 9/2005, soils are considered as contaminated by a heavy metal when concentrations 100 times over its corresponding baseline value are determined in them. In order to evaluate if this criterion is realistic for Cd in representative agricultural Mediterranean soils under a non-accumulator crop (*Solanum Lycopersicum* L.), the OECD biomass assay test 208 was carried out and the toxicity values EC50 and EC10 (effective concentrations of metal in soil that reduce the biomass production by 50% and 10%, respectively) were tried to be established. Four agricultural soils with different properties relevant to regulate the behaviour of heavy metals were selected from the Valencian Region, a representative area of the European Mediterranean Region. Soil pH was between 7.6 and 8.5, organic matter content between 1.5 and 5.9% and clay content between 21 and 46%. Concentrations of Cd in soil representing 0, 1, 10, 30, 50 and 100 times the baseline value for this metal were achieved by spiking appropriate volumes of a contamination solution CdCl₂. The results showed no statistical difference in terms of biomass production between the control and the rest of doses assayed in the different soils. This indicates that the concentrations applied had no effect over biomass production. In fact, the toxicity values EC50 y EC10 could not be established. Therefore, the criterion evaluated seems not valid for Cd in the studied soils considering the biomass production of the selected crop. However, metal content in plant should be determined to corroborate these results.*



S12.07-P -29

EVALUATION OF THALLIUM TOXICITY WITH PLANT BIOASSAYS AND BIOCHEMICAL TESTS

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*Thallium (Tl) is a potentially harmful element that has not been studied extensively despite several studies have shown its high toxicity for human, plants and animals. Environmental accumulation of Tl is the result of both geogenic and anthropogenic inputs (farming, mining, manufacturing process, combustion of coal, and cement production). We used plant bioassays (root elongation test with *Hordeum vulgare* L., germination test with *Lepidium sativum* L., growth test with *Lactuca sativa* L.) and biochemical tests (glutathione and nonprotein thiols contents in barley roots, plasma membrane H⁺-ATPase activity and transmembrane electric potential in maize roots) to study the thallium phytotoxicity. Cress germination was shown to be affected by Tl⁺ (as TlCl) at concentrations up to 5 μmol/L, barley root elongation and lettuce growth at Tl⁺ concentrations up to 147 μmol/L. Uptake and translocation of Tl⁺ into aerial parts of lettuce increased linearly with doses, with biological absorption coefficient (BAC) ranging from 0,02 to 0,03.*



S12.07-P -30

EXPERIENCE OF THE REMEDIATION OF SOILS POLLUTED BY HEAVY METALS IN IRRIGATION DISTRICT IN SOUTHERN GEORGIA

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*The fertile irrigated soils of the Mashavera valley (South Georgia) have a high agricultural yield potential. The river water used for irrigation, however, is polluted with mining waste from a copper and gold mine situated in the mountainous region of the middle reached of the Mashavera river. Furthermore waste water from a floatation plant, erosion material from floatation waste deposits, and acid mine drainage leads to high concentrations of dissolved and suspended sulphidic heavy metals. By food chain heavy metals falls in organism of mans and animals and have lethal results. Measurement of the uptake of Cu, Zn an Cd by different food crops in order to determine the health threat of the local population. Field experiments were organized on top soil of arable land close Bolnisi mining factory. Aim of the experiment were: investigation of the effect of the irrigation with clean water; evaluation of a adequate extraction method to characterize the bio-available heavy metal fraction in weakly alkaline soils. It were organized two experimental plots: moderate polluted and strong polluted. Plots were depended on the sections: on the first plot - 8 sections and second plot - 22 sections. Three variants were investigated: control, elaborate with iron oxides and elaborate with zeolits. Experiment vegetation - Spinach (*Spinacia oleracea*). Fixation of heavy metals by Fe-oxides has been proven in extensive laboratory and greenhouse experiments. Reduced plant uptake up to 35 %.*



S12.07-P -31

FIELD EVALUATION OF ONE CU-RESISTANT TOBACCO VARIANT AND ITS PARENTAL LINES FOR COPPER PHYTOEXTRACTION AT A WOOD PRESERVATION SITE.

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A Cu-resistant somaclonal tobacco variant and its parental lines (FoP-F1 and BaG-F1) were cultivated at a wood preservation site on Cu-contaminated soils (163-1120 mg Cu kg⁻¹) and at an uncontaminated control site to determine their use for shoot Cu removal. Influences of Cu exposure and three soil treatments, i.e. untreated soil, compost with dolomitic limestone (OMDL) and with zerovalent iron grit (OMZ), on plant growth and mineral composition were measured. Shoot DW yields varied between 0.5-6.9 Mg DW ha⁻¹ yr⁻¹, depending on tobacco genotypes, soil treatments, and Cu exposure, and peaked for all cultivars in OMDL plots at intermediate levels of total soil Cu (239-518 mg Cu kg⁻¹). Shoot DW yield negatively influenced shoot Cu concentration. At high total soil Cu (753-1140 mg kg⁻¹), highest shoot Cu concentrations were obtained with BAG-F1 plants in the untreated soil, BAG-F1 plants and variants in the OMZ plot, and FOP-F1 plants in the OMDL plots. At lower total soil Cu, shoot Cu concentrations were similar in all tobacco genotypes. Copper concentrations in plant parts were in decreasing order: roots > leaves > inflorescence > stem. Shoot Cu removal (in g Cu ha⁻¹yr⁻¹) ranged from 13.3 (BAG-F1 on the control soil) to 173.3 (BAG F1 on the OMDL#1-#2 soils). For OMDL plots, the variant had a higher shoot Cu removal than its parental lines at high total soil Cu, but the BAG-F1 plants showed the highest values at intermediate total soil Cu. BAG-F1 shoots phytoextracted more Cu in the OMZ and untreated plots.



S12.07-P -32

FRAMEWORK TRANSFORMATION OF FAU TYPE ZEOLITE IN HIGH ALKALINITY

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Cement based waste disposal is the most important option to provide safe storage of the non-recyclable often highly toxic waste fraction remaining at the end of today's waste processing chain. To avoid contamination of the environment due to slow leaching of the metals from these waste forms, engineered barriers are built around the waste disposal sites in order to provide containment of the metals leaching out. Zeolites are crystalline aluminosilicates with tetrahedral frameworks containing pores and cavities of molecular dimensions, with a wide range of applications. The combination of their stability in alkaline aqueous conditions with their cation exchange capacities makes them highly promising candidates for the application as a buffer material in a cement based waste disposal. Several zeolite types are synthesized via inter-zeolite transformations, exploiting advantages like a fast crystallization rate, low synthesis temperature and high selectivity. For example synthetic chabazite (CHA) can be prepared by an ultra-alkaline hydrothermal (1M KOH, 95°C) transformation of faujasite (FAU). Such frameworks have an inherent alkaline stability and are promising candidates for efficient sorption in concrete porewaters. Framework transformations of FAU type zeolites with different Si/Al ratios and ion contents (Na⁺, NH₄⁺, H⁺, K⁺, Ca²⁺) were studied in ultra-alkaline conditions and revealed the crucial role of the nature and concentration of the cations present during FAU transformations. Different alkali ions not only directed the ultra-alkaline transformations towards specific frameworks, but also provided additional stabilization of the frameworks in detrimental conditions.



S12.07-P -33

GEOCHEMISTRY ANALYSIS OF RARE EARTH ELEMENTS OF SOUTHERN ITALY SOILS

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Soils geochemistry is commonly used to evaluate weathering, soil formation conditions and concentration of chemical elements. Trace elements and especially rare earth elements (REEs) are widely used to investigate soil environmental pollution, becoming potentially toxic at high concentrations. The main objective of this paper was to investigate the relationship between REEs and soil properties in an olive orchard of southern Italy. Soil samples were collected at 100 locations and were analysed for REEs content, particle-size distribution. REEs content in dry topsoil samples was determined by using inductively coupled plasma-mass spectrometry (ICP-MS). At the same sample locations, water content measurements were taken using a reflectometer. Soil particle-size distribution was prevalently sandy and REEs concentration was consistent with the average abundances of the earth's crust: it's slightly lower; in particular, the chondrite-normalized curve, method often applied to study the distribution patterns of REEs using the chondrite concentration provided by Haskin et al (1968), showed significant light REEs enrichment than heavy REEs and a negative anomaly of europium which, typically, substitutes calcium in sedimentary rocks such as those in study area. In addition, the average REE's concentration between southern and northern parts of olive orchard is different: in the southern area it's distinctly higher than the northern area. This may results because the southern soils contain more water than the northern soils being most clayey and so favouring the enrichment of REEs.



S12.07-P -34

HEAVY METAL ADSORPTION IN SALT-AFFECTED LAKE SEDIMENTS AT FEHÉR-LAKE, SZEGED, HUNGARY

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The aim of the research was to determine the adsorption characteristics of nickel, copper, zinc and lead in saline lake sediments. These elements are toxic for the ecosystem of saline lake systems, therefore it is crucial to investigate their adsorption to sediment components. The 16 km² system of Lake Fehér at Szeged proved to be an ideal site to investigate these processes. The system is built up of both natural and artificially managed lake basins, thus differences in adsorption characteristics could be determined. Adsorption experiments were also carried out: for each investigated element 5 suspension samples (20 g/l) with different mineralogical composition were made and treated with different concentration solutions of the relevant metal ion. Based on the results, each of the investigated samples effectively immobilised the total metal content up till a 500 mg/l initial concentration. In case of each element the adsorption was the most effective when the carbonate content was above 20 %. The adsorption of nickel and copper was significant in samples of high organic content, while zinc was immobilised the best by samples rich in clay minerals. In all, each element was bound effectively by saline sediments. The most frequent way of immobilisation was coprecipitation with carbonate, while organic matter and clay minerals had a subordinate role in this respect. Highly effective immobilisation of metals is however illusive, since metal-carbonate precipitations can go back to solution even at slight changes of pH, occurring easily on saline areas.



S12.07-P -35

**HEAVY METAL CONTENT IN CULTIVATED SOILS OF UPPER RIO NEGRO VALLEY
(PATAGONIA, ARGENTINA)**

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The distribution patterns of heavy metals concentration are primarily influenced by the lithology of parent material, and secondly by the soil forming processes, that modify the basic geochemical composition and redistribute the content of metals within the soil profile. To evaluate natural variations in concentrations of trace elements, representative agricultural profiles of north Patagonia region were studied. The soil samples were collected from three depths. Concentration and distribution of total and available seven heavy metals were investigated. The organic carbon content ranges from 0.6 to 1.5% at the soil surface. The topsoil is strongly alkaline with pH 7.7 to 9.1. Cation exchange capacity is rather high at the soil surface (average 25.5 cmol⁺•kg⁻¹). The total heavy metal concentration (average +/- standard deviation) of the topsoil (mg•kg⁻¹) was 459 +/- 43 (Ba), 21.43 +/- 2.03 (Cu), 14.53 +/- 2.62 (Ni), 31.46 +/- 8.87 (Pb), 301 +/- 16 (Sr), 111 +/- 2 (V) and 76.93 +/- 3.26 (Zn). The available concentration (mg•kg⁻¹) was 1.08 +/- 0.09 (Ba), 0.16 +/- 0.02 (Cu), 0.18 +/- 0.32 (Ni), 0.44 +/- 0.12 (Pb), 0.89 +/- 0.11 (Sr), 0.57 +/- 0.03 (V) and 0.45 +/- 0.02 (Zn). According to one-way Anova, the total Pb concentration is always significantly greater in the top soil; although no differences were found for the rest of the analyzed heavy metals. In this study, a strong association between total Pb and Sr and organic carbon content was found. Furthermore, available Pb showed a strongly positive correlation with pH and EC.



S12.07-P -36

INCREASING THE KNOWLEDGE ON THE TRANSFERENCE OF ZN TO AN ACCUMULATOR CROP (LACTUCA SATIVA L.) IN REPRESENTATIVE MEDITERRANEAN SOILS

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The present work increases our knowledge on the transference of Zn from soil to an accumulator crop (Lactuca sativa L.) in agricultural soils of the Valencian Region, a representative area of the European Mediterranean Region. A set of four agricultural soils with different properties relevant to regulate the behaviour of heavy metals in soil were selected and sampled from this region. Soil pH was between 7.8 and 8.5, electrical conductivity between 1.1 and 17.9 dS/m, organic matter content between 1.6 and 9.7%, sand content between 16 and 56% and clay content between 20 and 41%. Concentrations of Zn in soil representing 1, 5, 10, 25, 50 and 100 times the baseline value for this metal in the Valencian Region were achieved by spiking appropriate volumes of a contamination solution ZnSO₄. Zinc content in the edible part of the plant was determined using the USEPA 3052 method for organic matrices and analysed by Atomic Absorption Spectrometry. The concentration of Zn in the crop overcame the normal concentration for this essential element (20 to 100 mg/kg) after the fifth dose for the saline soil and for the soil with a coarser texture, while the soils having high clay content and high organic matter content overcame this range after the last one. High organic matter and clay content reduced Zn accumulation in plant while high salinity and a coarse texture had the opposite effect. Therefore, these soil properties seem relevant when establishing soil quality standards useful to declare Mediterranean agricultural soils as contaminated.



S12.07-P -37

INFLUENCE OF SOIL PROPERTIES ON POTENTIALLY HARMFUL ELEMENTS (PHES)

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Soil pollution has become an important environmental issue in developed countries due to urban-industrial development. Among other pollutants, potentially harmful elements (PHEs) are especially dangerous because of their persistence and toxicity. In general, the mobility and availability of PHEs are controlled by absorption and desorption characteristics of soils, in particular they can be associated with soil properties including pH, organic matter content. The aims of this study were to determine contents of Ag, Be, Bi, Cd, Co, Cr, Cu, Ni, Pb, Sn, Ti, Zn related to intervention values imposed by Italian government and to establish relationships between PHEs and some soil properties in an olive orchard of southern Italy. Soil PHEs content, pH, electrical conductivity and organic matter content were determined in 100 soil samples. Soil pH ranged from 5.73 to 7.45 i.e. strong acid to mild alkaline, organic matter contents ranged from 0.027 to 23.78 g/kg, electrical conductivity ranged from 106.80 to 654 $\mu\text{S}/\text{cm}$. These results indicated that the sampled soils covered a wide range of pH, organic matter and electrical conductivity being suitable for studying the influence of these soil properties on availability and plant uptake of PHEs. Correlation matrix was used to identify the relationship between PHEs contents and soil properties. The Italian government established intervention values for some toxic elements in soil. Among these, five elements exceeded the regulatory threshold value (Limit A of Italian Law no. 152/2006) in analysed soils.



S12.07-P -38

MECHANOCHEMICAL IMMOBILIZATION OF COPPER BY DIOCTAHEDRAL AND TRIOCTAHEDRAL SMECTITES

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Clay minerals have revealed highly potential in soil remediation due to their low cost, availability, and low toxicity. Mechanochemical processes allow to activate chemical reactions by inducing different kinds of mechanical stress and without any other energy supply. This study investigated the effect of dry milling on the ability of dioctahedral and trioctahedral smectites to immobilize heavy metals cations. To this purpose a dioctahedral smectite "bentolite L" and a trioctahedral one "laponite RD" were ground with different amount of copper(II) chloride in dry conditions into a zirconia planetary ball mill (mechanochemical treatment). Increasing milling time and Cu/clay minerals mass ratio were selected for experimental tests. From the ground mixtures two different kinds of samples were extracted using the following procedures: 1) with deionised water; 2) with 1 M MgCl₂ solution. Copper immobilization degree was evaluated by ICP/OES analysis of extracts as difference between the amount of Cu(II) spiked in the mixture and the amount of Cu(II) ions present in the extracted fraction. The analyses showed an increased Cu retention as time increases for both bentolite L and laponite RD. Mechanochemical treatments, depending on time and different mass ratio, induced the increase of retention efficiency. The solid phases were also characterized by means of solid-state NMR and spectroscopic techniques such as FTIR and XPS, to investigate the mechanisms of the "mechanochemical retention" of copper by both the clay minerals.



S12.07-P -39

MERCURY ACCUMULATION IN SOILS AND CROPS IN A MINING REGION OF SAN JOAQUÍN, QUERETARO, MÉXICO.

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*The geological origin of the cinnabar mining of San Joaquín's region is hydrothermal, which have been the main economic source for its inhabitants. Since pre-Hispanic times until end of 20th century this area has been exploited. Such mining activities resulted in the mercury dispersion in soils and its consequent exposure to the environment. This work quantified the content of mercury in soils and its possible accumulation and incorporation into maize (*Zea mays*), beans (*Phaseolus vulgaris*), salt-wort (*Beta vulgaris*), coriander (*Coriandrum sativum*) and some endemic plants. The study area include hydrological basin of Gatos river in Queretaro, México. 20 soil samples sites and 60 plant specimens were analyzed. Soils were characterized according to ISRIC (2000). Plants were rinsed with nitric acid, dried and subjected to digestion acid in a microwave oven. The mercury quantification was made by ICP-MS. Statistical analysis showed high mercury content in salt-wort (26.30 mg/kg), coriander (17.74 mg/kg), beans (0.24 mg/kg), maize (0.15 mg/kg) and guava (0.11 mg/kg). A low correlation between mercury content in soils and plant specimens was established; nevertheless, high total mercury contents in root, stem and leaf were found out. These results show mercury accumulation in crops and a human ingest; in addition, the authorities must pay attention about the risk of this food contamination.*



S12.07-P -40

**METHODOLOGY FOR ASSESSING ENVIRONMENTAL HAZARDS RESULTING FROM
GEOCHEMICAL ANOMALIES OF TOXIC ELEMENTS IN SOILS OF THE IBERIAN MASSIF (SW
SPAIN)-**

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The aim of this paper is to propose a working methodology for assessing possible hazards derived from high geochemical anomalies of toxic elements in agricultural and forest soils. The methodology was applied to soils of the Seville Province (SW Spain). The working plan includes the determination of soil parameters, availability, bioavailability and speciation (partitioning) of anomalous trace elements, enrichment and geo-accumulation factors, and comparison with regional baselines and contamination thresholds accepted for the regional administration. In the case study, 100 samples were analyzed to obtain the baselines of the different trace elements in the three geological domains represented in Seville: the South Portuguese Zone, the Ossa-Morena zone (both zones in the Iberian Massif) and the Tertiary Guadalquivir basin. Most relevant anomalies were found for As in the South Portuguese Zone, and As Cd, Cu, Ni, Pb and Zn in the Ossa More Zone. No anomaly was detected in the Guadalquivir basin soils. The application of the methodology proposed, has lead to delimit some areas potentially polluted due to high concentrations of toxic trace elements in two Zones of the Iberian Massif, but because their availability is low, the environmental concern is not too important. Regarding the soils of the Guadalquivir basin, no significant problems have been detected



S12.07-P -41

MODEL OF PROPOSED TREATMENT FOR IN SITU REMEDIATION IN PORTMAN BAY

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Portman Bay, located in the province of Murcia, south-eastern Spain, Murcia, has been completely inundated with more than 63 million tonnes of mining waste discharged through the Roberto washer. The mining operations for pyrite, sphalerite and galena, started its operation in the 1950s and continued until 1990. Portmán bay is a singular point of mining impact in the area, and one of the black spots in the area of the Mediterranean. Flotation is a process of separation and concentration of minerals that allows the treatment of low grade ore, when no other concentration treatments are economically profitable. The direct discharge waste, with fine texture and a higher content in sulfur, undergoes the process of supergene alteration with pyrite oxidation, release of H₂SO₄ and formation of iron oxide and jarosite. The remediation of sediments contaminated by heavy metals need the following basic premises: Prevent contaminated sediments from supergene alteration. Avoid the rising of soluble salts that can bring heavy metals to the surface. Avoid the side and downstream leachate of the surface layers. Prevent erosion of the upper layers of treatment, by regulating the slopes and introducing suitable vegetation. Control and monitoring of pollutants.



S12.07-P -42

NICKEL PRESENCE IN OLIVE OIL MILL WASTE DISPOSAL AREAS

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Most of the world olive oil production is produced in the Mediterranean region. Olive oil production results in an annual generation of more than 30 million m³ of wastes (OOMW) and their quantitative and qualitative characteristics differ broadly and depend mainly on climate, soil type, variety and ripeness of olives, physiological stage, harvesting time, as well as on the extraction method used. The inorganic fraction contains chloride, sulphate and phosphoric salts of potassium and calcium, iron, magnesium, sodium, copper and other trace elements in various chemical forms. Uncontrolled soil disposal causes substantial increase in the concentration of inorganic and organic soil constituents. In the framework of the LIFE+ project "Strategies to improve and protect soil quality from the disposal of olive oil mills wastes in the Mediterranean-PROSODOL", it was observed that soils that accept direct disposal of un-treated OOMW are characterized by high Ni and other recalcitrant heavy metals concentration, which in several cases exceeded the thresholds for safe use of soil and is not justified by the geology of the site or the soil forming processes. The present study attempts to elucidate the origin of Ni, detected in OMW evaporation ponds and nearby agricultural soils. The potential dependence of the high soil Ni concentration measured at OOMW disposal areas with the olive oil production processes is discussed.



S12.07-P -43

NITRATE LEACHING AND NITROGEN TRANSFORMATIONS ON A SAND LOAM SOIL UNDER DIFFERENT FORMS OF NITROGEN AND SULPHUR APPLICATION

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Nitrate nitrogen ($\text{NO}_3\text{-N}$), which is an essential source of nitrogen for plant growth, is now also considered a potential pollutant by the environmental protection agency (EPA). This is because excess applied amount of $\text{NO}_3\text{-N}$ can move into streams by runoff and into ground water by leaching, thereby becoming an environmental hazard. Fertilizers have retentive properties depending on their forms of nitrogen and nitrogen content. Incubation and leaching experiments were carried out to study the effects of forms of the nitrogen and sulphur addition on the $\text{NO}_3\text{-N}$ retention and leaching to reduce $\text{NO}_3\text{-N}$ contamination in the environment. The results showed that adding N-serve to urea managed to retard the oxidation of ammonium to nitrate all along the experimental time, there was a steady increase of NH_4 and NO_3 from one leached to another. Combining Sulphur with urea decreased N losses and slow down the nitrification process. $\text{Ca}(\text{NO}_3)_2$ treatment showed a rapid NO_3 leaching, especially in the first 3 weeks. Total leached amount for both soils was highest in $\text{Ca}(\text{NO}_3)_2$ treatment followed by urea > urea + Sulphur > urea + N-serve. Residual N was in the following order urea + Sulphur + N-serve > urea + N-serve > urea + Sulphur > $\text{Ca}(\text{NO}_3)_2$ + Sulphur > $\text{Ca}(\text{NO}_3)_2$



S12.07-P -44

PB TOXICITY VALUES FOR A NON-ACCUMULATOR CROP IN REPRESENTATIVE AGRICULTURAL MEDITERRANEAN SOILS.

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*This paper establishes the toxicity values EC50 and EC10 (effective concentrations of metal in soil that reduce the biomass production by 50% and by 10%, respectively) of Pb for a non-accumulator crop (*Solanum Lycopersicum* L.) in representative agricultural Mediterranean soils. These values were established by means of the OECD biomass assay test 208. A set of four different agricultural soils with different properties relevant to regulate the behaviour of heavy metals in soil were selected and sampled from the Valencian Region, a representative area of the European Mediterranean Region. Soil pH was between 7.6 (Soil 3) and 8.5 (Soil 1), organic matter content between 1.5 (Soil 1) and 5.9% (Soil 3) and clay content between 21 (Soil 4) and 46% (Soil 2). The values of EC50 y EC10 obtained were 561.8 and 13.7 mgPb/kg, respectively, for Soil 1; 2882.8 and 162.1 mgPb/kg, respectively, for Soil 2; 3434.1 and 1750.1 mgPb/kg, respectively, for Soil 3 and 2350.1 and 738.8 mgPb/kg, respectively, for Soil 4. The lowest EC50 and EC10 values were obtained for the soils with the lowest clay (Soil 4) and organic matter content (Soil 1). Therefore, these two soil properties seem to be relevant when establishing soil quality standards that are useful to declare Mediterranean agricultural soils as contaminated. Assessing the contents of heavy metals in soils and establishing adequate quality standards are priority objectives within the European Union, as it is indicated in the European Commission report "Towards a Thematic Strategy for Soil Protection".*



S12.07-P -45

PHES CONTAMINATION FROM A MINING SITE IN NE ITALY: ASSESSMENT OF METAL ACCUMULATION AND TOXICITY IN WILLOW

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Heavy metals released in soil and water from mining sites is one of the most permanent toxicological problems for terrestrial ecosystems and it is of a great concern worldwide today. This study was performed: i) to assess total concentrations of some potentially harmful metals in soil and plants samples, collected in 6 different sites from an abandoned mining area in Northeast Italy, ii) to evaluate the toxicity of metals in plants by using lipid peroxidation assay, and iii) (to assess the effect of heavy metals on soil enzymatic activities that are bioindicators related to biogeochemical nutrients cycling. Results showed that willows accumulated significant quantities of PHEs in both leaves (Cr, Zn, Fe and Mn) and roots (Cd, Pb), regardless of the species selected. The lipid peroxidation levels (expressed as MDA contents) in Salix spp. were strongly correlated with heavy metals of the soil. Similarly, all investigated soil enzymes activities (arylsulfatase, leucine-aminopeptidase, β -glucosidase, chitinase and alkaline phosphatase) were inhibited according to the degree of contamination, but were also correlated to soil properties such as total organic carbon content and soil acidity. Lipid peroxidation assay and soil enzymatic activities were thus efficient indicators of pollution level in the soil/plant system, and alteration of soil biochemical functions.



S12.07-P -46

PHES INDUCE ADVERSE EFFECTS ON WILD PLANTS GROWING ON MINE WASTE. PRELIMINARY RESULTS ON DANDELION (*TARAXACUM OFFICINALE* WEBER) FROM VALLE IMPERINA (ITALY).

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In the frame of a research aimed at restoration of contaminated sites, an experimental trial was carried out on dandelion specimens gathered in Imperina Valley (NE Italy). Three sites with different levels of contamination from mixed sulphides (Cu, Fe, Pb, Zn) mine waste, and one from a not contaminated site, were selected. Plants with their corresponding soils were transferred in pots at the Botanical Garden of the University of Florence and assisted during growing season. Fresh leaves were fixed with OsO₄, and small pieces were included in Spur's resin for light and electron microscopy application. Preliminary observations on the leaf anatomy of contaminated samples revealed significant reduction in the leave thickness with respect to the control plant. This is mainly due to a change in the organization of the palisade parenchyma cells, which loose their typical cylinder morphology, and assume a subspherical shape. The recorded reduction appears strictly related to contamination levels. Yet, in plants growing on the most contaminated soil parenchyma cells are isodiametric, and large intercellular spaces develop. Instead, with decreasing metal concentration, leave morphology assumes a conformation more and more similar to the one typical of the control plant. Observations on the leave ultrastructure are still in progress, in order to ascertain possible damages to organelles, and alteration of metabolic functions. Further investigations could help understanding if dandelion could be a metal-tolerant plant to grow on slightly metal-contaminated soils for restoration purposes.



S12.07-P -47

PHOSPHORUS FRACTIONS IN VINEYARD SOILS IN THE SOUTH REGION OF BRAZIL

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Successive applications of phosphorus (P) along the years in vineyards can cause nutrient accumulation in the soil and possibly alter the fractions what can increase plant availability, but potentiates environmental contamination. The objective of this study was to quantify the P fractions accumulation in grapevines cultivated soils and with history of phosphate fertilizing application. In January of 2011, soil was collected in a natural field area, without history of cultivation and in two vineyards: one with 15 years of cultivation (vineyard 1) and another one with 30 years of cultivation (vineyard 2), located in the city boundaries of Santana do Livramento, in the state of Rio Grande do Sul, South region of Brazil. The soil samples were collected in grapevines rows, each in three trenches areas and in the layers of 0-5, 5-10 and 10-20 cm. The soil was dried, grinded, passed through the sieve and submitted to P chemical fractioning analysis proposed by Hedley. The highest accumulation of P fractions in the soil was found in vineyard 2 and in both vineyards, the P rather accumulate in the recalcitrant fractions, extracted by HCl 1 mol L⁻¹ and labile fractions these can be rapidly absorbed by plants, but can be lost in the system.



S12.07-P -48

POTENTIAL USE OF BAMBOOS AS BIOFILTERS IN BELGRADE

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Bamboos have been introduced around Europe as fast growing decorative plants that easily propagate by rhizomes. Beside their decorative value, these plants have been recognized for their ability to act as biofilters, thus decreasing urban pollution. Two species, Phyllostachis bissetti and P. aureosulcata aureocaulis, have been chosen and planted in three sites in Belgrade, and their ability to accumulate and adsorb airborne particles was tested. The first site was the most heavily polluted part of Belgrade (DS), due to industria and traffic, the second site was situated near lake Ada Ciganlija (ADA), also close to traffic, and the third site was in the park Kosutnjak (KS), away from pollution sources. Parameters as biomass increase, the number of new seedlings and chlorophyll and metal content, were monitored from spring until winter. Metal analysis revealed higher concentration of Zn, Cr, Fe and Mn in the leaves of plants growing at the most polluted site, and particle deposits were visible on the adaxial and abaxial leaf surface by SEM. Bamboo leaf surface has the capacity to absorb dust to over 10% DW. The results indicated both species were successfully introduced to all sites, as evidenced by the large number of new seedlings. Ratio of chl_a/chl_b was higher in P. bissetti, suggesting these plants were better adapted to higher light intensities. According to the results of metal analysis, bamboo plants can efficiently remove dust particles and improve air quality in Belgrade, contributing to better health conditions in most populated and most polluted urban areas.



S12.07-P -49

**PRELIMINARY STUDY ABOUT MERCURY THERMAL DESORPTION ON SOILS FROM
ALMADÉN DISTRICT AREA**

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The aim of this work is to evaluate the potential of mercury thermal desorption using solar energy. Two different soils from the former mercury mining district of Almadén (Spain) were studied. One of the soils was sampled from a “dehesa,” where natural Mediterranean vegetation is combined with agrosilvopastoral activities and, the other one, was collected from an area where metallurgical processes were carried out in past centuries. The experimental work was carried out into a Solar furnace at selected different temperatures. The mercury thermal desorption was evaluated at low, medium and high temperatures in both soils. As a result we obtained that more than 80 % of mercury from original sample was released once 280°C was reached. The analysis results of the mercury released from a soil at different temperatures confirm the origin of the samples, showing the natural character of soil from “dehesa” compared to more anthropogenic origin of the soil from the old former metallurgical plant. Furthermore, these data could be used in order to evaluate the optimum temperature at which a mercury contaminated soil could be considered remediated. Keywords: Mercury, soil, Almadén, thermal desorption, Solar furnace.



S12.07-P -50

THE INFLUENCE OF INTERFERING IONS IN SOIL ON CHELATE-ASSISTED PHYTOEXTRACTION OF COPPER

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The aim of study was to analyze the effects of the interfering ions Fe^{3+} , Ca^{2+} , Mn^{2+} , Zn^{2+} and Mg^{2+} from the soil on complexation of copper with EDTA and EDDS and then copper uptake and translocation in the plant. We used a soil polluted with copper whose bioavailability was low due to it being firmly bound with particular soil fractions. The addition of EDTA and EDDS to the soil resulted in the bonding of copper into a complex, which increased the element's mobility in the soil and its availability to plants. Due to the nonselectivity of the chelators, not only copper but also the interfering ions from the soil were bound into the complexes. The ions' stability constants of the complexes were lower than those of copper, but their concentration in the soil was very high. It was determined that the efficiency of Cu mobilization in the soil was higher when using EDDS than when using EDTA. The significant difference in the efficiency of complexation cannot be explained by the stability constants of the Cu-EDDS and Cu-EDTA complexes, because the values of these constants were very close. Instead, it is attributable to the presence of the interfering ions, which compete with Cu for the formation of complexes to varying degrees. The greatest interference comes from Ca, especially when Ca is found in the soil in the form of the Ca^{2+} ion.



S12.07-P -51

TO INVESTIGATE THE VARIATION OF HEAVY METALS CONCENTRATION IN DEPOSITS OF ZAYANDERUD RIVER BED

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To investigate the variation of heavy metals concentration in deposits of Zayanderud river bed ?Ali Izadi Ghorveh?^1, ?Mahmood Solhi?^2, ?Hamid Ghayumi Mohamadi?^3, ?Saeed Vazan?^4 Department of Agronomy, Collage of Agriculture, Karaj Azad University, Karaj, Iran. Phone: +98-913-9021157 Email: ali.izadi.gh@gmail.com Isfahan Research Center of Agriculture and Natural Resources, Isfahan, Iran. Isfahan Research Center of Agriculture and Natural Resources, Isfahan, Iran. Department of Agronomy, Collage of Agriculture, Karaj Azad University, Karaj, Iran. The previous research showed that Gavkhooni wetland was contaminated with Ag and Cd in large amount and Ni and Pb in lower amount. The contamination of wetlands to the south has an increasing trend. The concentration of Cd, Sr, Co, Ni, Zn, Mn in the west and south West of wetland increased and similar results obtained for wetland water. Studies in the Zayanderud river downstream showed high Cr and Pb contamination in plants and soil and water of this area. The contamination of Zayanderud sediments with Sb, Cd, V, U, Pb and Zn was reported by some researchers. In this study the samples collected before and after the entrance of industrial and municipal and agricultural waste water to the river and analyzed for concentration of heavy metals along upstream to downstream. The primitive results showed increasing trend of contamination along the river. The final result will presented in the complete article. Keyword: Zayanderud river, Heavy metals, contamination, sediment.



S12.07-P -52

TRACE ELEMENTS ACCUMULATION AND TRANSLOCATION IN *CISTUS LADANIFER* L.
GROWING IN PORTUGUESE IBERIAN PYRITE BELT MINE AREAS

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Cistus ladanifer L. is a plastic species that shows biological adaptations allowing its development in contaminated mine areas like Iberian Pyrite Belt (IPB). This study aimed to compare the accumulation and translocation of As, Cu, Pb and Zn in *Cistus ladanifer* populations growing in Portuguese IPB mine areas (Brançanes, Caveira, Chança, Lousal, Neves Corvo, São Domingos). These mines originate different contamination levels and are in abandoned state, except Neves Corvo that is operating. Composite samples of soils ($n=34$) and *C. ladanifer* plants (roots and aerial parts) growing on these soils were studied. Soils were developed on different mine wastes which contribute to large heterogeneity of their characteristics. Soils presented multielemental contamination, large pH range (3.45-6.16), small-medium fertility but, in some cases, large Kextractable (0.08-3.56 g/kg). Soils from Caveira, Lousal, Neves Corvo and São Domingos showed great concentrations (g/kg) of As (0.13-3.03), Cu (0.19-6.14), Pb (0.19-9.21) and Zn (0.04-0.79), while the smallest concentrations of these elements (g/kg, As: 0.01-0.15; Cu: 0.03-0.50; Pb: 0.01-0.12; Zn: 0.03-0.12) were observed in Chança and Brançanes soils. Available fractions of these elements (extracted with aqueous solution of diluted organic acids) were <6% of total concentrations, except in some subareas from Lousal and Caveira for Zn (10% of total, 32.49-80.79 mg/kg). Although trace elements concentrations in plants had varied in mine areas, plants from all mines translocated, mainly, Cu and Zn from roots to leaves. Arsenic and Pb were stored in roots, except in Neves Corvo plants. Brançanes, Chança and São Domingos plant samples were Zn accumulators.



S12.07-P -53

TRANSFER OF CD, CU AND ZN FROM SOIL INTO FOOD CROPS IN THE MASHAVERA VALLEY, GEORGIA

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*Soil pollution with trace elements resulting from mining activities is an urgent problem in many industrial regions. The study focuses on the Mashavera Valley, Georgia. It is situated 80 km south of Tbilisi, the capital. It is characterised by a semiarid climate and very fertile, alkaline Chernozems and Kastanozems. The intensive agricultural land use is limited by the aridity of the climate. Due to this, vegetable gardens, grape fields and orchards as well as arable land are intensively irrigated with water supplied by a canal system fed by water from the Mashavera River. As a result of non-ferrous metal mining in the mountainous area of the middle reaches of the Mashavera, the river is loaded with fines containing sulphidic metals (Cu, Zn, Cd), which derive from erosion of mining waste deposits and waste water of a flotation plant. After decades of irrigation the soils of the Mashavera valley area are highly contaminated with Cu, Zn and Cd to such an extent that German and international threshold values for food production are greatly exceeded. Therefore a high risk of the transfer of these metals into the food chain can be assumed. In 2009-2011 more than 200 top soils and related crops were sampled. Elevated concentrations of Cu, Zn and Cd can be measured in crops sampled on soils irrigated with Mashavera water compared to soils irrigated with non-contaminated water (e.g. ground water). Partly Cd concentrations exceed the EU threshold for food crops. Especially in leafy vegetables like *Spinacia oleracea* up to the 2.5 fold. In addition the measured values of Cu and Zn partly exceed the concentrations toxic for crops grown on.*



S12.07-P -54

USING LIBS TO INVESTIGATE ELEMENTAL CONTENT IN PLANTS AND COMPOSTS DURING SOIL REMEDIATION PROCESSES

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Laser Induced Breakdown Spectroscopy (LIBS) is a fast and multi-elemental analytical technique particularly suitable for the qualitative and quantitative analysis of several elements in solid samples including metal alloys for metallurgy and jewellery, and cultural heritage materials. Due to negligible or virtually absent pre-treatments of samples, high sensitivity, simultaneous multielemental detection of major and trace elements, and especially capability for microanalysis with low sample consumption, LIBS has been recently used also for analysis of environmental samples, i.e., meteorites, soils, sediments, and vegetables. In the present work, the authors test the feasibility of the LIBS technique to be used during the remediation/restore of soils by plants (phytoremediation) and compost application. In detail, Cr, Cu, Fe, Pb, and Zn content were investigated in four plant species (i.e., Atriplex halimus, Brassica napus, Rucola sativa, and Sorghum bicolor) and two different composts, and concentration values compared with those obtained by ICP-OES. Although the LODs for the LIBS-detected elements were sometimes quite higher if compared with other analytical techniques, data obtained underline the capability of LIBS method for the monitoring of the studied elements in plants growing in polluted soils, also allowing to calculate a "translocation" factor between roots and leaves. Good results were obtained also for composts. Furthermore, as some metals like Cu and Fe have to be considered, below certain concentrations, micronutrients, the authors propose the application of the LIBS in investigating deficit in plant uptake (e.g., Fe-chlorosis), and/or to evaluate the concentration of nutrients (e.g., Ca, Mg, Mn) in amendments/fertilizers.



S12.07-P -55

VALIDATION OF BATCH TESTS FOR THE EXAMINATION OF LEACHING BEHAVIOUR OF ORGANIC POLLUTANTS FROM CONTAMINATED SOILS

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Associated with the amendment of the German Ordinance on Soil Protection and Contaminated Sites, further development of leaching tests for the impact assessment of contaminated materials to the soil-groundwater pathway is required. These procedures, applicable to examine the long and short term leaching behaviour and dedicated to determine the source term of contaminated soils, are supposed to serve as the basis for a reliable leachate prognosis. Recently, two leaching procedures have been validated in Germany (DIN 19528 - Column test for examination of the leaching behaviour of organic and inorganic substances and DIN 19529 - Batch test at a liquid to solid ratio of 2 L/kg for compliance testing taking into account only inorganic substances). In contrast to that, the draft E DIN 19527 comprises a batch test for the examination of the leaching behaviour of organic substances. Within the framework of a project funded by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety this standard is currently being validated for PAH, TPH, PCB, and phenols. The robustness of the procedure has been proved in a first step. Some special issues have been investigated, e.g. the influence of centrifugation acceleration, duration and agitation frequency on the turbidity and pollutant concentration in the eluates. Based on the results of the robustness tests an inter-laboratory comparison is currently being in execution in order to obtain the relevant performance characteristics of this batch test procedure. Selected results of the validation will be presented.



S12.07-P -56

VICIA FABIA RESPONSES TO LEAD POLLUTION AND ROLE OF METAL SPECIATION

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Lead (Pb), a common and persistent pollutant with no known biological function, continues to cause severe hazards to environmental and human health. The soil pollution and biogeochemical behaviour of Pb profoundly depends on its speciation and soil pedological processes. Nevertheless, very rare data is available concerning Pb pollution and toxicity in relation with its chemical form. In current experimental study, young (3 weeks old) Vicia faba seedlings were subjected to Pb pollution as lead nitrate for 1, 4, 6, 8, 12 and 24 h. The metal was also exposed to Vicia faba seedlings chelated by ethylenediaminetetraacetic acid (EDTA) and citric acid (CA). The experiment was carried out under controlled hydroponic conditions in a phytotron. Visual Minteq software was used to predict Pb speciation in nutrient solution. Complexation of Pb by EDTA resulted in increased Pb uptake in Vicia faba roots while reduced translocation to shoot tissues. The results showed reduced genetic and photosynthetic toxicity of Pb to Vicia faba in the presence of EDTA. In the case of CA, the effect was non-significant regarding Pb uptake, translocation and toxicity.



S12.07-P -57

ZEOLITES AS SORPTION SINK FOR $^{137}\text{Cs}^+$ IN ULTRA-ALKALINE CONDITIONS

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Cement based waste disposal is the most important option to provide safe storage of the non-recyclable often highly toxic waste fraction remaining at the end of today's waste processing chain. Despite all engineering efforts and safety investments ultra-alkaline, concrete derived, pore waters (pH 12 – 14) will always remain associated with cement based waste disposal. To avoid contamination of the environment due to slow leeching of the metals from these waste forms, engineered barriers are built around the waste disposal sites in order to provide containment of the metals leeching out. Upon consideration of a concrete-based storage scenario for ^{137}Cs containing radioactive waste, care must be taken to provide buffer materials that ensure the retention of this cation in presence of concrete pore water with changing composition. Since the applicability of organic ion exchangers in ultra-alkaline, radioactive conditions is limited to a fairly short timeframe, such a buffer sink should include inorganic materials combining long-term stability in such conditions with a high selectivity for the monovalent Cs^+ cation, thereby enabling its efficient sorption in the saline, alkaline conditions imposed by the concrete. Zeolites (natural and synthetic) represent a family of crystalline framework materials typically formed at high pH from different starting materials such as clays, fly ash, high purity silicon sources (TEOS, aerosil,...), etc. The combination of their stability in alkaline aqueous conditions with their cation exchange capacities makes them highly promising candidates for the application as a buffer material in a cement based storage scenario for radioactive waste.



W12.01-P - PESTICIDES IN SOIL, FATE AND EFFECTS ON ENVIRONMENT - In collaboration with GRIFA

Monday 02 July 2012 from 17:00 to 18:30. Room Poster Areas

W12.01-P -1

ADSORPTION OF METALAXYL IN WASTE ORGANIC SUBSTRATES AND SOILS AND EFFECT OF DIFFERENT ORGANIC CARBON QUALITY

Elga Monaci, Ancona - Italy

W12.01-P -2

ANALYSIS OF FLUAZINAM AND ITS DEGRADATION IN SOIL

Kati Hakala, Helsinki - Finland

W12.01-P -3

ASSESSING BIOLOGICAL ACTIVITY OF SOIL ORGANISMS IN NO-TILL SOILS UNDER DIFFERENT AGRICULTURAL PRACTICES USING THE BAIT LAMINA METHOD

Sophie Campiche, Lausanne - Switzerland

W12.01-P -4

ATRAZINE CONTROLLED RELEASE FORMULATION APPLIED ON MAIZE CROP UNDER NO-TILLAGE

Daniela Barbosa, Porto Alegre - Brazil

W12.01-P -5

BROMOXYNIL OCTANOATE A HERBICIDE WIDELY USED AFTER ATRAZINE BANNING: MICROBIAL DEGRADATION IN DIFFERENT SOIL TYPES

Ángeles Prieto-Fernández, Santiago de Compostela - Spain

W12.01-P -6

COMPARISON OF FOUR EXTRACTION METHODS FOR THE MULTIRESIDUE DETERMINATION OF PESTICIDES IN SOIL BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY DETECTION

Vojislava Bursic, Novi Sad - Serbia



W12.01-P -7

COPPER INPUTS INTO SOIL BY RAINDROP IMPACT ON POTATO LEAVES SPRAYED WITH COPPER-BASED FUNGICIDES

Marcos Paradelo, Ourense - Spain

W12.01-P -8

DEGRADATION OF S-METOLACHLOR AND METRIBUZIN IN TWO INTENSIVE-CROP SOILS AMENDED WITH TWO-PHASE OLIVE MILL WASTE

Javier Sánchez Llerena, Badajoz - Spain

W12.01-P -9

DETERMINATION OF ORGANOCHLORINE PESTICIDES IN SOIL USING GAS CHROMATOGRAPHY–TANDEM MASS SPECTROMETRY

Vojislava Bursic, Novi Sad - Serbia

W12.01-P -10

DOES COMPOST ADDITION AFFECT THE MINERALISATION OF ¹⁴C-PESTICIDES NON-EXTRACTABLE RESIDUES IN SOIL ?

Thomas Lerch, Paris - France

W12.01-P -11

EFFECT OF DE-OILED TWO-PHASE OLIVE MILL WASTE ON THE LEACHING OF MCPA AND METRIBUZIN IN A LUVISOL

David Peña Abades, Badajoz - Spain

W12.01-P -12

EFFECTS OF PIG SLURRY CO-APPLIED SULFADIAZINE (SDZ) ON THE STRUCTURAL AND FUNCTIONAL DIVERSITY OF MICROORGANISMS IN EARTHWORM CHANNELS AND SOIL AGGREGATES

Rüdiger Reichel, Trier - Germany

W12.01-P -13

EROSION AFFECTED DISPERSION OF GLYPHOSATE IN SOIL ENVIRONMENT

Gorana Todorovic, Vienna - Austria

W12.01-P -14

FATE AND IMPACT OF PESTICIDES: A MULTI-SCALE AND INTERDISCIPLINARY STUDY FOR A RATIONAL USE

Pascale Besse-Hoggan, Aubière Cedex - France



W12.01-P -15

FATE OF THE HERBICIDE MECOPROP IN MEDITERRANEAN SOILS AMENDED WITH FRESH AND COMPOSTED OLIVE-MILL WASTE

Beatriz Gamiz, Sevilla - Spain

W12.01-P -16

FATE OF THE HERBICIDE MESOTRIONE IN THE ENVIRONMENT: COUPLING OF CHEMICAL AND BIOLOGICAL (2D-DIGE) APPROACHES TO IDENTIFY ITS DEGRADATION PATHWAY BY A BACILLUS SP. STRAIN ISOLATED FROM AN AGROSYSTEM

Joly Pierre, Aubière - France

W12.01-P -17

IMPACT OF DE-OILED OLIVE MILL WASTE AMENDMENT ON THE SORPTION, LEACHING, AND DEGRADATION OF S-METOLACHLOR IN A CALCAREOUS CLAY SOIL

Ángel Abarrán Liso, Badajoz - Spain

W12.01-P -18

IMPACT OF MCPA IN NITROGEN MINERALIZATION AND UREASE ACTIVITY IN ANDISOL SOIL.

Evelyn Padilla, Temuco - Chile

W12.01-P -19

LONG TERM MONITORING OF ATRAZINE CONCENTRATIONS IN A SHALLOW AQUIFER

David Vonberg, Jülich - Germany

W12.01-P -20

MODULATION OF ATRAZINE BIODEGRADATION BY PSEUDOMONAS SP. STRAIN ADP ADSORPTION ON ANIONIC CLAYS AND ANIONIC CLAY / HUMIC ACID COMPLEXES

Pascale Besse-Hoggan, Aubière Cedex - France

W12.01-P -21

PERCOLATION LOSSES OF PESTICIDE APPLIED AS CONTROLLED RELEASE FORMULATIONS IN STRUCTURED SOIL CORES

Marcos Paradelo, Ourense - Spain

W12.01-P -22

PH EFFECT ON THE ADSORPTION OF NEUTRAL PESTICIDES BY SOILS

Dora Gondar, Santiago de Compostela - Spain



W12.01-P -23

REMOVAL OF CR(VI) FROM INDUSTRIAL WASTEWATER USING CLAY-MICELLE COMPLEX

Mohannad Qurie, Potenza - Italy

W12.01-P -24

ROLE OF SOIL COLLOIDS IN THE TRANSFER OF GLYPHOSATE AND AMPA FROM A SMALL VINEYARD SUBCATCHMENT TO SURFACE WATER OF WESTERN SWITZERLAND

Silwan Daouk, Lausanne - Switzerland

W12.01-P -25

SEDIMENT-ASSOCIATED PESTICIDES IN A SUBTROPICAL RIVER IN NORTHERN THAILAND

Thilo Streck, Stuttgart - Germany

W12.01-P -26

SLOW RELEASE FORMULATIONS OF DIURON BASED ON CLAY-PHOSPHATIDYLCHOLINE COMPLEXES

Tomas Undabeytia, Seville - Spain

W12.01-P -27

SOLUBILIZATION OF HERBICIDES BY SINGLE AND MIXED COMMERCIAL SURFACTANTS

Tomas Undabeytia, Seville - Spain

W12.01-P -28

STUDY OF THE SORPTION OF TWO SULFONYLUREA TYPE HERBICIDES, THEIR FORMULATION AS WELL AS ONE ADDITIVE ON SOILS AND SOIL COMPONENTS

Rita Földényi, Veszprém - Hungary

W12.01-P -29

TRANSPORT OF HEAVY METALS IN SOILS TREATED WITH MUNICIPAL SLUDGE

Elham Asgharzadeh, Hamedan - Iran, Islamic Republic of

W12.01-P -30

USING THE DIGITAL SOIL MAP OF WALLONIA (SOUTHERN BELGIUM) AND AN EXISTING DATABASE OF SOIL ANALYSIS TO ASSESS THE RISKS OF PESTICIDE LEACHING TO GROUNDWATER.

Boubacar Billo Bah, Gembloux - Belgium



W12.01-P -1

ADSORPTION OF METALAXYL IN WASTE ORGANIC SUBSTRATES AND SOILS AND EFFECT OF DIFFERENT ORGANIC CARBON QUALITY

Vischetti Costantino^[1], Coppola Laura^[1], Monaci Elga^{*[1]}, Mincarelli Laura^[1], Taffi Marianna^[1], Casucci Cristiano^[1], Agnelli Alberto^[2]

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A laboratory experiment has been carried out to determine organic carbon content and quality of different organic waste substrates (urban and green compost, moist olive oil husks) to be used as organic bio-filters to retain and degrade pesticides, compared with organic carbon content and quality of two soils (forest and agricultural). An adsorption/desorption experiment was also performed in the same substrates and soils, using metalaxyl, one of the most used fungicide in vineyard treatment in Italy. The goal of the work was to determine the main responsible carbon fraction governing adsorption and desorption phenomena, by characterizing the relationship between different carbon fractions and the adsorption/desorption parameters determined. The K_{ads} values found in the organic substrates resulted higher than those reported for soils. The quality of organic carbon strongly influenced the entity and the reversibility of bonds between substrates and fungicide. The influence on adsorption of different fractions of organic carbon can be summarized in order of intensity: humic acid carbon > humified carbon > organic carbon > total carbon, driving to the conclusion that the presence of the humified fraction in organic substrates is essential for a good performance of bio-filters. Desorption studies showed a high degree of reversibility of the adsorbed fungicide in substrates with low content of humified carbon and this is crucial from a practical point of view, because it could be possible that pesticide adsorbed on bio-filter in the previous waste water treatment could be desorbed and released in solution when a further treatment is made.



W12.01-P -2

ANALYSIS OF FLUAZINAM AND ITS DEGRADATION IN SOIL

Hakala Kati*^[1]

^[1]University of Helsinki ~ Food and environmental sciences ~ Helsinki ~ Finland

Fungicide fluazinam, 3-chloro-N-[3-chloro-2,6-dinitro-4-(trifluoromethyl)phenyl]-5-(trifluoromethyl)-2-pyridinamine, CAS No. 79622-59-6, protects potato against late blight, caused by *Phytophthora infestans*. The behaviour of this moderately persistent pesticide in soil is poorly known, preventing proper risk assessment. Analytical standard fluazinam and commercial product Shirlan® were added into five untreated soils samples (sand, clay, organic) and into four subsamples from which organic matter was decomposed. Fluazinam was extracted with acetonitrile and quantified by high performance liquid chromatography with photodiode array detector (HPLC-DAD). This method differs fundamentally from the majority of published methods for analysing fluazinam in soil. Fluazinam was quantitatively recovered from soil readily after addition. After 90 days of incubation, degradation of fluazinam was clearly promoted by the abundance of organic matter. It is likely that fluazinam occurred in soil as bound residues, extractable with acetonitrile, since the chemical was not detected in CaCl₂ extract, mimicking soil solution. Therefore it is unlikely that fluazinam is leached from soil in dissolved form but it can be transported to watercourses with eroded soil particles. The degradation of fluazinam will be further investigated in four soils under different temperature and moisture conditions. The influence of organic matter content, soil pH, cation exchange capacity and soil texture on degradation will also be taken under accurate examination. The results of this six-month experiment will be available in spring 2012.



W12.01-P-3

ASSESSING BIOLOGICAL ACTIVITY OF SOIL ORGANISMS IN NO-TILL SOILS UNDER DIFFERENT AGRICULTURAL PRACTICES USING THE BAIT LAMINA METHOD

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In agriculture, application of fertilizers and phytosanitary products varies depending on the cultivation methods used. Sustainable farming practices such as zero tillage increase the amount and variety of life in the soil but may require the use of herbicides. In the present work, the impact of different fertilizer and herbicide treatments on the biological activity of soil organisms of a no-till soil was compared. Using the bait lamina test, the changes in overall feeding activity of the soil biocenosis were measured in an agricultural brown soil (15% clay, 3% humus) with and without application of glyphosate for two types of fertilizers. The experiment was conducted at different exposure times, immediately and several weeks after the herbicide application, at different application rates and with different crops (corn, winter barley). The results of the bait lamina test show that according to the exposure parameters and application rates of the herbicide, the biological activity of the soil organisms tends to be higher in soil where glyphosate was applied. The bait lamina results were completed by physico-chemical analyses and by reproduction tests with Collembolans on the collected field samples.



W12.01-P -4

ATRAZINE CONTROLLED RELEASE FORMULATION APPLIED ON MAIZE CROP UNDER NO-TILLAGE

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*The present study evaluated the distribution of atrazine (ATZ) in straw and soil after its application as commercial (ATZ-C) and as controlled release formulation (ATZ-XG) on a maize crop field. The control efficiency of the two formulations along time was investigated by a bioassay, employing *Raphanus sativus* as bioindicator. Straw and soil (0-3 cm depth) samples were collected at 1, 5, 10, 15, 21, 28 and 35 days after the application (DAA) of ATZ at 5400 g a.i. ha⁻¹. ATZ was extracted by methanol and quantified by Gas-Chromatography. Soil samples were used for the bioassay. For both formulations ATZ concentration was higher in straw than in soil indicating that under no-tillage, straw retains great part of applied ATZ. The occurring rainfall between the 7th and the 9th DAA mobilized ATZ-C from both compartments to a more accessible form, and after the 10th DAA, ATZ concentration decreased. The concentration of extracted ATZ under the ATZ-XG treatment was always greater than that of the ATZ-C, and decreased gradually with time in both compartments. Until the 15th DAA the control efficiency of both formulations was similar; thereafter only ATZ-XG decreased the bioindicator dry mass production. It follows that ATZ on the xerogel was less dissipated than ATZ-C and thus showed longer herbicide efficiency. The lower mobility of ATZ-XG was corroborated by a leaching assay, where the concentration of extracted ATZ was high only in the 0-5 cm while that under ATZ-C treatment was evenly distributed until 15 cm.*



W12.01-P-5

**BROMOXYNIL OCTANOATE A HERBICIDE WIDELY USED AFTER ATRAZINE BANNING:
MICROBIAL DEGRADATION IN DIFFERENT SOIL TYPES**

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Bromoxynil, frequently applied as bromoxynil octanoate, is a post-emergence herbicide, widely used for control of broad-leaved weeds on a variety of crops, particularly since the banning of atrazine in most countries. This study analysed the degradation of bromoxynil octanoate by microorganisms from non-organically managed agricultural soils developed over granite (G) and schist (S) as well as from an organically managed agricultural soil developed over granite (Go). As a means of analysing the role of the most abundant members of the soil microbial community, degradation of bromoxynil octanoate was evaluated in microcosms incubated with distinct amounts of soils. Furthermore, the effect of the herbicide on soil microbial communities (community level physiological profiles, CLPP) was analysed. Bromoxynil octanoate was rapidly degraded by microorganisms from the 3 soils and was no longer detectable three days after initiating the experiment. At this time, about half of the herbicide applied was present as the active compound, bromoxynil. Thereafter, bromoxynil was degraded more rapidly in G and S than in Go, in which the herbicide was still detectable 2 weeks after its application. In the short-medium term (3-15 days), the metabolites 3,5-dibromo-4-hydroxybenzamide (DBHB amide) and/or 3,5-dibromo-4-hydroxybenzoic acid were detected in all three soils. The most abundant members of the soil microbial communities were also able to degrade bromoxynil and its ester, though this degradation was slower, or incomplete, and bromoxynil and/or DBHB amide were detected 6 weeks after application. The herbicide had little effect on the functionality of the microbial communities in the soils.



W12.01-P -6

COMPARISON OF FOUR EXTRACTION METHODS FOR THE MULTIRESIDUE DETERMINATION OF PESTICIDES IN SOIL BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY DETECTION

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The LSE, QuEChERS, ultrasonic and Soxhlet extraction were compared regarding the analysis of the simazine, atrazine, promethrin, chlorpyrifos, fenitrothion, diazinon, heptachlor, aldrin, alachlor, chlorothalonil, carbofuran, linuron, clomazon, acetochlor, dimethenamid, metribuzin, pendimethalin and trifluralin in soil. The pesticides were extracted from the soil with physico-chemical properties as follows: pH 7.64, organic matter content of 3.96%, sand content 49.80%, silt content 33.40% and 16.80% of clay. None of the analysed pesticides could be detected after the ultrasonic extraction which indicates that the corresponding solubility of the analysed analites has not be achieved. With the exception of linuron and chlorothalonil, the QuEChERS has proved to be the best method. Comparing the LSE and Soxhlet method, the latter is better for the determination of pendimethalin and heptachlor. The recoveries (10, 75 and 200 ng/g) for the LSE were 40.2-91.1%; for QuEChERS 53.56-105.67% and for Soxhlet 2.19-95.74%. RSD for the LSE ranged from 0.18 to 17.95%, for QuEChERS 0.15-14.23% and for Soxhlet 2.19-18.74%. The LODs were between 0.9 and 25.7 ng/g with the LSE, 0.1 and 7.3 ng/g with QuEChERS and from 0.2 to 4.6 ng/g with the Soxhlet extraction. All the substances were observed to be linear in the range of 10-300 ng/g, except for the determination of chlorothalonil and linuron by the LSE where it was 40-300 ng/g. The authors acknowledge the financial support of the Ministry of Education and Science, Republic of Serbia, Project Ref. III43005, TR31043 and BTR 31072.



W12.01-P -7

COPPER INPUTS INTO SOIL BY RAINDROP IMPACT ON POTATO LEAVES SPRAYED WITH COPPER-BASED FUNGICIDES

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Foliar wash-off of pesticides is an important source of diffuse pollution in agricultural soils. Losses of Cu-based fungicides sprayed on several crops led the accumulation of copper in soils. Laboratory tests performed on synthetic surfaces reported that droplet impact energy contributes to increasing Cu losses by wash-off, both as particles and copper in solution. However, such losses depend on complex interactions involving properties of the leaf surface the pesticide formulation and drop impact mechanics. Wash-off tests were made using a laboratory scale single drop rainfall simulator on potato leaves sprayed with Cu-based fungicides. A full factorial design was performed to study the influence of the dose, the droplet size (2.6 - 3.8 mm in equivalent diameter) and its impact velocity on pesticide loss. Three commercial formulations were tested, namely BM (Bordeaux Mixture), copper oxychloride as wetting powder of 1 µm particle size (CO), and aqueous suspension of 0.5 µm particle size (CO-PG). Average BM losses in all experiments were 54.2% of total sprayed. Copper removed from CO and CO-PG were 20% and 25.3% respectively. More than 50% total loss occurred as particles. Dose and velocity of the droplets were significant for BM wash-off. Higher the dose and the droplet size increased the CO losses; droplet size and the interaction with the other factors were significant for CO-PG. These results confirm that hydrodynamics of droplet impact on leaves has significant influence on wash-off. Copper inputs to soil can be empirically modelled based on rainfall properties, the pesticide type and its dosage.



W12.01-P-8

DEGRADATION OF S-METOLACHLOR AND METRIBUZIN IN TWO INTENSIVE-CROP SOILS AMENDED WITH TWO-PHASE OLIVE MILL WASTE

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The loss of soil organic matter as a consequence of agricultural intensification can negatively affect the sustainability of agricultural production. Although organic amendments are often applied to improve soil quality and productivity, they can also affect the behaviour of pesticides in the soil. Two-phase olive mill waste (OW), a by-product of olive oil extraction, contains up to 90% organic matter, and may be used as a soil amendment. The objective was to evaluate the effect of OW on the persistence of S-metolachlor and metribuzin in two intensive-crop soils. The soil studied were a loam (L) and a sandy loam (SL). Treatments included an unamended control (L0 and SL0), and 2.5% (L1 and SL1) and 5% (L2 and SL2) of fresh OW. The results showed that the addition of OW significantly increased the half-life ($t_{1/2}$) of both S-metolachlor and metribuzin, with the increases being significantly greater for the former. Thus, for S-metolachlor, $t_{1/2}$ increased from 42 days for L0 to 115 days for L2, and from 48 days for SL0 to 89 days for SL2, while the $t_{1/2}$ for metribuzin increased from 23 days for L0 to 48 days for L2, and from 36 days for SL0 to 51 days for SL2. The results thus showed OW application to increase the persistence of herbicides, suggesting that, while such application could help the farmer reduce the rate and frequency of the use of these two herbicides, it could also increase the risk of their run-off and the consequent contamination of water bodies.



W12.01-P-9

DETERMINATION OF ORGANOCHLORINE PESTICIDES IN SOIL USING GAS CHROMATOGRAPHY–TANDEM MASS SPECTROMETRY

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A method was developed for the determination of organochlorine pesticide (OCP) residues in soil/sediment using gas chromatography-tandem mass spectrometry (GC-MS/MS). The analytical procedures consisted of microwave-assisted extraction method (MAE). The analytical procedure consisted of MAE of pesticides from 5g of soil with 25 ml of 1:1 acetone:n-hexane mixture. After extraction the organic layer was cleaned up with water. Hexane layer was separated and evaporated to dryness. The residue was re-dissolved and directly analysed by GC-MS/MS. The analytes were separated on the HP-5MS capillary column, detected in multiple reaction monitoring mode (MRM) and quantified using internal standard calibration. The linear correlations of calibration standard solutions were good for all the OCPs. The recoveries and relative standard deviations of compound solutions ranged from 57% to 140% and from 1.5% to 18%, respectively. The limits of detection ranging from 0.2 to 1.0 µg/kg were established for the 19 OCPs. The method showed a satisfactory clean-up effect and precision quantification. It is suitable for the determination and confirmation of organochlorine pesticides in complex matrices such as soil, sediment. Acknowledgment The authors acknowledge the financial support of the Ministry of Education and Science, Republic of Serbia for Project Ref. III43005.



W12.01-P -10

DOES COMPOST ADDITION AFFECT THE MINERALISATION OF ¹⁴C-PESTICIDES NON-EXTRACTABLE RESIDUES IN SOIL ?

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The formation and the fate of pesticide non-extractable residues (NER) in soil are important processes that should be taken into account when assessing pollution risks. However, the underlying mechanisms are still poorly understood. In particular, the compost often applied on agricultural soils to sustain the content in soil organic matter (SOM) is likely to alter the biodegradation of such xenobiotics residues, either by reducing their availability or stimulating the microbial biomass. The main objective of this study was to assess the long and short terms effects of compost on the mineralisation of pesticide NER. To this aim, we set up an incubation with a 5x2x3 factorial design using NER coming from 5 different ¹⁴C-labelled pesticides (atrazine, simazine, pendimethaline, metsulfuron-methyl and 2,4-dichlorophenoxy acetic acid), initially formed in a soil amended or not with compost (Barriuso et al., 1996), and incubated with 3 different doses (0, 10 or 20%) of composts during 386 days at 28°C and 80% WHC. During the incubation, total CO₂ and ¹⁴C-CO₂ were trapped in NaOH solution and measured with colorimetric or scintillation counting, respectively. The mineralisation kinetics showed differences among NER, simazine- and pendimethaline-NER being the least mineralised (<6%) and metsulfuron NER the most (>12%). The short term effect of compost on NER mineralisation was minor compared to long term effect, especially for 2,4-D and atrazine. These results suggest that the addition of compost strongly affects NER fate when applied at the same time as the pesticides in soil, but has only small effects years after.



W12.01-P -11

EFFECT OF DE-OILED TWO-PHASE OLIVE MILL WASTE ON THE LEACHING OF MCPA AND METRIBUZIN IN A LUVISOL

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The pesticide retention capacity of agricultural soils with low organic matter contents is usually very poor, with the concomitant risk of a major contamination of groundwaters. The application of organic amendments to such soils could reduce this risk. Olive oil extraction generates an organic slurry (two-phase olive mill waste, OW), which after drying is usually subjected to a further chemical extraction of oil leaving a solid residue (de-oiled two-phase olive mill waste, DW). Laboratory experiments were conducted to evaluate the influence of DW amendments on leaching of the herbicides MCPA and metribuzin in a Luvisol. The soil was amended with DW at the rates of 2.5% and 5% (w/w). The results showed that, while the addition of DW did not significantly affect MCPA leaching, it did significantly reduce that of metribuzin, attributable to the greater sorption of this latter herbicide by these soils. There was increased retention of both herbicides in the DW amended soil columns, which was especially significant in the case of metribuzin. One may thus conclude that, at least in a Luvisol, DW amendment may constitute an effective management practice for the control of groundwater contamination by certain herbicides.



W12.01-P -12

EFFECTS OF PIG SLURRY CO-APPLIED SULFADIAZINE (SDZ) ON THE STRUCTURAL AND FUNCTIONAL DIVERSITY OF MICROORGANISMS IN EARTHWORM CHANNELS AND SOIL AGGREGATES

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Effects of antibiotics on soil microbial diversity were previously reported and depend on the presence of manure and the spatial proximity of agents, organisms, and soil sorbent surfaces such as the rhizosphere. However, effects in soil microcompartments such as earthworm channels and soil aggregates were not further investigated. Hence, antibiotic-induced shifts of β -proteobacteria and pseudomonas DGGE profiles and enzyme activities were determined in SDZ amended agricultural Luvisol. The organic matter composition and potential wettability of earthworm channels were mapped by 2D-DRIFT-FTIR along transects. Antibiotic concentrations were determined using accelerated solvent extraction and LC-MS/MS. Field soil aggregates and earthworm channels were sampled 36 weeks after application of SDZ contaminated pig slurry. Under laboratory conditions, earthworm channels of Lumbricus terrestris were sampled 30 days after top application of antibiotic spiked slurry to soil columns. Soil amendment with slurry and SDZ affected enzyme activity, DGGE profiles and C/N ratios. In separated aggregates lower antibiotic concentrations were found in shells compared to cores. However, SDZ significantly decreased total enzyme activity in aggregate cores. Under field conditions, antibiotic concentrations of earthworm channels were higher compared to adjacent bulk soil, resulting in significantly decreased enzyme activities. Laboratory experiments confirmed this and indicated clearly shifted β -proteobacteria and pseudomonas DGGE profiles, along with significantly decreased C/N ratios at the inner surface of earthworm channels. The DRIFT mapping revealed the larger hydrophobicity of inner surfaces of earthworm channels, whereas the boundary layer to the bulk soil was hydrophilic. This documents specific antibiotic fate and effects in soil microcompartments.



W12.01-P -13

EROSION AFFECTED DISPERSION OF GLYPHOSATE IN SOIL ENVIRONMENT

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A more effective environmental protection needs a better understanding of the pollutant behavior in soils. A better attenuation of the pollution risk can be achieved through the more specified pesticide management based on the adaptation of the pesticide type and application rates to the specific characteristics of the area of application. Glyphosate is highly water soluble and traces were found in surface- and groundwater systems. For a better understanding of the influence of water erosion processes after application of Glyphosate in the practice, two rain simulation experiments were conducted on two representative agricultural sites in Austria. The results of the experiments showed that under normal practical conditions (e.g. no rainfall is expected after application), the potential adsorption capacity of the stagnic Cambisol, with about 16.000 ppm pedogenic Fe-oxides is confirmed compared to the low adsorption of the Chernozem (about 8.000 ppm pedogenic Fe-oxides). Considering the enormous differences in the run-off amounts between the two investigated sites, the importance of soil surface conditions and vegetation cover (e.g. soil structure and infiltration rate) for the dispersion of glyphosate must be stressed. In the rainfall simulation experiments the amount of run-off at Kirchberg (stagnic Cambisol) was app. 10 times higher than at the Pixendorf site (Chernozem), which had much better infiltration conditions. Consequently, the total loss of glyphosate through run-off was more than double on the Kirchberg site, which confirms the higher risk of pesticide pollution for surface waters from agricultural fields with high erosion intensity.



W12.01-P -14

FATE AND IMPACT OF PESTICIDES: A MULTI-SCALE AND INTERDISCIPLINARY STUDY FOR A RATIONAL USE

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According to European (Water Framework Directive, 2000) and French (Ecophyto2018) regulations, pesticide use for agricultural and public applications must be reduced by 50% within 10 years to maintain good health status of waters and avoid sanitary and environmental problems. This interdisciplinary and integrative research project (2010-2014) consists in a multi-scale study from laboratory to field that aims (i) to understand all the processes involved both in the transfer of pesticides from soil to the connected aquatic compartments and those involved in their transformation by chemical, photochemical and biological mechanisms and (ii) to evaluate the impacts of the parent molecules and their transformation products on various target and non-target organisms (plants, bees, soil microbial communities, aquatic microorganisms). An agricultural field located in the Limagne plain (France) is used to validate laboratory data. It is equipped with piezometres and lysimetres. A complete characterization of the site and its soil has shown a high capacity of xenobiotic retention due to its substantial clay and organic matter content. Pesticides belonging to various chemical families with different action modes have been chosen (herbicides: sulcotrione, mesotrione; fungicide: tebuconazole, insecticide: deltamethrine). The potential pesticide life cycle from the plant to the ground and surface waters via the soil is investigated. The long term aim is to help farmers choosing the most efficient and least harmful pesticides, depending on soil responses by coupling biological and chemical data. This work is supported by the Région Auvergne, CNRS, MESR and FEDER (CPER project).



W12.01-P -15

FATE OF THE HERBICIDE MECOPROP IN MEDITERRANEAN SOILS AMENDED WITH FRESH AND COMPOSTED OLIVE-MILL WASTE

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Olive-mill waste (OMW), a byproduct of the olive oil production process, is often added to Mediterranean agricultural soils as an ecological and economic way for its disposal, and also to improve soil structure, increase soil fertility, and control soil erosion. In this work, laboratory experiments were conducted to assess the effects of two OMWs, fresh and composted, when added at a rate of 5% (w/w) to two agricultural soils (a clay soil and a sandy loam soil), on sorption, degradation, and leaching, of the herbicide mecoprop (MCP). Addition of fresh and composted OMW to the sandy loam soil equally increased MCP sorption by about 30%. A more pronounced increase in MCP sorption was observed when the clay soil was amended with fresh OMW (20% sorption) compared to composted OMW (7% sorption). Fresh OMW enhanced the persistence of MCP in both soils, whereas the composted OMW had no impact on MCP persistence. MCP leaching in soil columns was retarded by the addition of both fresh and composted OMW to the soils, but higher herbicide concentrations were found in leachates from the clay soil treated with fresh OMW, due to the long MCP persistence in this system. Therefore, OMW addition to agricultural soils can significantly affect the behavior of MCP and that these effects should be considered to optimize the performance of the herbicide in OMW-amended soils. Acknowledgment: Projects P07-AGR-03077 of Junta de Andalucía and AGL2011-23779 of the Spanish Ministry of Science and Innovation, cofinanced with FEDER-FSE funds.



W12.01-P -16

FATE OF THE HERBICIDE MESOTRIONE IN THE ENVIRONMENT: COUPLING OF CHEMICAL AND BIOLOGICAL (2D-DIGE) APPROACHES TO IDENTIFY ITS DEGRADATION PATHWAY BY A BACILLUS SP. STRAIN ISOLATED FROM AN AGROSYSTEM

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Mesotrione is a triketone molecule recently used as a selective herbicide on maize cultures. To date, the mesotrione degradation pathway is little studied, and only two degradation products, MNBA and AMBA, have been identified. Therefore, understanding its fate in the environment to subsequently study its impact on edaphic communities is of great concern. To achieve this goal, isolation of pure mesotrione-degrading bacteria is a necessary step to characterize the metabolic degradation pathway of the molecule in the environment. In this study, bacterial enrichment cultures were realized from a soil surface layer sampled in Limagne (France) and with increasing concentrations of mesotrione (25 to 100 mg.L⁻¹) as the sole source of carbon. One mesotrione-adapted strain, identified as *Bacillus* sp., was shown to rapidly and completely transform the herbicide. Five degradation products were revealed, but only 3 of them were chemically identified allowing the proposition of a degradation pathway model. The proteome of this *Bacillus* sp. was studied by using 2D-DIGE (2-Dimensional Differential in-Gel Electrophoresis), and we highlighted 30 differential expressed proteins when *Bacillus* sp. was cultivated with mesotrione compared to control culture without herbicide. The preliminary analyses showed that a nitrite-reductase was overexpressed in the presence of mesotrione. These data agree with the chemical results that showed the formation of the hydroxylamine metabolite. The other differentially expressed proteins are under investigation and could help to assess metabolites as yet unidentified. Thus, coupling chemical and biological data will enable us to understand the fate of the mesotrione herbicide and to identify its complete degradation pathway.



W12.01-P -17

IMPACT OF DE-OILED OLIVE MILL WASTE AMENDMENT ON THE SORPTION, LEACHING, AND DEGRADATION OF S-METOLACHLOR IN A CALCAREOUS CLAY SOIL

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Agricultural practices based on periodic inputs of organic amendments are strongly recommended for Mediterranean agro-ecosystems. Such amendments can change the soil's properties and transport characteristics, and hence affect the behaviour and fate of pesticides. S-metolachlor is a herbicide commonly used in intensive crops such as maize, sunflower, potato, as well as in other non-intensive crops. The aim of this study was to investigate the influence of fresh de-oiled two-phase olive mill waste (DW) amendments on the sorption, leaching, and degradation of the herbicide S-metolachlor in a calcareous clay soil. The soil was amended in the laboratory with DW at the rates of 2.5% and 5% (w/w). Significant increases in S-metolachlor sorption were observed in the amended soils. The addition of DW increased the herbicide's half-life from 27 days for the original soil to 41 days at the higher DW application rate. Although the amount of S-metolachlor in the leachate was unaffected by increasing the amount of DW, there was significantly greater retention of the herbicide at the higher DW loading rate. The results lend support to the potential of DW amendment as an effective management practice to increase S-metolachlor's persistence in soils, although this increase does not necessarily ensure decreased leaching of the herbicide.



W12.01-P -18

IMPACT OF MCPA IN NITROGEN MINERALIZATION AND UREASE ACTIVITY IN ANDISOL SOIL.

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Beef and dairy production in Chile is based on grassland production, but mostly area of soil used for this crops are acidic, of volcanic ash derived (Andisol). Consequently, the soil acidification is one of the main factors limitind for grassland crops and production in the area. Part of agricultural management involves the application of acidifying herbicides as such MCPA (4-chloro-2-methylphenoxy acetic acid) in order to increase the crops yield. The aim of this work was to evaluate the chemical and biological parameters changes produced in response to the application of MCPA. Andisols soils used in incubation tests belong to the serie Freire (FS, 38 ° 50' S, 72 ° 42 'W), corresponding to 0-20 cm deep. The samples were dried at constant temperature and sieved (2 mm). The experiment were incubated at 10 and 21 °C under aerobic soil samples in triplicate with MCPA dose (1 L/kg), equivalent to field conditions. During incubation we determined Olsen phosphorus, pH, urease activity and N mineralization (NH₄ +-N and NO₃ - N). This results will be compared with previous work without application the herbicides in soil. The preliminary results indicated the N- mineralization rate reduce in 50% in soil with MCPA application over control, we need a deeper analysis for concluding results. Acknowledgements: The study has been supported by DIUFRO DI11-2013, Doctorate Program in Science of Natural Resources and Scholarship Conicyt N°21100497.



W12.01-P-19

LONG TERM MONITORING OF ATRAZINE CONCENTRATIONS IN A SHALLOW AQUIFER

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Atrazine is one of the most widespread pesticides for weed control used worldwide. Since it was found in groundwater at concentrations that exceed the threshold limit of 0.1 µg/l, it was prohibited in Germany already in 1991. However, since then atrazine concentrations in many aquifers were reported to remain at a constant level. One example is the aquifer Zwischenscholle which is a phreatic aquifer with a shallow water table and which is located in a region with intensive agriculture. Continuous groundwater monitoring showed that atrazine concentrations have not ceased more than 20 years after its ban. This data indicates a strong inertia of the coupled soil groundwater system and accordingly policies taken to improve groundwater quality may be rather ineffective on the short term. Two main hypotheses for slow decrease in atrazine concentrations are raised. The first states that former atrazine concentrations are only marginally diluted due to large groundwater volume compared to the groundwater recharge. The degradation potential of atrazine in several aquifer samples was found to be negligible but will be reevaluated in this study. The second assumption states that extensive atrazine residues in the vadose zone are present. Gradual desorption and leaching to the groundwater is supposed to sustain the atrazine concentrations in the groundwater. The quantification of these processes will be carried out to be able to predict contaminant attenuation more accurately and thus being able to elaborate appropriate groundwater action plans.



W12.01-P-20

**MODULATION OF ATRAZINE BIODEGRADATION BY PSEUDOMONAS SP. STRAIN ADP
ADSORPTION ON ANIONIC CLAYS AND ANIONIC CLAY / HUMIC ACID COMPLEXES**

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To mimic the role of hydroxide minerals and their humic complex derivatives on the biodegradation of pesticides in soils, synthetic Mg₂Al anionic clays (referred as Layered Double Hydroxides or LDH) and Mg₂Al modified by Humic substances (LDH-HA) were prepared and fully characterized. Various chemical compositions and corresponding anion exchange capacities (R = 2, 3 and 4) were tested. Atrazine is a widely used selective herbicide in corn crop production throughout the world. Adsorption properties of LDH and LDH-HA toward Pseudomonas sp. strain ADP, one of the well-known atrazine-degrading bacterium, were evaluated. The adsorption kinetics were very fast (< 5 min) to reach equilibrium. Pseudomonas sp. strain ADP displayed a strong affinity for LDH surfaces. The adsorption capacities varied with both surface charge and textural properties. Surface modification by HA reduced the adsorption capacities of cells by 2 to 6 folds. Biodegradation kinetics of atrazine by Pseudomonas sp. adsorbed on both LDHs and LDH-HA complexes were measured for various solid/liquid ratios and adsorbed cell amounts. Biodegradation activity of bacterial cells was strongly boosted after adsorption on LDHs, the effect depending on the quantity and properties of the LDH matrix. No sorption of atrazine on these solid matrixes was observed. The maximum biodegradation rate was obtained in the case of a 100mg/mL Mg₂Al LDH suspension (26 times higher than that obtained with cells alone). The obtained results make this type of synthetic products with their unique structure an ideal and promising solid for bioremediation applications.



W12.01-P -21

PERCOLATION LOSSES OF PESTICIDE APPLIED AS CONTROLLED RELEASE FORMULATIONS IN STRUCTURED SOIL CORES

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Controlled release formulations of pesticides (CRFs) used in control of soil-borne pests are designed to optimize the efficiency of the active ingredient (AI), minimize deep percolation losses and premature inactivation of in soil. In field conditions, transport of the AI can be influenced by the interaction between CRF components with soil. Physicochemical heterogeneity of the soil and water status control release of AI from CRF granules and deep percolation. We present results of percolation of the pesticide carbofuran applied as granulated CRF in structured soil cores undergone to diffusion in controlled moisture conditions before percolation tests. Breakthrough curves (BTC) of AI in percolates were analysed by means of time moment analysis. Results show the influence of soil moisture condition and release time prior to the percolation on the loss of the AI. Large diffusion times (30 d) in higher matric potential (field capacity, -33 kPa) produced the largest loss of AI (35 % of pesticide dose) during percolation (high rate, 20 mm h⁻¹). With shorter diffusion time (1 d) losses were 13 %. Diffusion in a drier moisture condition (-1500 kPa matric potential) decreased pesticide losses, presumably by a less extent of release during no flow conditions. The most influential factors in pesticide loss from CRF granules are the initial moisture and diffusion time. Preferential flow and initial spatial distribution of the pesticide in soil before percolation play a major role. Flow rate during the in percolation step has secondary influence.



W12.01-P -22

PH EFFECT ON THE ADSORPTION OF NEUTRAL PESTICIDES BY SOILS

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Numerous studies had pointed out that the predominant sorbent of neutral organic contaminants in soils is the natural organic matter. So far, most of the research has focused in the analysis of sorption properties of different soils and the relationship between its sorption capacity and the organic carbon content and properties. In order to reach a better knowledge of this type of interactions, it was analyzed the effect of the pH on the interaction between two neutral pesticides (metalaxyl and penconazole) and four soil samples: an organic peat soil, an agricultural soil, an agricultural soil amended with straw, and a forest soil. It was found a significant decrease in the amount of adsorbed pesticide as the soil suspension pH increases. However the behaviour of the four soils is markedly different. The organic partition coefficients (KOC) at different pH values are the same for the peat and agricultural soil, but significantly higher than those obtained for the other two soils. The influence of the pH on this type of hydrophobic interactions may be related to the increase of the soil organic matter charge with pH, making less favourable the hydrophobic interaction between the neutral pesticides and the soil organic matter phase. On the other hand, the different behaviour among soil samples may be related to the quality of their organic matter fraction itself, as revealed by their ¹³C NMR spectra.



W12.01-P-23

REMOVAL OF Cr(VI) FROM INDUSTRIAL WASTEWATER USING CLAY-MICELLE COMPLEX

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Chromium is generally present in soils, surface and groundwater in low concentrations, but high levels may be found in these environments due to human activities. Chromium can exist in multiple valence states, with 3+ and 6+ being the most frequently encountered. Trivalent Cr is ubiquitous in the environment and occurs naturally: it has a very stable crystal structure and is considered essentially immobile in the environment. In contrast, hexavalent chromium mostly derives from anthropic activities, it is highly mobile and is well known for its high toxicity as well as its mutagenic and carcinogenic properties. At today, different methods of Cr(VI) removal from natural and waste water have been experimented giving limited results. Our work is aimed at the introduction of a new filtration stage, based on micelle-clay materials, in a wastewater treatment plant installed at University Al Quds (Palestine). A micelle-clay complex, prepared using SWY-2 Wyoming Na-montmorillonite and octadecyltrimethylammonium bromide (ODTMA) as surfactant, was used to remove Cr(VI) from industrial wastewater. This complex has very large surface area which includes hydrophobic domains and can retain either positively or negatively charged ions and also neutral molecules. Two types of experiments were conducted: batch and column trials under different pH values. The removal efficiency of Cr(VI) in batch experiments was 88% and 97% at pH=6 and pH=1, respectively. In column trials the adsorption of Cr(VI) is pH dependent and is influenced by its initial concentration and water flowing through the column, but conditions for the complete removal of Cr(VI) were easily achieved.



W12.01-P -24

ROLE OF SOIL COLLOIDS IN THE TRANSFER OF GLYPHOSATE AND AMPA FROM A SMALL VINEYARD SUBCATCHMENT TO SURFACE WATER OF WESTERN SWITZERLAND

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In this study, two vineyard parcels of a small catchment were investigated to evaluate the role of colloids in the transfer of glyphosate and AMPA from soils to surface waters. The parcels were equipped with lysimeters at four different depths and runoff collectors at their bottom. Two automatic samplers were installed in the adjacent river: one up the vineyard subcatchment and one at the river's mouth at Lake Geneva. The results reveal the important role of lateral flows in investigated soils, due to textural boundaries between the more clayey deep and the silty surface layers. During spring rains, much higher concentrations (3-5µg/l) of glyphosate are observed at the river outlet than upstream, confirming its transfer from the vineyards to surface water. More generally, diffuse losses of agrochemicals from plots are mainly governed by rain event's intensity, duration and the delay between them and the application. Indeed, runoff samples, naturally loaded with suspended solids, show very high glyphosate concentrations (70-100µg/l) after first important rain events. Moreover, about 75% of the total concentrations of glyphosate and AMPA remain "dissolved" (<0.45µm; n=10). In river samples, a good correlation between total suspended solids (>1.2µm) and concentrations of glyphosate and AMPA has been established for several rain events. Thus, the question whether they are preferentially transported adsorbed to particles (>1µm), in the colloidal (5nm-1µm) or in the "truly dissolved" phases (<5nm) still remains. Nevertheless, these results give a better understanding of the behaviour of glyphosate, almost the only herbicide applied on vineyards in Switzerland.



W12.01-P -25

SEDIMENT-ASSOCIATED PESTICIDES IN A SUBTROPICAL RIVER IN NORTHERN THAILAND

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Sediment-associated pesticides are an important issue due to potential adverse effects on the benthic zone and the aquatic ecological system. The concentrations of even frequently used pesticides were monitored in the Mae Sa watershed (Thailand). In total, 176 samples of river bed sediment were collected from the Mae Sa River and its tributary Mae Sa Noi between July 2007 and November 2008. Additionally, samples of suspended sediment were collected during 23 runoff events in the rainy season (July to September 2008). The mean organic matter content in bed and suspended sediments was 8.8 ± 7 and 49.5 ± 16 g/kg, respectively. Four of the seven pesticides investigated, chlorothalonil, chlorpyrifos, (α , β endosulfan), and cypermethrin, were detected in the samples. The average concentrations of pesticides in suspended sediment were 2-8 times higher than in river bed sediment. Cypermethrin was most frequently detected in both types of sediment. Mean concentrations were $3.5 \mu\text{g/kg}$ in river bed sediment and $28 \mu\text{g/kg}$ in suspended sediment. Dichlorvos, atrazine and dimethoate were not detected in the sediment samples. Our results indicate that pesticide concentrations in sediment samples depend mainly on hydrophobicity ($\log K_{ow}$) and the organic matter content of the sediment.



W12.01-P -26

SLOW RELEASE FORMULATIONS OF DIURON BASED ON CLAY-PHOSPHATIDYLCHOLINE COMPLEXES

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Slow release formulations (SRFs) of crop protection agents are aimed at reducing the losses of active ingredient occurring by transfer and dissipation mechanisms, which results in the use of larger applied doses for controlling weeds and pests, and for maintaining bioefficacy. SRFs of the herbicide diuron were designed for reducing the water-polluting risk derived from its use in conventional formulations. The new formulations were based on herbicide incorporation in phosphatidylcholine (PC) vesicles that were sorbed on a clay mineral, montmorillonite. The active ingredient contents of the formulations reached up to 28% w:w. Thermal analysis methods demonstrated that a closed packing arrangement of PC on clay enhanced diuron sorption by disrupting the interactions among PC molecules. Adsorption experiments using diuron were performed in soils with different physico-chemical properties to evaluate the relationship between the sorption and mobility of the herbicide. In soil column experiments with a sandy soil, the herbicide in PC-clay-based formulations was mainly accumulated in the top soil, and there was a 1/3 reduction in leaching compared to the commercial formulation. These differences in leaching were lower when using a loam soil due to a higher sorption of the herbicide and hysteresis. In the sandy soil, bioassay experiments showed a higher herbicidal activity in the top soil layer for the PC-clay formulations than for the commercial formulation. Therefore, PC-clay formulations of this herbicide can be used at a lower dose than recommended, which reduces environmental risks associated with the application of diuron formulations.



W12.01-P-27

SOLUBILIZATION OF HERBICIDES BY SINGLE AND MIXED COMMERCIAL SURFACTANTS

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Environmental applications of surfactants have been increasing during the late decades due to their unique properties as solubilizing agents. Surfactants are amphiphile molecules which aggregate in solution beyond certain concentration called the critical micellar concentration (cmc), forming usually spherical structures of several nm with large hydrophobic domains in their core whereas hydrophilic surface groups are located in the outer surface. Non-aqueous phase liquids (NAPLs) such as polycyclic aromatic hydrocarbons (PAHs) and in general, hydrophobic organic chemicals (HOCs) tend to be strongly incorporated within the micellar core because the hydrocarbon region forms a liquid-like region having a viscosity approximately an order of magnitude greater than that of liquid hydrocarbons of similar chain length. Surfactant-enhanced remediation (SER) technologies take the benefit of this property. Most of the studies on solubilization by surfactants have focused on non-polar solutes such as PAHs, NAPLs. In the current work, the solubilization of three herbicides (two nonionic, flurtamone and metribuzin, and one acidic, mesotrione) by single and binary combinations of several commercial surfactants was examined. The surfactants used were two alcohol alkoxylates, a polyalkylglucoside and a tallow alkyl ethoxylated amine. The results will help to understand the processes involved in the solubilization of molecules with different functional moieties in their structure, and to predict the solubilization properties of mixed surfactant solutions based on that of single surfactant. This will provide valuable information for the selection of different surfactant systems on their employment in environmental technologies.



W12.01-P -28

STUDY OF THE SORPTION OF TWO SULFONYLUREA TYPE HERBICIDES, THEIR FORMULATION AS WELL AS ONE ADDITIVE ON SOILS AND SOIL COMPONENTS

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The retention of pesticides in the soil strongly influences their fate in the terrestrial and aquatic environment. Without sorption the mobility of these compounds is high while the probability of their biological degradation is small resulting in groundwater pollution. The sorption of two sulfonylurea type herbicides (chlorsulfuron, tribenuron methyl) was studied on quartz and chernozem soil adsorbents. Experimental results of pure standard containing solution were compared to those of its appropriate formulation. Adsorption of the active ingredient was better from the standard than from the formulation containing solution at small equilibrium concentrations ($c < 20$ micromol/L). Forming agents are less investigated because they rarely have environmental limit value. For this reason the sorption of such an additive was also studied. This is the dispersant named Supragil WP (diisopropylnaphthalenesulfonic acid sodium salt) being an anionic forming agent and applied in a lot of pesticide formulations. Supragil resulted in a C type of isotherm on quartz. Using three different soils (sand, brown forest, chernozem) as adsorbents the role of the organic matter (OM) was significant because the adsorbed amounts correlated with the total organic carbon (TOC) content of the soils. It indicates hydrophobic interaction between the soil OM and the dispersant which can cooperate with the pesticide for the non-polar binding sites of the soil. Zeta potential measurements proved that higher concentrations of the anionic forming agent assisted the peptization of soil OM resulting in stable colloidal solution. These dissolved organics can enhance the solubility of the pesticide due to "solubilization effect".



W12.01-P -29

TRANSPORT OF HEAVY METALS IN SOILS TREATED WITH MUNICIPAL SLUDGE

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Soil structure is one of key factors playing important role on flow characteristic, transport, filtration and retention of solutes in vadose zone. This study was conducted to assess the transport of Zn, Ni and Pb through repacked and intact columns of a clay loam (CL) soil under unsaturated flow condition. The treatments were arranged in a factorial design with main design of complete random blocks in three replications. The steady state flow condition was established using tap water prior to injecting a pulse solution of municipal sludge containing 7.8, 1.18, 3.57 ppm of Zn, Ni and Pb on the columns, respectively. For the unsaturated condition, a flux equal to the 1/4 of the lowest K_s (3.07 cm h⁻¹) of treatments (i.e. repacked columns) was imposed on the columns. Leaching was monitored up to five pore volumes (5PV) in 0.2 intervals for each column. Heavy metals concentration in the effluent was measured using atomic absorption apparatus. In order to eliminate the influent concentration effect, relative concentration (C/C_0) of elements in drain water was drawn vs. PV. Effluent concentration significantly was affected by soil structure. Stable structure and the preferential pathways caused the early appearance of elements in the leachate of intact columns. Closer contact and stronger interaction of elements and soil particles may have resulted in low concentration and delay in appearance of tracer in repacked soils due to enhanced pollutants soil particle interactions at low water fluxes.



W12.01-P -30

USING THE DIGITAL SOIL MAP OF WALLONIA (SOUTHERN BELGIUM) AND AN EXISTING DATABASE OF SOIL ANALYSIS TO ASSESS THE RISKS OF PESTICIDE LEACHING TO GROUNDWATER.

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The study aims to combine the Digital Soil Map of Wallonia (Southern Belgium) and an associated soil database with the MetaPEARL metamodel to assess the sensitivity of agricultural soils against pesticide transfer to groundwater in Wallonia. MetaPEARL is based on an analytical expression which predicts the concentration of leachable pesticides at the bottom of soil profile (1m) according to climate, soil characteristics, and pesticide properties. The results show an important sensitivity to transfer for pesticides presenting very weak retention coefficient on organic matter (K_{om} above 10 dm³ kg⁻¹) or with a relatively high half-life time (DT₅₀ about 60 days). In other respects, the pesticide sensitivity to leaching is strongly correlated with soil texture and organic matter content. It is also observed that the concentration of leached pesticide is strongly depending of the rainfall surplus. A sensitivity analysis has shown that the metamodel is very sensitive to soil thickness, to organic matter content, to the bulk density of the mineral fraction by textural classes and of the organic matter. The analysis of "spatial" uncertainty due to the consideration of a unique representative value by soil type and by region (deterministic approach) shows that this approach tends to under-estimate the concentration of pesticide leached from the soil, compared to the use of a stochastic simulation which takes into account the soil characteristic variability within a given soil type. Therefore, stochastic approach should allow the calculation of a more relevant threshold of risk probability in view of natural resources management.



S13.01-P - SOIL MEMORY: ARCHAEOLOGICAL AND NATURAL HERITAGE PRESERVED IN SOILS

Friday 06 July 2012 from 17:00 to 18:30. Room Poster Areas

S13.01-P -1

CHEMICAL ANALYSES OF AN IRON AGE FLOOR DEPOSIT AT ROTZO (VICENZA, ITALY)

Diego Pizzeghello, Legnaro (Padova) - Italy

S13.01-P -2

CONSERVING AND RESTORING THE SOIL MONOLITH COLLECTION OF THE BELGIAN SOIL MAP: HISTORY, CHALLENGES, NEW DEVELOPMENTS AND EDUCATION POTENTIAL

Karen Vancampenhout, Leuven - Belgium

S13.01-P -3

FROM COMPLEX VISION TO SIMPLE ACTION: WHERE IS THE GAP BETWEEN SOIL BIODIVERSITY, SCIENCE AND POLICY?

Elena Havlicek, Bern - Switzerland

S13.01-P -4

GEOARCHAEOLOGICAL EVIDENCE OF OCCUPATION AND HUMAN MODIFICATION OF THE ENVIRONMENT IN THE NEOLITHIC SITE OF MONTE DOS REMEDIOS (NW SPAIN)

Cruz Ferro, Santiago de Compostela - Spain

S13.01-P -5

HISTORICAL SOIL LEGACIES IN THE CARPATHIAN BASIN

György Fülek, Gödöllo - Hungary

S13.01-P -6

LATE PLEISTOCENE-HOLOCENE PALEOENVIRONMENT RECONSTRUCTION AND EARLY PEOPLE IN SONORA DESERT, NE MEXICO: A PALEOPEDOLOGICAL APPROACH.

Tamara Cruz Y Cruz, Mexico City - Mexico



S13.01-P -7

LONG TERM SOIL EROSION ANALYSIS ON A TERRACED SYSTEM WITH THE SUPPORT OF ARCHAEOLOGICAL DATA IN THE AREA OF AKSUM (ETHIOPIA)

Rossano Ciampalini, Montpellier - France

S13.01-P -8

OUR SOIL MAP AS CULTURAL HERITAGE: WHAT OF THE SOIL MAP OF BELGIUM SURVEY SHOULD BE PRESERVED AND WHAT IS BEING LOST ?

Xavier Legrain, Gembloux - Belgium

S13.01-P -9

PALEOSOLS OF ALLUVIAL SEQUENCES IN SOUTHERN MEXICO AS EVIDENCES OF PALEOENVIRONMENTAL CHANGE AND HUMAN OCCUPATION

Berenice Solis Castillo, - Mexico

S13.01-P -10

POLAND'S FIRST SOIL MUSEUM – PROJECT INFORMATION

Ewa Blonska, Krakow - Poland

S13.01-P -11

QUANTIFICATION OF CARBON SURPLUS AND C/N RATIO IN CHARCOAL-AFFECTED SOILS UNDER ANCIENT MOUND KILNS IN CULTIVATED AREAS OF WALLONIA (BELGIUM)

Joseph E. Dufey, Louvain-la-Neuve - Belgium

S13.01-P -12

ROCK MAGNETISM PROPERTIES IN PALEOSOLS AS INDICATORS OF PRE-HISPANIC HUMAN ACTIVITIES IN THREE ARCHAEOLOGICAL SITES IN MEXICO.

Hermenegildo Barceinas, Ciudad de México - Mexico

S13.01-P -13

SOIL CHEMICAL ANALYSES AS INTERPRETIVE TOOLS FOR ANCIENT HUMAN ACTIVITIES IN A MEDIEVAL SETTLEMENT IN CENTRAL ITALY: PRELIMINARY RESULTS

M. Cristina Moscatelli, Viterbo - Italy



S13.01-P -14

SOIL CHEMICAL LEGACIES OF 17TH AND 18TH C WHISKY PRODUCTION IN NORTH-EAST SCOTLAND

Clare Wilson, Stirling - United Kingdom

S13.01-P -15

SOIL QUALITY AND SCIENCE OF SUSTAINABILITY:MAKE RESEARCH INTO PRACTICE

Stefano Grego, Viterbo - Italy

S13.01-P -16

SOILS AND ARCHAEOLOGY. THE COSTANCIACUS PROJECT IN THE FRAME OF THE VENICE LAGOON EVOLUTION, ITALY.

Claudio Bini, Venice - Italy

S13.01-P -17

SOILS IN URBOSEDIMENTS OF THE ANCIENT CITIES OF EUROPEAN RUSSIA

Andrey Dolgikh, Moscow - Russian Federation

S13.01-P -18

THE DYNAMICS OF SOLONETZIC SOILS ASSOCIATIONS PROPERTIES AFTER 30 YEARS OF RECLAMATION

Valerie Kalinitchenko, Persianovka - Russian Federation

S13.01-P -19

THE ECONOMICS OF SOIL EROSION CONTROL AND INCREASE VEGETATION

Kaveh Khaksar, Karaj - Iran, Islamic Republic of

S13.01-P -20

THE IMPACT OF CINNABAR (HGS) MINING IN SOILS AND ANCIENT WORKERS IN TWO ARCHAEOLOGICAL SITES IN MEXICO

Gilberto Hernández-Silva, Querétaro - Mexico



S13.01-P -1

CHEMICAL ANALYSES OF AN IRON AGE FLOOR DEPOSIT AT ROTZO (VICENZA, ITALY)

Migliavacca Mara^[1], Pizzeghello Diego^{*[2]}, Ertani Andrea^[2], Nardi Serenella^[2]

^[1]Università di Padova ~ Dipartimento di Archeologia ~ Padova ~ Italy ^[2]Università di Padova ~ Dipartimento di Biotecnologie Agrarie ~ Legnaro (Padova) ~ Italy

Chemical analyses of the phosphorus (P), carbon (C) and nitrogen (N) content of the soil were applied to an Iron age building located at Rotzo in the Asiago plateau (North-eastern Italy). The building was already interpreted as a dwelling with two distinct phases of life. Both total P by ignition (PTI) and organic P (OP) distributions were high in the south-western entrance zone, where we can imagine both an accumulation of the organic matter coming from outside and a possibly temporary store of stuff coming in or going out the dwelling. High OP values were also in the northern area where the activity was connected with a garbage pit. The inorganic P (IP) distribution shows the higher values in a area along the western wall that could be connected with the most ancient entrance to the building. The clustering of highest IP values along the western wall suggested, for the first phase of life of the building, the opposition of domestic activities between eastern and western areas, according to the highest values of the C:N ratio indicating the gathering of the organic matter. The organic carbon content and C:N ratio, together with the different P, provided good suggestions about the use of the inner space. In particular, among the different P, oxalate individuated the ancient forms of P, connected with the most ancient phase of life of the house.



S13.01-P -2

CONSERVING AND RESTORING THE SOIL MONOLITH COLLECTION OF THE BELGIAN SOIL MAP: HISTORY, CHALLENGES, NEW DEVELOPMENTS AND EDUCATION POTENTIAL

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Between 1947 and 1991, a detailed national soil survey was conducted in Belgium. Maps were published at a scale of 1:20 000 and were based on at least one soil augering per hectare and one soil profile pit described per 2 km². In support of the soil survey work, a collection of soil monoliths was constructed as a reference and for illustrating the soil diversity of the territory. The monolith collection remains an important scientific educational tool and also represents an heritage value by providing a tangible link to the actual observations made by the soil surveyors in the past. Nevertheless, preserving and displaying the Belgian monolith collection posed significant challenges over the years. The monoliths suffered substantial damage due to movement, display and the degeneration of the resins. Hence, in order to safeguard the displays for the future, the entire collection was rehoused and reorganised. Novel methods were tried-out for restoration the monoliths. Simplified approaches were also tested for displaying soil monoliths and lacquer profiles for educational purposes, particularly in ecological tourism settings. Important lessons were learned from these experiences for the dissemination of pedological information to a wider public.



S13.01-P -3

FROM COMPLEX VISION TO SIMPLE ACTION: WHERE IS THE GAP BETWEEN SOIL BIODIVERSITY, SCIENCE AND POLICY?

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Whereas water and air have been receiving ongoing care and attention from scientific and legislative institutions for last decades and in such a manner that is has been widely spread out to a public at large, soils, until recently, didn't benefit from such interest. They are recognized for their high biodiversity but in fact, the soil biology is still widely unclosed. Moreover, soils are not only a milieu for living organisms, they are formed by these organisms and without their presence they can't develop. Determining and monitoring soil biodiversity is far from completion; nevertheless, in order to achieve soil protection goals at policy level, bioindicators - even imperfect - are being implemented. The choice of accurate tools is challenging because beside biological parameters, socioeconomic factors, such as effectiveness, inexpensiveness, or capacity to provide information, are to be considered. The question which remains open is why there is so less interest in soil topic, particularly in soil biodiversity, among politicians and the public and to highlight the gap between soil biodiversity and soil policies.



S13.01-P -4

GEOARCHAEOLOGICAL EVIDENCE OF OCCUPATION AND HUMAN MODIFICATION OF THE ENVIRONMENT IN THE NEOLITHIC SITE OF MONTE DOS REMEDIOS (NW SPAIN)

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Signals preserved in environmental archives can be used to reconstruct the occupational history of archaeological sites. Using a geoarchaeological approach, we searched for physico-chemical signals from the Neolithic site of Monte dos Remedios, aiming to identify formation processes, including human-induced. We analysed a sedimentary sequence and selected samples from archaeological structures. We quantified the proportion of gravel and charcoal, studied the morphometry of coarse material and analysed the fine earth fraction for pH and elemental composition. Statistical techniques were applied to identify the processes responsible for data covariance. The main processes were slope transport and pedogenesis. In addition, some physico-chemical and geochemical properties may have resulted from both the non-intentional as well as deliberate human modification of soils. For example, the low content of coarse material and high concentrations of Ti and Fe in some samples (from hut floors) compared to the soils and rock weathering products, suggest a preparation of the material by particle size selection and burning, which would have provided advantages such as the elimination of soil organic matter (increasing compactability, decreasing water retention), disinfection of occupation soil (elimination of pathogens) and deactivation of the seed bank. These results combined with radiocarbon dates reveal a long-term, though intermittent, occupation: phases of relatively intense signals of occupation were found for the Late Neolithic, Late Bronze/Initial Iron Age and the Medieval Period. We conclude that geochemical signals are useful tools for reconstructing the occupational history of archaeological settlements. Acknowledgements. This research was partially funded by the Project 09SEC015606PR (2009-2012).



S13.01-P -5

HISTORICAL SOIL LEGACIES IN THE CARPATHIAN BASIN

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Without soils no human life can be imagined and the utilization of soils is just as diverse as human culture itself. Therefore, in this presentation only some of the outstanding historical soil legacies of the Carpathian basin will be highlighted. Earthworks are one of the most important testimonials of the soil-men relationship through history in the Carpathian Basin. The neolithic tells are one of the earliest remnants of this type of soil utilization together with Bronze Age tells, Late Bronze and Iron Age earthworks. Neolithic tells had cultic enforcement, the Copper Age circular ditches served for the protection and delineation of cultic areas and the ditches surrounding Bronze Age tells were also created with meaningful purpose. The appearance of real earthworks (ditch together with wall) can be dated to the Late Bronze and to the Iron Age, when massive soil movements could be detected for the fortification of settlements. The Csörsz-ditch is a well known monumental earthwork of the Carpathian basin. The origin of the ditch system that encircles the Great Hungarian Plain is still controversial. Although its origin has not yet been clarified, it is a great example of human impact on soils. Burial mounds are another type of soil legacy. In Hungary burial mounds (kurgans) from the Copper Age (3600 BC) and the Early Iron Age (700 BC) are known and studied. Agro terraces are the last type of soil exploitation, discussed in this presentation, which are great examples of human talent in soil management.



S13.01-P -6

**LATE PLEISTOCENE-HOLOCENE PALEOENVIRONMENT RECONSTRUCTION AND EARLY
PEOPLING IN SONORA DESERT, NE MEXICO: A PALEOPEDOLOGICAL APPROACH.**

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Early peopling has been documented in NW Mexico in sites as Fin del Mundo, El Bajío, and La Playa, in Late Glacial-Holocene. In the archaeological site La Playa, paleopedological research was made to provide information on environmental conditions during the time of settlement. In this area two paleosol pedocomplexes were distinguished: the older, San Rafael (SRP), with a buried sequence of reddish A/Bw/BCK/2BCgk/2Ck horizons and the youngest one, Boquillas (BOP) consisting of several Ah horizons separated by alluvial sediments. SRP shows moderate clay accumulation and illuvial carbonates with a minimum content in Bw and the maxima in BCK and 2BCgk horizons. In contrast, BOP is a pedosediment, which has weak humus accumulation and the development of pedogenic structure over alluvial sediments. The age of SRP, has been established by AMS dating of carbonates concretions found in BCK (Cal BP 14910 to 14230), as well as charcoal found in A horizon (Cal BP 4440 to 4250), evidencing the cycles of soil formation. BOP is 3660 yr. BP., obtained from organic matter of the A horizons. Those differences in pedogenetic trends are related to different environmental conditions. SRP properties (rubification; moderate clay accumulation; higher values of magnetic susceptibility, revealing a higher weathering degree; illuvial carbonates; and the reductomorphic features in the base) evidence a more humid environment. In middle Holocene, environment changes drastically and presence of fires were detected. Actually, Holocene soil is less developed and strongly affected by fires thus revealing a high landscape instability caused by natural and human influence.



S13.01-P -7

LONG TERM SOIL EROSION ANALYSIS ON A TERRACED SYSTEM WITH THE SUPPORT OF ARCHAEOLOGICAL DATA IN THE AREA OF AKSUM (ETHIOPIA)

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Landscape evolution in agricultural contexts is primarily the result of soil redistribution processes done by human activity and water erosion. The analysis of such soil dynamics in archaeological areas is useful to understand the evolution of the landscape structures. This study is focused on the area of Aksum (Ethiopia), one of the most relevant archaeological sites in East Africa, where the flourishing and decay of the Aksumite Kingdom (400yBC, 800yAD) took place. It provided favorable conditions for long term approach to the study of soil conservation techniques since they have been maintained from ancient times to present. In the present study, three terrace systems have been surveyed and analysed in terms of soil loss across the last two millennia by physical and archaeological evidences. Tillage and water erosion has been simulated by a long-term expert-system model (LandSoil) (Ciampalini et al., 2011) based on a raster distributed-approach accounting the principal components in soil erosion-deposition processes. The results of model analysis, integrating tillage erosion, diffusive and concentrated erosion have been compared and calibrated with the plough marks technique (Ciampalini et al., 2008; 2011), soil loss computing procedures such as the PSIAC model for Ethiopian Highlands (Negussie et al., 2005) and a re-parameterisation of P factor (USLE) for stone-bounds (Desta et al., 2005). This analysis provides values for tillage soil displacement and water erosion comparable with these reported in the literature, accounts for the relative influence of both mechanical and hydrological processes, and confirms the high efficiency of these traditional soil conservation practices.



S13.01-P -8

OUR SOIL MAP AS CULTURAL HERITAGE: WHAT OF THE SOIL MAP OF BELGIUM SURVEY SHOULD BE PRESERVED AND WHAT IS BEING LOST ?

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Between 1947 and 1991, soils of Belgium were mapped to establish a systematic inventory of the country soil resources. Field observations were done by soil auger to a standard depth of 1.25 m and at a mean density of 2 points per hectare. Cadastral plans at scale 1:5,000 were used for georeferencing field observations and for delimiting map units, subsequently generalized on the 1:10,000 topographic base map. The final map was published on sheets at scale 1:20,000 along with descriptive texts. Besides, data on about 15,000 described and analyzed soil profiles were reported in technical annexes. With the advent of computers, data on soil profiles have been transferred into relational databases and soil sheets have been digitized. Coding of the data rendered them more accessible, but inevitably implied a standardization and hence a reduction of some information. Still most of the soil surveyors have already passed away, besides their intangible expert knowledge, a wealth of information is also being lost when their field notes, unpublished reports, minutes of meetings and draft maps are being disregarded. The map legend was developed during the first decade of the survey, reflecting state of knowledge on soil formation and their relative importance for agricultural land-use in the 1950s. To guarantee that future generations will be able to appreciate the value and concepts underpinning the soil information, it is important that at least a minimum set of such historical documents would be preserved, analyzed and documented.



S13.01-P -9

PALEOSOLS OF ALLUVIAL SEQUENCES IN SOUTHERN MEXICO AS EVIDENCES OF PALEOENVIRONMENTAL CHANGE AND HUMAN OCCUPATION

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Paleosols in alluvial sequences are used to reconstruct landscape evolution during the Late Pleistocene – Holocene. The results reflect an interdisciplinary effort to recognize the mechanisms of change, whether natural and / or cultural environment, as well as the possible relationship between environmental characteristics and occupation in the Maya Lowlands. We studied alluvial Holocene sequences in the Usumacinta River: Tierra Blanca, El Pochote, Vicente Guerrero and Balankán. The first three have radiocarbon dates, covering since middle to late Holocene. Balankán is located in an older alluvial flood plain, perhaps of Pleistocene age, based on the geomorphological evidences. Dated sequences recorded stability periods in relation to human occupation, separated by erosional-depositional phases that coincide with the temporal abandonment of the area. Soils developed of Formative Maya (3050-900 14C yr. B. P.) are characterized by angular blocky structure, stress clay coatings. The soils corresponding to the Classic Maya (1860-900 14C yr. B. P.) are less developed than the previous ones. They have granular structure and dark humus accumulation, with absence of vertic features. During the Postclassic Maya (900 14C yr. B. P.) the sedimentations is higher, resulting in poorly developed soils but, with a great accumulation of dark humus. In Balankán soils are quite different with higher content in clay, showing mottling and redox features. In Tierra Blanca, underlying the vertic paleosols, found the presence of gleyic soils (similar to those found in Balankán), but there are nodules of calcium carbonates, which age is 5450 yr. BP, evidencing a regional climate change.



S13.01-P -10

POLAND'S FIRST SOIL MUSEUM – PROJECT INFORMATION

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Thanks to the European Union financing the University of Agriculture in Kraków is in the process of implementing a few projects, one of which is the Soil Science Education Centre (CEG). The project covers both the construction works and exhibition items. The construction part covers the design and adaptation of a space of around 150 m² where soil monoliths will be displayed. The exhibition part covers designing, collecting and preparation of soil monoliths together with geochemical, film and photo documentation. In a public call for offers the University of Agriculture in Kraków selected a team (authors of this paper) who have prepared the exhibition project and are now in the process of implementing it. The project assumes preparation of soil profiles from across Europe characteristic for given climate zones of the continent. In the first phase of the project in 2010 soil samples have been collected from Northern and Southern Europe (from Barents' Sea to the Mediterranean Sea). Majority of the sites are located in national parks thanks to which the profiles are little affected by human economic activity. Another expedition to collect soil profiles from Europe's East to West is planned for the current year 2011 (from the Caspian Sea to the Atlantic). Finalising the works and opening of the Centre is planned at the break of 2011/2012. In this way Poland will gain its first Soil Museum and Soil Education Centre.



S13.01-P -11

QUANTIFICATION OF CARBON SURPLUS AND C/N RATIO IN CHARCOAL-AFFECTED SOILS UNDER ANCIENT MOUND KILNS IN CULTIVATED AREAS OF WALLONIA (BELGIUM)

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^[1]Université Catholique de Louvain ~ Earth and Life Institute - Environment ~ Louvain-la-Neuve ~ Belgium

Black spots of 20-40 m diameter are easily observed on bare soils in many agricultural areas of Wallonia. These fields correspond to previous forest areas that were cleared for cultivation in the XIXth century. The dark circles or ellipsoids are the imprints of ancient sites of charcoal production by mound kiln. This fuel was required in very large quantities mainly for iron industry until the mid-XIXth century. After cutting the forest for cultivation, the C-enriched soil under mound kilns of about 10 m diameter at the origin was diluted laterally by repeated ploughing during the last 150-200 years. Here we study the variations of C and N content in top soil along perpendicular transects across dark spots. These variations are well fitted with a Gauss equation truncated over the background N and C content in the adjacent soil. A numerical integration procedure was developed to calculate the total C surplus in the dark spots where charcoal remains are sequestered since a long time. The soil bulk density needed in calculation decreases with increasing C content. Current values for C surplus in one dark circle are in the range of 1.5 to 3 tons. The C/N ratio increases from about 10 outside the charcoal-affected areas to 15-20 at the center of the dark spots. This can be used as an index of carbon type knowing that the C/N ratio in particles derived from charcoal residues is much higher than the C/N ratio in humic substances.



S13.01-P -12

ROCK MAGNETISM PROPERTIES IN PALEOSOLS AS INDICATORS OF PRE-HISPANIC HUMAN ACTIVITIES IN THREE ARCHAEOLOGICAL SITES IN MEXICO.

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The rock magnetic properties of three pedo-sedimentary sequences formed during the Holocene have been studied, in order to detect changes in the magnetic mineralogical composition, concentration and particle size as consequence of pre-hispanic human occupation. Study sites are located in different environmental and geological conditions: (1) in northeast Mexico (Sonora, archaeological site of La Playa), developed in arid environments over fluvial sediments; (2) in central Mexico (near the famous archaeological site of Teotihuacan), where climate is semi-arid and parent material contains abundant volcanic minerals; (3) and in the south, Usumacinta, in the Maya lowlands, where climate is hot and humid and fluvial sediments are present. Each site presents evidences of environmental changes, in some cases associated with cultural activities. All sites have high values of magnetic susceptibility, and differentiation of its values among the horizons of each profile. This indicates that there are different concentrations of some magnetic minerals that could be due to some processes of soil formation correlated to environmental conditions. Preliminary observations from the magnetic susceptibility values indicate clear differences among soil horizons and they are in accordance to pedogenetic trends. However, changes in the patterns are related to human activities as cultivation, fires, deforestation, burials, among others.



S13.01-P -13

**SOIL CHEMICAL ANALYSES AS INTERPRETIVE TOOLS FOR ANCIENT HUMAN ACTIVITIES
IN A MEDIEVAL SETTLEMENT IN CENTRAL ITALY: PRELIMINARY RESULTS**

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Soil science has a powerful analytical potential for archaeological investigations concerned with feature prospection, household studies, agricultural practices and a wide range of other topics central to anthropological research. Reconstructing activity patterns using soil chemistry is possible because certain chemical compounds are deposited in soils as a result of certain human activities, thus a differential enrichment of archeological soil depends on the distribution and diversity of the activities made over that particular area. Most chemical compounds are rapidly fixed to soil mineral surfaces and tend to remain stable (resistant to horizontal and vertical migration) for very long periods through adsorption and complexation processes on clay surfaces. In particular analyses of soils within domestic structures may reveal information on areas devoted to food preparation, food consumption, resting, animals presence etc. This study was performed within the medieval settlement of Ferento (Viterbo, Italy) where 30 soil cores were sampled within two different excavation sites (IV e V). We analyzed soil pH, total carbonates, available phosphorus (P), available iron (Fe), total organic carbon (TOC), protein residues and fatty acids. All analyses were performed as reported in Barba et al., 2007.



S13.01-P -14

SOIL CHEMICAL LEGACIES OF 17TH AND 18TH C WHISKY PRODUCTION IN NORTH-EAST SCOTLAND

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^[1]University of Stirling ~ Biological and Environmental Sciences ~ Stirling ~ United Kingdom

“Thee Ferintosh! O sadly lost! Scotland lament frae coast to coast! Now colic grips, an’ barkin’ hoast May kill us a’; For loyal Forbes’ charter’d boast Is taen awa’!” (Robert Burns, 1786, “Scotch Drink”) Whisky has an important place in the Scottish national identity. However, although whisky is mentioned frequently in historical texts there is little documentary evidence concerning the actual processes involved, particularly at the numerous small illicit still sites that were established in concealed locations throughout the Scottish hills in the 18th Century. This poster explores the history of both licensed and illicit whisky production in northeast Scotland through its chemical soil legacy. Multi-element soil analysis, soil characterisation and magnetic susceptibility have been used to explore the chemical pollution legacy of 17th and 18th Century whisky production. The aim was to determine whether the soil legacy could confirm the whisky producing history of these sites and elucidate the nature and organisation of the production process. The sites investigated are West Mulchaich, Ross-shire, which is thought to have been the site of one of the famous Ferintosh Distilleries, which held a privilege to produce whisky between 1690 and 1786. The results from Mulchaich are contrasted with those from late 18th C illicit still sites in nearby Strathconon Valley, an area renowned for illicit whisky production.



S13.01-P -15

SOIL QUALITY AND SCIENCE OF SUSTAINABILITY:MAKE RESEARCH INTO PRACTICE

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One of the challenges we face in developing agricultural strategies that are truly sustainable is maintaining the resource base, the soil and water that make agriculture possible. But the pressures on these resources are extraordinary: eight billion people will inhabit the earth in 2030. The specter of possible changes in climate adds another level of uncertainty. It is time to ask how we can move "toward sustainability," toward a strategy of agriculture and natural resource management that supports current populations while leaving future generations an equitable share of the earth's great wealth. Soil is vital to both production of food and fiber and global ecosystem function. Meeting the world's increased needs and expectations will require concerted effort and Science of Sustainability could be the tool necessary to link science and practice. It is an emerging field of research dealing with the interactions between natural and social systems, and with how those interactions affect the challenge of sustainability: meeting the needs of present and future generations while reducing poverty and conserving the planet's life support systems. It should be clear that sustainability science will be an integrative science, a science which sets out to break down the barriers that divide the traditional sciences, promoting the integration between different disciplines (earth sciences, biology, social sciences, economics and technology) and between aspects of human activity (energy, agriculture, heath). Finally, sustainability science must ensure the integration of different styles of knowledge creation in order to make a link between science, practice and politics.



S13.01-P -16

SOILS AND ARCHAEOLOGY. THE COSTANCIACUS PROJECT IN THE FRAME OF THE VENICE LAGOON EVOLUTION, ITALY.

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Soils are privileged archives of the history and evolution of the landscape and of human settlements. The ancient settlement Costanciacus was located in the Venice lagoon, between the present coast line and Torcello island (NE Italy). The objective of this work was the pedostratigraphic study of the archaeological site of S. Ariano, a part of the Costanciacus settlement, and the contest in which it developed, expanded and disappeared. The first human settlement in the area dates back to VI-V century B.C.. After a period of alternating abandonment and settlement, related to marine ingression/regression, a quite long stability period occurred during the Roman age, with several military camps, both in the mainland at Altinum and in the closest islands. Churches and monasteries were built up in the VII-VIII century, following a great marine regression which left many emerged areas. During the late Medieval age, in coincidence with climate worsening and land paludization, a monastery, settled in the island of S. Ariano in XII century (1160 A.C.), was abandoned, and the site declined rapidly, until settlement abandonment in XV century. In the course of geoarchaeological excavations, the topography of the area was ascertained, and soil samples allowed full understanding of the site history and what happened in the period immediately consequent to the living phases. Soil features (colour, redoxymorphic features, texture, organic carbon and carbonate content) confirm marine ingression/regression and testify for groundwater rise and temporary settlement until final abandonment, outlining a complete reconstruction of the environmental conditions of the site.



S13.01-P -17

SOILS IN URBOSEDIMENTS OF THE ANCIENT CITIES OF EUROPEAN RUSSIA

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Urban habitation deposits of ancient towns represented by thick cultural layers somewhat transformed by pedogenesis and containing the profiles of buried weakly developed soils, as well as the underlying natural soils, have been studied. These deposits have the greatest thickness: up to 10 m, or even up to 20 m in the depressions. The habitation deposits of ancient cities can be referred to as urbo-sediments, or as urban habitation deposits. Their formation occurs under the following three main groups of processes: primary sedimentation, as well as the subsequent transformation of the accumulated sediment under the influence of soil (pedogenic) and diagenetic processes. Soils and soil horizons occurring in habitation deposits of urban and rural areas indicate periods with interrupted sedimentation, formation of natural vegetation, and in some cases they have signs of agricultural landscapes. The thickness of these horizons can vary from a few centimeters to one meters. Weakly developed soils are characterized by homogenization, aggregation, transformation of the humus state. Soils in the wet organic layer (peat-like mass with wooden chips) are characterized by loss of organic carbon. Soils buried in the dry mineral layer (low humus sandy-loam and loam) are characterized by accumulation of organic carbon. Soil horizons in urbo-sediments mark the periods of desolation (in abandoned areas) and changing types of land use. They also allow us to give chronological assessment of these breaks duration (from tens to hundreds of years) on the basis of soil thickness and structure.



S13.01-P -18

THE DYNAMICS OF SOLONETZIC SOILS ASSOCIATIONS PROPERTIES AFTER 30 YEARS OF RECLAMATION

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^[3]Chechen Federal University ~ Grozny ~ Russian Federation ^[1]South Russia Institute of Soil Fertility ~ Persianovka ~ Russian Federation ^[2]Don State Agrarian University ~ technology ~ Persianovka ~ Russian Federation ^[4]Southern Federal University ~ soil ~ Rostov-on-Don ~ Russian Federation ^[5]Don Scientific Research Institute of Agriculture ~ Rassvet ~ Russian Federation ^[6]Southern Scientific Center of RAS ~ institute of arid systems ~ Rostov-on-Don ~ Russian Federation

The properties of solonetzic soil associations (chestnut solonetzic soils and chestnut solonetztes) of the dry steppe after reclamation have been studied for 30 years. The reclamation included the deep three-tier plowing and the new approach of rotary intrasoil tillage. A single rotary intrasoil tillage operation resulted in the formation of fine aggregates of equal sizes in the 50 sm plow layer; any morphological features of the restoration of solonetzic pedogenesis are absent. The atmospheric moisture easily penetrates into the soil, soluble salts are leached off to a great depth. In 30 years since the soil amelioration with PMS-70 rotary intrasoil tiller, the humus content has increased up to 3.3%, the content of adsorbed Na⁺ has decreased to 10.6% of the cation exchange capacity (19.8% in the nonreclaimed soil). The spatial heterogeneity of the soil cover has decreased in comparison with that prior to the reclamation. During the entire observation period, crop yields after the use of rotary tiller have been by 25–60% higher in comparison with those on the fields with traditional treatments.



S13.01-P -19

THE ECONOMICS OF SOIL EROSION CONTROL AND INCREASE VEGETATION

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Soil erosion is widely considered to be a serious threat to the long-term viability of agriculture in many parts of the world. The costs of erosion can be used to priorities implementation of soil conservation, and economic analysis of alternative conservation technologies can be used to identify courses of action that efficiently employ available resources. That is why it should be considered of great importance. An effective and cheap way to preserve valuable soil is using up geogrid. A research has been conducted in Chandab. It shows that they can present soil degradation and soil erosion plots of 12x2 meters, in the two slopes of 85% & 110% were chosen in the research. At the end of plots, runoff is caught and measured and sediment amount in the runoff was measured. Different treatments along with replications were chosen. Two slopes rate and there replication were among the treatments 6 sampling in the 6 season were recorded (18 months). These data during the operation of project is shows variations in the vegetation covering in the different plots. The percentage of vegetation covering is variable in the different seasons. Vegetation covering has been increase up to 15 % in the plots with geograd treatments. Conclusions and analysis proved that it is very economic compared with other protective methods like to gabion, retaining wall, pitching and terracing decreased expenses respectively 450, 490 and 219 percent to hectare. So geogrid can be used with great success in arid and semiarid areas.



S13.01-P -20

THE IMPACT OF CINNABAR (HGS) MINING IN SOILS AND ANCIENT WORKERS IN TWO ARCHAEOLOGICAL SITES IN MEXICO

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During pre Hispanic and recent periods cinnabar has been exploited in Sierra Gorda, México; this mining activity has left an extensive trail of waste and debris exposed to the open air. Ranas and Toluquilla were the main ancient cities related to cinnabar exploitation. In order to establish the relationships between mercury dispersion in soils and the impact of cinnabar mining on ancient workers, we conducted a total Hg content analysis in 23 skeleton bones from the archaeological cities and 101 soils and tailings in a landscape of 170 km². Soils, tailings and bones were analyzed by AMA 254 (Advanced Mercury Analyzer) apparatus. By using a GIS, the total Hg dispersion map was constructed. One of the highest mercury content in soils was showed by the surroundings of Ranas site dominated by ancient mining (> 250 mg/kg). The soils located inside of this ancient city, exhibit the highest average of total Hg content (65.46 mg/kg), compared with agricultural (55.28 mg/kg) and forest (11.64 mg/kg). An ancient individual from Ranas showed 20.40 and 8.60 mg/kg of Hg in skull and femur respectively, higher than the few existing references. Periostitis, Schmorl's nodules, osteophytosis and arm attrition damages related to repetitive movements of mining activities were exhibited in the remains. A close relationship between physical anthropology, pathology studies, total mercury content in pre-Hispanic skeleton bones and total Hg dispersion in soils and tailings showed the impact of mining ancient activities on Pre Hispanic's health and in the environment of the studied area



S13.02-P - SOIL STATUS AND SOCIETY

Tuesday 03 July 2012 from 17:00 to 18:30. Room Poster Areas

S13.02-P -1

EUROPEAN NETWORK ON SOIL AWARENESS

Gabriele Broll, Osnabrueck - Germany

S13.02-P -2

INNOVATIVE MECHANISMS FOR SOIL ENGAGEMENT – THE SCOTTISH EXPERIENCE

Willie Towers, Aberdeen - United Kingdom

S13.02-P -3

MULTITEMPORAL ANALYSIS OF THE CHANGES OF USE AND SOIL COVER ON THE ISLAND OF MARANHÃO – BRAZIL

Sandra Maria Oliveira Sá, São Luis - Brazil

S13.02-P -4

SOIL AWARENESS RAISING AS ONE OF THE MOST IMPORTANT WAYS OF ENVIRONMENTAL PROTECTION

Beata Houskova, Bratislava - Slovakia

S13.02-P -5

SOILS AS SINKS AND SOURCES FOR CO₂: HANDS-ON STUDENT EXPERIMENTS ABOUT THE TERRESTRIAL CARBON CYCLE

Anett Hofmann, Zurich - Switzerland

S13.02-P -6

TEACHING SOIL EROSION IN HIGH SCHOOLS. A COHERENT SET OF EXPERIMENTS SHOWING PROCESSES AND FACTORS.

Baptiste Algayer, Orléans - France



S13.02-P -1

EUROPEAN NETWORK ON SOIL AWARENESS

Broll Gabriele*^[1]

^[1]University of Osnabrueck ~ Geoscience ~ Osnabrueck ~ Germany

A European network on soil awareness has been established in 2009. The goal of the network is to bring together soil scientists with no-scientists working on soils in Europe to enlarge the group of people interested in soil awareness in one or the other way. This group includes for example administrators, consultants, and colleagues working in education or for non-governmental organizations interested in working on outreach and/or education on soils and in exchanging their knowledge with colleagues within Europe. The network on raising soil awareness in Europe ENSA will help to expand our means to reach the public. We need strong activities on local and regional scales in close cooperation with target groups such as teachers, but the European Network does not want to compete with national activities. It would like to help in those countries where national activities in raising soil awareness are still lacking. At national and international scales, we could share ideas how to bring forward soil protection in Europe through soil awareness. A strong cooperation with national ministries is intended. One big step forward could be done if soil scientists and others involved cooperated with experts in marketing and related fields.



S13.02-P -2

INNOVATIVE MECHANISMS FOR SOIL ENGAGEMENT – THE SCOTTISH EXPERIENCE

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Although soil scientists recognise the importance of soils to society, it is very difficult to get the general public engaged in the subject – out of sight, out of mind. Two mechanisms have been developed in Scotland to try and overcome this. Firstly we have sought to use an anthropomorphic approach to soils and have developed a number of ‘soil characters’. We have worked with science communication specialists to ensure that the imagery is eye-catching and the text is not technical and will capture the public imagination. These characters have been described in different hard copy formats – folded cards and coffee (or beer!) coasters – and although the language is quirky, we have ensured that their descriptions are scientifically valid. The characters have been made into short videos available on our website and these will demonstrated. Our second initiative relates soil to a topic that in which there is high public interest – death, crime and mystery. Following a highly successful research programme on soil forensics and real case work experience, we have developed the “Murder, Mystery and Microscopes” initiative. Well-known Scottish crime writers appear on stage with Institute scientists and along with other forensic experts reveal the science behind the crime stories. A combination of video and still imagery will be presented to demonstrate some of the activities and how this national award winning initiative has provided technical advice to UK-wide television programmes. The public like to be provoked, entertained and educated - these initiatives have proved successful in doing this.



S13.02-P -3

MULTITEMPORAL ANALYSIS OF THE CHANGES OF USE AND SOIL COVER ON THE ISLAND OF MARANHÃO – BRAZIL

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The occupation process of Island Maranhão - Brazil, has intensified in function of the economic needs, politics and social and became worrying before of fragility of natural resources to anthropic action.. Therefore, the aim was to study the dynamics of the landscape and the occupation of physical space-territorial island of Maranhao in 1984 and 2010 through images TM/ Landsat 5. For the processing of images was build database in GIS, UTM projection, Datum SAD69, using the software SPRING 4.3. The images were segmented by a regions development algorithm and subjected to a visual classification. The time series of images showed a tendency for the abatement of vegetation areas, especially in the riparian forest (45.50%), secondary forest (17.83%) and mangroves (15.02%). In areas of restinga, according to the natural dynamics, the changes were less evident (1.50%). It was also observed that the urban area had a high growth rate (143.80%) being distributed over the north central portion of the island. These facts can be attributed to advances in industrialization projects that enhanced the process of urban occupation of the island, mainly in Sao Luis, capital of Maranhão, which in 2010 reached 1,011,943 people, spread over an area of only 828.19 km². In recent 26 years, Ilha presented one rate population growth 112.26% of which 84.56% represent the Capital. The results obtained confirm that analysis satellite images is one relevant instrument in use mapping and occupation soils and will assist in space planning physicochemical territorial Island Maranhão.



S13.02-P -4

SOIL AWARENESS RAISING AS ONE OF THE MOST IMPORTANT WAYS OF ENVIRONMENTAL PROTECTION

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Soils are an important part of the environment and must be protected if we want to preserve sound environment which is crucial for full-valued life on the Earth. Soil awareness raising is crucial in this process. It is important to address this message to all groups of people as one group can influence the other. An appropriate awareness, combined with a good soil policy will result in increase of soil value. Important part of soil awareness raising is the preparation of propagation and education materials, interactive web pages with this topic, competitions, quizzes, etc. It is necessary to have a permanent system of environmental education and to ensure that soils will have there an adequate proportion. Both, formal and non-formal types of education are important, but the main aim in this area is to increase amount of teaching hours concerning soil topic. Soil, contrary to air and majority of water sources is a property, thus very important is the harmonization of owners interests with the protection of nature on national and regional level and information of specialists, public, EC and the other international and national institutions about the status of soils, especially for the process of soil degradation prevention. This requests proper soil monitoring system and the public which will be interested in soils and will demand such type of information.



S13.02-P -5

SOILS AS SINKS AND SOURCES FOR CO₂: HANDS-ON STUDENT EXPERIMENTS ABOUT THE TERRESTRIAL CARBON CYCLE

Hofmann Anett^{*[1]}

^[1]ETH Zurich and University of Zurich ~ Life Science Zurich - Learning Center ~ Zurich ~ Switzerland

Soils are sinks (soil organic carbon stocks) and sources (soil respiration) for the greenhouse gas CO₂. Our educational project introduces soils as a vital element of the terrestrial carbon cycle and relates soils to the climate change topic. The project offers extracurricular learning activities to high school students and continued education courses to high school teachers. All activities are hands-on experiments using gas measurement sensors that were developed for school use. Students gain understanding of the dimensions of CO₂ fluxes and carbon stocks in the terrestrial carbon cycle and especially in the plant-soil system. In 2011 approx. 120 students and 25 teachers have conducted the experiments. Students and teachers appreciate the inquiry-based learning approach and the use of measurement devices. The project is based at the Life Science Zurich - Learning Center of ETH Zurich and University of Zurich. Scientific support is provided by the Department of Geography (unit Soil Science and Biogeography), University of Zurich.



S13.02-P -6

TEACHING SOIL EROSION IN HIGH SCHOOLS. A COHERENT SET OF EXPERIMENTS SHOWING PROCESSES AND FACTORS.

Algayer Baptiste^{*[1]}, Cottard Christine^[2], Voisin Vincent^[2], Morel-Deville Françoise^[2], Broussaud Marie-José^[2], Pajon-Perrault Nathalie^[2], Quincé Patricia^[3], Caillette Alban^[3], Dupont Jean-Yves^[3], De Quillacq Aude^[3], Desfougères Laurence^[3], Darboux Frédéric^[1]

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The national program for French high schools requires teaching about soils. Because soils are new in the curriculum, "Life and Earth sciences" teachers have a limited knowledge about soils. Pedagogic resources need to be expanded. A consistent set of experiments has been built to demonstrate some erosion processes and controlling factors. Simple experiments are considered and use soil samples brought by students. The aggregated structure of the top soil is shown by hand-breaking soil crumbs. Sensitivity of aggregates to water is explained by immersing aggregates into water: disaggregation can be seen and the range of sensitivity can be demonstrated using different soils. The splash process (impact of raindrops) is shown using a layer of aggregates put at the center of a plastic sheet. Water drops are dropped onto it, and splashed material and distances can be seen easily. Controlling factors (aggregate and drop sizes) can be exemplified. Interrill erosion is experimented using small trays. Slope can be adjusted. A soil cover (grass, straw) can be added to illustrate means of limiting soil erosion. To expand the pedagogic scope, a GIS-based software able to compute erosion risk depending on controlling factors has been setup, and short movies presenting rainfall simulation experiments have been made. This experimental set allows to use the knowledge acquired in both physics and biology-geology courses. Students' involvement in the building of the experiments allows to teach scientific methodology. The description of the experimental set is made available to teachers and requires only easy-to-find and cheap materials.



S13.03-P - SOIL POICY AND SOIL INFORMATION IN A CHANGING WORLD

Friday 06 July 2012 from 17:00 to 18:30. Room Poster Areas

S13.03-P -1

THE DEVELOPMENT OF AN INTEGRATED DATABASE OF SOIL RESOURCES OF RUSSIA, UKRAINE AND BELORUSSIA

Pavel Krasilnikov, Petrozavodsk - Russian Federation

S13.03-P -2

A METHODOLOGY TO TAKE INTO ACCOUNT SOIL QUALITY IN URBAN PLANNING: CASE STUDY OF TWO DISTRICTS IN PROVENCE, SOUTHERN FRANCE

Catherine Keller, Aix-en-Provence - France

S13.03-P -3

ACHIEVING EFFECTIVE LONG-TERM SOIL POLICIES IN A SHORT-TEM WORLD.

Johan Bouma, Wageningen - Netherlands

S13.03-P -4

DELIMITATION OF AREAS WITH NATURAL HANDICAPS IN HUNGARY ACCORDING TO COMMON EUROPEAN BIOPHYSICAL CRITERIA

Pásztor László, Budapest - Hungary

S13.03-P -5

RAISING AWARENESS ABOUT SOIL IN AFRICA: A HARMONIZED SOIL MAP AT THE CONTINENTAL SCALE

Olivier Dewitte, Ispra - Italy

S13.03-P -6

SOIL DATA AVAILABILITY TO CLASSIFY AGRICULTURAL LAND TO PRODUCTIVITY CLASSES

Sid Theocharopoulos, Athens - Greece



S13.03-P -7

SOIL MANAGEMENT AND POLICY: A SCOTTISH PERSPECTIVE

Willie Towers, Aberdeen - United Kingdom

S13.03-P -8

SPATIAL SOIL INFORMATION SYSTEMS AT RISSAC HAS AND THE RESULTS OF TESTING THEIR INSPIRE COMPATIBILITY

László Pásztor, Budapest - Hungary

S13.03-P -9

STRATEGY OF SOIL RESOURCES USE IN THE NATIONAL AND GLOBAL CONTEXT

Aldis Karklins, Jelgava - Latvia

S13.03-P -10

SUSTAINABLE AGRICULTURE AND SOIL CONSERVATION: STATUS AND FUTURE PERSPECTIVES

Luca Montanarella, Ispra - Italy

S13.03-P -11

TEA BAG INDEX FOR DECOMPOSITION: A CROWDSOURCING APPROACH TO OBTAIN PROCESS RATES AT THE SCALE OF THE GLOBAL SOIL MAP.

Joost Keuskamp, Utrecht - Netherlands

S13.03-P -12

THE DATASETS OF THE EUROPEAN SOIL DATA CENTRE IN AN INSPIRE CONTEXT

Marc Van Liedekerke, Ispra (VA) - Italy

S13.03-P -13

TOWARDS A HARMONIZED VIEW OF THE STATE OF SOIL ACROSS EUROPE

Arwyn Jones, Ispra - Italy



S13.03-P -1

THE DEVELOPMENT OF AN INTEGRATED DATABASE OF SOIL RESOURCES OF RUSSIA, UKRAINE AND BELORUSSIA

Shoba Sergey^[1], Alyabina Irina^[1], Ivanov Alexandr^[1], Kolesnikova Varvara^[1], Krasilnikov Pavel^[2], Laktionova Tatyana^[5], Medvedev Vitaliy^[5], Bigun Oksana^[5], Nakis'ko Svetlana^[5], Sheyko Sergey^[5], Tcytron Galina^[6], Matychenkov Dmitriy^[6], Shulhina Svetlana^[6], Kaliuk Vadim^[6], Shibut L.^[6]

^[1]Lomonosov Moscow State University ~ Faculty of Soil Science ~ Moscow ~ Russian Federation ^[2]Institute of Biology ~ Karelian Research Center, Russian Academy of Sciences ~ Petrozavodsk ~ Russian Federation ^[3]Sokolovsky Institute of Soil Science and Agrochemistry ~ Sokolovsky Institute of Soil Science and Agrochemistry ~ Kharkiv ~ Ukraine ^[4]Institute of Soil Science and Agrochemistry ~ Institute of Soil Science and Agrochemistry ~ Minsk ~ Belarus ^[5]Sokolovsky Institute of Soil Science and Agrochemistry ~ . ~ Kharkiv ~ Ukraine ^[6]Institute of Soil Science and Agrochemistry ~ . ~ Minsk ~ Belarus

In 2011 we started the development of an integrated multilingual soil information system in the frames of a project "Joint database of soil resources of Russia, Ukraine and Belorussia". The aim of the project is the integration of soil data available in Russia, Ukraine and Belorussia, information support of joint research work and harmonized educational programs, and creating perspectives for incorporating the three countries in the soil information space of the European Union and the whole world. Each of the three countries to the date already has a national soil database. The joint database concept is based on the following approaches: openness, the existence of mechanisms for reinforcement and permanent enlargement of the database. Common objectives and similarity in the structure of the national databases allow forming a unitary attributive block, which is based on the concept of hierarchical organization of soil. Each of the representative soil profiles used for the filling of the attributive block of the database has a grid reference. The data are accompanied with a precise indication of the method used for the determination of each parameter. The participants of the project develop a joint list of classifiers for soil properties taking into account the peculiarity of each country. The integrated soil information system is developed on the basis of the web resource <http://db.soil.msu.ru> and presupposes an online regime of collection, administration, and editing of the data uploaded via Internet, and involvement of experts for the work with incoming information.



S13.03-P -2

A METHODOLOGY TO TAKE INTO ACCOUNT SOIL QUALITY IN URBAN PLANNING: CASE STUDY OF TWO DISTRICTS IN PROVENCE, SOUTHERN FRANCE

Keller Catherine^{*[1]}, Lambert-Habib Marie-Laure^[2], Robert Samuel^[3], Ambrosi Jean-Paul^[1], Rabot Eva^[1]

^[1]Aix-Marseille University ~ CEREGE ~ Aix-en-Provence ~ France ^[2]Aix-Marseille University ~ CEJU ~ Aix-en-Provence ~ France ^[3]Aix-Marseille University ~ ECCOREV ~ Aix-en-Provence ~ France

Although soils are mostly recognized as a spatial support for human activities, they also fulfill many other essential functions such as support for agriculture or biodiversity tank. In urban and peri-urban areas, soils undergo urge pressure but with no real assessment of their various functions. We investigated whether and how the scientific knowledge on soil quality can be integrated into land use planning. The objectives are: 1. Establishment of a diagnosis of a studied area in terms of land consumption and land planners perception of soil; 2. analysis the existing legislative tools to identify how soil quality could be taken into account; 3. investigation on which knowledge can be produced that could be useful for urban planners and propose a soil use-orientated index incorporating the soil multifunctionality. The approach is applied to two municipalities within the periurban outskirts of Aix-Marseille (Southern France). The results indicate that there is room for incorporation of a soil index into the local land planning documents that would help to take more well-founded decisions for urban development.



S13.03-P -3

ACHIEVING EFFECTIVE LONG-TERM SOIL POLICIES IN A SHORT-TEM WORLD.

Bouma Johan*^[1]

^[1]formerly Wageningen University ~ Soils ~ Wageningen ~ Netherlands

The EU Thematic Strategy for Soil Protection (2006) represents a long-term Soil Policy Landmark. Unfortunately, so far the Strategy has not been followed by a legally binding Directive because of short-term political emotions. The soil community has not faced up to this stalemate because they: (i) fail to change their professional, inward-looking paradigms that are increasingly at odds with modern information society; (ii) continue to operate as separate sub-disciplines while an integrated approach is needed to face problems of a changing world ; (iii) are hardly visible when defining “ecosystem services” that are rapidly becoming key attributes for environmental policies aimed at sustainable development; (iv) don’t realize that uncritically providing all their basic data in accessible information systems may result in poor applications, harmful to the profession; and (v) are hesitant to provide: “quick-and-dirty” assessments, recognizing incompleteness of our current knowledge while the alternative of providing no assessment at all and waiting for perfection is much more harmful. Existing stereotypes about research and the policy arena need re-assessment: Many politicians have long-range visions beyond their short-term re-election, but they want their questions to be addressed seriously taking into account their particular position. Researchers don’t lose their independence when focusing on questions by politicians nor their scientific career if they focus on defining alternative options for problems. Researchers have a particular opportunity to involve various stakeholders, as will be illustrated. .



S13.03-P -4

**DELIMITATION OF AREAS WITH NATURAL HANDICAPS IN HUNGARY ACCORDING TO
COMMON EUROPEAN BIOPHYSICAL CRITERIA**

László Pásztor^[1], József Szabó^[1], Zsófia Bakacsi^[1]

^[1]RISSAC HAS ~ Department of Environmental Informatics ~ Budapest ~ Hungary

Recent delimitation of Less Favoured Areas is suggested to be carried out by using common biophysical diagnostic criteria on low soil productivity and poor climate conditions all over Europe. The operational implementation of the criterion system elaborated by JRC is under member state competence. This process requires the existence of adequate national spatial information systems on soils and climate with appropriate data structure and spatial resolution as well as proper methodologies for their analysis. Presently the climatic handicaps expressed by the common criteria don't occur in Hungary except for the dryness criterion. Consequently, incidence of naturally handicapped areas can be predominantly attributed to soil conditions. This fact enhances the importance of the proper usage of soil information in the delimitation process. The nationwide Kreybig legacy, which was digitally processed and developed into the Digital Kreybig Soil Information System has at least three major advantages in the present context as compared to any other possible Hungarian datasets: - The main objective of the original mapping is almost the same as that of present LFA assignment. - It is the most detailed nationwide spatial dataset covering the whole area of the country. - The database contains utilizable information to fulfill all the soil related criteria, and due to their spatial features they can also be used for countrywide regionalization of these criteria. In our paper we present the multiple approaches for the identification and delineation of areas in Hungary concerned by the common biophysical criteria related to soil.



S13.03-P -5

RAISING AWARENESS ABOUT SOIL IN AFRICA: A HARMONIZED SOIL MAP AT THE CONTINENTAL SCALE

Dewitte Olivier^[1], Jones Arwyn^[1], Spaargaren Otto^[2], Breuning-Madsen Henrik^[3], Brossard Michel^[4], Dampha Almami^[5], Gallali Tahar^[6], Jones Robert^[7], Kilasara Method^[8], Le Roux Pieter^[9], Michéli Erika^[10], Thiombiano Lamourdia^[11], Van Ranst Eric^[12], Yemefack Martin^[13], Zougmore Robert^[14], Bosco Claudio^[15], Montanarella Luca^[1]

^[1]European Commission, Joint Research Centre ~ Institute for Environment and Sustainability, Land Management and Natural Hazards Unit ~ Ispra ~ Italy ^[2]ISRIC ~ World Soil Information ~ Wageningen ~ Netherlands ^[3]University of Copenhagen ~ Department of Geography and Geology ~ Copenhagen ~ Denmark ^[4]Institut de Recherche pour le Développement (IRD) ~ Unité mixte de recherche Ecologie fonctionnelle et biogéochimie des sols et des agrosystèmes ~ Montpellier ~ France ^[5]African Union Commission ~ Department of Rural Economy and Agriculture ~ Addis Ababa ~ Ethiopia ^[6]University of Tunis El Manar ~ Department of Geology ~ Tunis ~ Tunisia ^[7]Cranfield University ~ National Soil Resources Institute ~ Cranfield ~ United Kingdom ^[8]Sokoine University of Agriculture ~ Department of Soil Science ~ Morogoro ~ Tanzania, United Republic of ^[9]University of the Free State ~ Department Soil- and Crop- and Climate Sciences ~ Bloemfontein ~ South Africa ^[10]Szent István University ~ Department of Soil Science and Agricultural Chemistry ~ Godollo ~ Hungary ^[11]Food and Agriculture Organization of the United Nations ~ Subregional Office for Central Africa ~ Libreville ~ Gabon ^[12]Ghent University ~ Department Geology and Soil Science ~ Ghent ~ Belgium ^[13]Institute of Agricultural Research for Development (IRAD) ~ Department of Soil Water and Atmosphere Sciences ~ Yaoundé ~ Cameroon ^[14]International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) ~ West and Central Africa ~ Niamey ~ Niger ^[15]Loughborough University ~ School of Civil and Building Engineering, Loughborough ~ Loughborough ~ United Kingdom

The Joint Research Centre of the European Commission is producing the first ever Soil Atlas of Africa with the main objective to raise the awareness of the general public, policy makers and other scientists to the importance of soil in Africa. To this end, the Atlas compiles existing information on different soil types as easily understandable maps (both at regional and continental scale) covering the African continent. In order to provide a harmonized picture of the soils in Africa, a new soil map at the continental scale has been produced. Here we show that the new map represents an ideal medium to raise awareness about soil. The basic information of the map is derived from the Harmonized World Soil Database (HWSD) (FAO/IIASA/ISRIC/ISS-CAS/JRC, 2009). The elaboration steps of the map are presented. We show how the database was corrected and updated according to the World Reference Base for Soil Resources 2006 classification system (IUSS Working Group WRB, 2007). In comparison to the initial map from HWSD, the new map represents a correction of 15% of the soil data for the continent. Together with the publication of the Atlas, associated datasets on soil characteristics for Africa will be made available. These datasets will be useful for making broad distinction among soil types and provide general trends at the global and regional scales. The datasets will be made accessible for free downloading from the portals of the SOIL Action (<http://eusoils.jrc.ec.europa.eu/>) and the ACP Observatory for Sustainable Development (<http://acpobservatory.jrc.ec.europa.eu/>).



S13.03-P -6

SOIL DATA AVAILABILITY TO CLASSIFY AGRICULTURAL LAND TO PRODUCTIVITY CLASSES

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^[1]NAGREF ~ Soil Science Institute of Athens ~ Athens ~ Greece

The availability of NAGREF-SSIA detailed scale soil data for policy issues are presented. Using Geonetwork and Geoserver web G.I.S open software tools NAGREF's Soil Science Institute of Athens (NAGREF-SSIA) has developed its web in order to enhance access to soil data for agronomic and environmental policy uses. This in the framework of the FP7, GSSoil: "Assessment and strategic development of INSPIRE compliant Geodata-Services for European Soil data". A web G.I.S system has developed based on Geonetwork, Geoserver, open source software tools the apache tomcat server, and mysql database fully cooperating and compliant to the GS SOIL portal (<http://gssoil-portal.eu/>). Primary and secondary data are stored in the database. The soil data of the database contain INSPIRE compatible metadata and soil data like reports, soil maps, mapping units, soil taxonomic units, soil sampling points, soil profiles, physical and chemical properties. Using this web portal, primary data can be extracted and secondary data can be predicted through pedotransfer functions. This system offers the possibility to download data to classify Greek soils at field scale on land quality, and land productivity classes based on 1528/7.9.2010 Greek Ministerial legislative decision for soil quality and productivity classification. According to this law soil hydromorphy, texture, depth, pH, gravel content, electrical conductivity, slope and calcium carbonate content are used to classify land to quality and productivity. This web portal can also be used in a series of agricultural and other environmental policy issues in Greece.



S13.03-P -7

SOIL MANAGEMENT AND POLICY: A SCOTTISH PERSPECTIVE

Towers Willie*^[1]

^[1]The James Hutton Institute ~ Environmental and Biochemical Sciences ~ Aberdeen ~ United Kingdom

Scottish soils are diverse and distinctive in both a UK and European context. They contain large amounts of organic carbon, are predominantly acid and of low inherent fertility. The services that these soils provide are often not focussed on food production (only 25% are used for arable or improved grassland) but other services often prevail, most notably as a store of terrestrial carbon. The Scottish Soil Framework published in 2009 identifies a number of desired and agreed soil outcomes supported by a range of Actions by different stakeholders. The greatest emphasis is on the role of soil management in climate change mitigation and seeking to protect and enhance soil carbon stocks across all soils and land uses; the Framework (and Soil Focus Group) provides the mechanism to integrate policies and initiatives from different sectors to facilitate this. Soil carbon management is further developed in the Scottish Land Use Strategy (LUS) published in 2011 under the Climate Change (Scotland) Act. Scotland seeks to reduce greenhouse gas emissions by 42% by 2020 from 1990 levels. The LUS sets out 'to guide, support and inform all those involved in deciding how land should be used, by setting out a vision and long term objectives for an integrated approach to sustainable land use in Scotland'. Sustainable soil management from productive arable soils to the restoration of blanket peat soils is a theme that runs through the strategy. These policy documents and the role of research will be described and discussed in more detail.



S13.03-P -8

SPATIAL SOIL INFORMATION SYSTEMS AT RISSAC HAS AND THE RESULTS OF TESTING THEIR INSPIRE COMPATIBILITY

Pásztor László^[1], Zsófia Bakacsi^[1], József Szabó^[1], Annamária Laborczy^[1]

^[1]RISSAC HAS ~ Department of Environmental Informatics ~ Budapest ~ Hungary

There is great diversity among countries in data availability on soil. Hungary has long traditions in soil survey and mapping. A large amount of soil information is available, the collected data are accessible in various dimensions: at national, regional, micro-regional scales, at farm and field level, and generally presented in maps, serving different purposes as to spatial and/or thematic aspects. Since the late 1980s, a gradually increasing proportion of soil related data has been digitally processed and organised into various spatial soil information systems (SSISs). The most current SSISs (AGROTOPO and DKSIS) have been elaborated by and available at RISSAC HAS. The existing maps, data, and characterization systems served the society very well for many years, however the available data are no longer fully satisfactory for the current needs of policy making. There were numerous initiatives for the completion, improvement and integration of the existing soil datasets. Some examples will be given. Another approach for the user friendly reformation of soil information systems and services is coming from the INSPIRE concept. In Europe to support Community environmental policies or activities which may have an impact on the environment the INSPIRE Directive has been entering in force. Soil information having both spatial and environmental impacts will also be concerned. An opportunity as well as a future duty of soil information services are the establishment of their INSPIRE compatibility. In our paper we present the results of the INSPIRE testing of SSISs maintained by RISSAC HAS.



S13.03-P -9

STRATEGY OF SOIL RESOURCES USE IN THE NATIONAL AND GLOBAL CONTEXT

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^[1]Latvia University of Agriculture ~ Institute of Soil and Plant Sciences ~ Jelgava ~ Latvia

With the global increase of population up to 7 billion currently and about 9 billion in 2050, the issue of food requirement and security is becoming more and more important. The current world agricultural land area is estimated to be 4889.0 million ha including arable land of 1381.2 million and permanent crops – 152.1 million ha (FAO 2009). This area could hardly be estimated as growing, but rather diminishing due to the soil and land degradation, water scarcity and climate change. Non-food agriculture is a sector strongly competing with the traditional farming for the same land, soil, water, climate and plant nutrient resources. The same as Latvia, some countries still have remarkably more land resources than indicated by the average world indices. Currently, 1.09 ha of land, which is more or less suitable for agriculture (including 0.83 ha of arable land and 0.27 ha of grassland), per person are available. Gradually these areas are also decreasing because of the urbanization, afforestation and conversion in other types of non-agricultural use. Different types of soils with significant variability of fertility and therefore with various land productivity represent the agricultural land of Latvia. A long-term strategy for sustainable use of soil and land resources taking into consideration the current and future food, feed and bioenergy needs as well as environmental aspects is important. Some scenarios, which could be relevant for Latvia situation, will be discussed in presentation.



S13.03-P -10

SUSTAINABLE AGRICULTURE AND SOIL CONSERVATION: STATUS AND FUTURE PERSPECTIVES

Montanarella Luca*^[1]

^[1]European Commission ~ DG JRC ~ Ispra ~ Italy

The European Commission has presented in 2006 to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions the EU Soil Thematic Strategy, including the related legislative proposal for a EU Framework Directive for Soil Protection. After 5 years it is now time for a full evaluation of the implementation of the strategy and the future perspectives for soil protection in Europe. Several projects of the European Commission, including the "Sustainable agriculture and soil conservation (SoCo)" project of the JRC, have highlighted the current status of soil conservation in Europe and the potential for improvement by adopting good agricultural practices. Several of the proposed practices fall within the broad category of "Conservation Agriculture". A full evaluation of the positive and negative effects of these practices in relation to the environment, human health and economic feasibility in the current European agricultural landscapes is still missing. Nevertheless the SoCo project as put in evidence some of the benefits of Conservation Agriculture as well as some of the contradictory results highlighting the need for further research efforts in this domain.



S13.03-P -11

TEA BAG INDEX FOR DECOMPOSITION: A CROWDSOURCING APPROACH TO OBTAIN PROCESS RATES AT THE SCALE OF THE GLOBAL SOIL MAP.

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The climate warming-induced acceleration of soil carbon mineralization may form a strong positive feedback between the terrestrial carbon cycle and climate. Data from the digital soil map of the world containing soil properties and climate information are now used to predict soil carbon parameters with pedotransfer functions. However, large-scale direct measurements on soil carbon process rates (e.g. decomposition) to validate and parameterize global soil carbon models are missing in the current global soil map. Here we propose a simple, cheap and time-efficient standardized litterbag method to acquire mass loss data at the scale of the global soil map. We show that commercially available synthetic tea bags with tea as a standard litter are very suitable to obtain comparable decomposition rate measurements. We intend to use crowdsourcing methods (i.e. outsourcing a task to a community through an open call) to collect a large amount of data from all over the world. By encouraging tea-consumers and school classes to assist in these simple litterbag experiments, we can generate many data while simultaneously raising awareness of soil carbon dynamics and soil health.



S13.03-P -12

THE DATASETS OF THE EUROPEAN SOIL DATA CENTRE IN AN INSPIRE CONTEXT

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In 2006, the European-Commission and the EEA decided on a European-Soil-Data-Centre (ESDAC) at the EC-Joint-Research-Centre, acting as the primary data contact point for the EC-DG-Environment to fulfil its soil information needs. Since then, ESDAC was populated with European soil datasets, in various formats. In 2007, The INSPIRE Directive, aiming at an Infrastructure for Spatial-Information in the European-Community, entered into force, with ultimate goal of making environmental-spatial-data in Europe interoperable and usable by organizations and citizens. Soil data are regarded as spatial data in the INSPIRE Annex III and therefore Member-States will have to make them available in INSPIRE dictated formats when setting up or adapting their national spatial data infrastructures. Since the middle of 2010, a so-called INSPIRE Thematic Working Group on SOIL was set-up to specify the general formats to achieve soil data interoperability. ESDAC contributes to these specifications, relying on a vast body of knowledge of integrating soil data from various countries of Europe. A first version of the data specifications was publicly available for testing to registered parties in June 2011. ESDAC embarked on a testing campaign for the duration of four months and provided feedback on the feasibility of transforming ESDAC datasets into the INSPIRE format. The ESDAC feedback and responses from other testing parties, will feed into updated specifications for a final version. This paper will report on the testing experiences and on the prospect of using INSPIRE as the glue that will allow to assemble data from various Member-States into pan-European soil related maps



S13.03-P -13

TOWARDS A HARMONIZED VIEW OF THE STATE OF SOIL ACROSS EUROPE

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Recent experiences in developing pan-European assessments of soil have the disparity of data collection programmes in different Member States. This state, combined with uncertainty issues in data generation exercises (both modeling and field sampling) and legacy datasets, make the development of pan-European appraisals of soil state and trends difficult, if not impossible. In addition, the paper will assess whether policy makers across Europe (at all levels) are formulating the correct requests to the soil science community and, in turn, whether the soil scientists are able to provide answers to the pertinent issues of the day. The merits of potential and several recent soil data collection programmes will be discussed.



S13.04-P - INTERNATIONAL CRITICAL ZONE OBSERVATORY RESEARCH FOCUSING ON SOIL

Friday 06 July 2012 from 17:00 to 18:30. Room Poster Areas

S13.04-P -1

SPATIAL AND TEMPORAL TRENDS IN SOIL SOLUTE CHEMISTRY AND STABLE ISOTOPE COMPOSITION AT A CRITICAL ZONE OBSERVATORY (CZECH REPUBLIC)

Martin Novak, Prague - Czech Republic

S13.04-P -2

ATMOSPHERIC DEPOSITION OF INORGANIC ECOTOXINS IN THE CZECH REPUBLIC: COMPARISON OF THE LYSINA CRITICAL ZONE OBSERVATORY AREA WITH THE SATELLITE SITE U DVOU LOUCEK

Martin Novak, Prague - Czech Republic

S13.04-P -3

CARBOZALF-D – AN INTERDISCIPLINARY FIELD EXPERIMENT ON CARBON DYNAMICS

Michael Sommer, Muencheberg - Germany

S13.04-P -4

CHARACTERIZATION OF THE EUROPEAN CRITICAL ZONE OBSERVATORIES AT SOIL PROFILE SCALE – SOIL PHYSICAL STRUCTURE

Milena Kercheva, Sofia - Bulgaria

S13.04-P -5

FATE OF ANTROPOGENIC PB STORED IN CENTRAL EUROPEAN FOREST SOILS DURING THE PEAK POLLUTION PERIOD

Martin Novak, Prague - Czech Republic

S13.04-P -6

HYDROCHEMICAL DYNAMICS IN RECHARGE-DISCHARGE TRANSECTS AT THE CZO KINDLA

Lars Lundin, Uppsala - Sweden



S13.04-P -7

MODELING OF SOIL TRANSFORMATIONS IN THE CZECH CRITICAL ZONE OBSERVATORY

Pavel Kram, Prague - Czech Republic

S13.04-P -8

MODELING SOIL ORGANIC CARBON ASSESSMENT FOR THE KOILIARIS CZO BY USING A GEOSTATISTICAL APPROACH

Ece Aksoy, Ispra - Italy

S13.04-P -9

PEDOGENIC CHARACTERIZATION OF SOILS AT KOILIARIS CZO ALONG A CLIMATIC AND LITHOLOGICAL GRADIENT

Daniel Moraetis, Chania - Greece

S13.04-P -10

RARE EARTH ELEMENTS AS TRACERS OF CHEMICAL TRANSFER PROCESSES IN TROPICAL RAIN FOREST SOILS IN FRENCH GUIANA

Anne-Lise Floch, Besançon - France

S13.04-P -11

RESPONSE OF SOIL PROPERTIES TO DIFFERENT FARMING PRACTICES – CASE STUDIES IN ICELAND AND AUSTRIA

Taru Lehtinen, Vienna - Austria

S13.04-P -12

SURFACE AND SUB-SURFACE HYDROLOGY AT THE DAMMA GLACIER CRITICAL ZONE OBSERVATORY

Florian Kobierska, Davos Dorf - Switzerland

S13.04-P -13

UNDERSTANDING THE HYDROLOGICAL PROCESSES IN THE WATERSHED OF DAMMA GLACIER, SWITZERLAND, USING SWAT

Maria Andrianaki, Zürich - Switzerland



S13.04-P -14

USEFULNESS OF STABLE ISOTOPES IN CRITICAL ZONE STUDIES: OVERVIEW OF RESULTS FROM THE STRESSED ECOSYSTEMS OF CENTRAL EUROPE

Martin Novak, Prague - Czech Republic



S13.04-P -1

SPATIAL AND TEMPORAL TRENDS IN SOIL SOLUTE CHEMISTRY AND STABLE ISOTOPE COMPOSITION AT A CRITICAL ZONE OBSERVATORY (CZECH REPUBLIC)

Novak Martin^{*[1]}, Kram Pavel^[1], Farkas Juraj^[1], Zemanova Leona^[1], Curik Jan^[1], Veselovsky Frantisek^[1]

^[1]Czech Geological Survey ~ geochemistry ~ Prague ~ Czech Republic

As part of the experimental part of the EU-funded project Soil TrEC, we installed 57 suction lysimeters and 19 gravitational (zero-tension) lysimeters at the Critical Zone Observatory Lysina (LYS), and its three satellites (PLB, NAZ and UDL; Czech Republic). Gravitational lysimeters are located mainly at depths of 10 and 20 cm below soil surface. Suction lysimeters form nests at soil depths between 25 and 90 cm. LYS, PLB and NAZ are sites situated nearby in the Slavkov Forest, thus experiencing similar environmental and climatic conditions. They differ in bedrock (leucogranite, serpentinite and amphibolite, respectively). The fourth site, UDL, underlain by gneiss, is located 270 km east. It differs mainly in higher pollution loads compared to LYS. Following lysimeter installations (2009-2011), ample time is allowed for equilibration of the systems. Regular solute sampling is planned for autumn 2011 and spring 2012. Soil solute chemistry, along with inventory of pool sizes of environmentally relevant elements, will provide an insight into biogeochemical cycling of nutrients and pollutants. The paper will present time-series of solute chemistry and pilot Mg isotope gradients at the studied soil profiles.



S13.04-P -2

**ATMOSPHERIC DEPOSITION OF INORGANIC ECOTOXINS IN THE CZECH REPUBLIC:
COMPARISON OF THE LYSINA CRITICAL ZONE OBSERVATORY AREA WITH THE
SATELLITE SITE U DVOU LOUCEK**

Novak Martin^[1], Voldrichova Petra^[1], Prechova Eva^[1], Kram Pavel^[1]

^[1]Czech Geological Survey ~ geochemistry ~ Prague ~ Czech Republic

The Czech Republic is known for steep spatial and temporal gradients of atmospheric pollution. We present concentrations of 12 potentially toxic trace elements (As, Bi, Be, Cu, Co, Cr, Cd, Ni, Pb, Sb, V and Zn) in snow and ice accretions in the northwest and northeast of the country. Precipitation samples were collected over three winter seasons (2009-2011) at ZAJ, 41 km north of Lysina catchment (a European Soil Observatory) and at TET, 6 km southwest of U Dvou Loucek (a satellite site). Whereas snow represents vertical atmospheric deposition, ice accretions capture horizontal deposition. Larger atmospheric particles deposited gravitationally originate mainly from nearby point sources of pollution. In contrast, horizontal deposition (smaller particles) may provide information on more remote, diffuse pollution sources. Both mountain-top sampling sites (ZAJ, TET) were situated at an elevation of 1000 m. Mean concentrations were higher for the northeastern site TET in case of As, Cd, Pb, Be, Sb, V, Bi and Ni. For most elements, TET was the more polluted site. In contrast, ZAJ was one of the least polluted study sites in the Czech Republic. At both sites, the pollution level decreased dramatically compared to peak industrial emission rates in the late 1980s. Present-day pollution at TET mirrors ore and coal processing industries in nearby Silesia (Poland).



S13.04-P -3

CARBOZALF-D – AN INTERDISCIPLINARY FIELD EXPERIMENT ON CARBON DYNAMICS

Sommer Michael^[1], Juergen Augustin^[2], Madlen Pohl^[2], Helene Rieckh^[1], Horst Gerke^[1]

^[1]ZALF ~ Institute of Soil Landscape Research ~ Muencheberg ~ Germany ^[2]ZALF ~ Institute of Landscape Biogeochemistry ~ Muencheberg ~ Germany

Understanding carbon dynamics in soil-plant-systems has made a substantial progress during the last decade. However, studies on complex interactions between different processes are scarce at landscape scale. Especially feedback mechanisms between lateral fluxes (in-/output by erosion and/or farming practice) and CO₂ exchange deserve more attention, because they are the rule rather than the exception in real world landscapes. Thus we initiated an interdisciplinary project, so-called “CarboZALF”, which involves soil scientists, biogeochemists, agronomists and modellers. From soil landscape analysis based on DSM techniques we selected and characterized a representative landscape segment of 6 ha in a hummocky ground moraine. This includes sensitive areas on which plot scale investigations are performed: (i) two soil types of different erosional stage - Haplic Regosol (calcaric), eroded Luvisol, (ii) one depositional soil type (Colluvic Regosol), and, (iii) one non-eroded soil type (Haplic Luvisol) as a reference (steady state in terms of erosion). Soil manipulations were conducted at midslope and in adjacent depression. At 9 plots we quantify long-term changes in the soil organic carbon stock (12 years minimum) by both, C stock changes in 3y intervals and annual carbon budgets of all C fluxes. Sites are instrumented with automatic and manual chambers for gas fluxes, TDR and tensiometers for soil water regime and suction cups to determine DOC/ DIC concentrations. Subscale experiments in the lab include C sorption experiments as well as isotopic studies of C flux separation to enhance a mechanistic understanding of the phenomena observed in the field.



S13.04-P -4

CHARACTERIZATION OF THE EUROPEAN CRITICAL ZONE OBSERVATORIES AT SOIL PROFILE SCALE – SOIL PHYSICAL STRUCTURE

Kercheva Milena*^[1], Dimitrov Emil^[1], Nenov Martin^[2], Rousseva Svetla^[3], Bernasconi Stefano M.^[4], Kram Pavel^[5], Lair Georg J.^[6], Moraetis Daniel^[7], Shishkov Toma^[8], Ilieva Rossitsa^[8]

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Development and sustainability of the physical structure of soil is the key to entire life cycle of soil functions from soil formation to soil degradation. Four field sites were sampled in 2010 to study soil structure and soil aggregate formation in order to test the hypothesis that soil aggregate dynamics and the processes creating or degrading favourable soil structure correlate strongly with the stages of the life cycle, and with the duration and intensity of the land use. These sites form the SoilTrEC Project network of European Critical Zone Observatories (CZOs) representing key stages of soil development and degradation. Soil physical structure was evaluated through the following characteristics: dry aggregate-size distribution; water stability of aggregates; particle-size distribution; particle density; hygroscopic water content; soil water retention at suctions less than 33 and above 50 kPa; bulk density and fine-earth density; pore-size and pore-shape distributions. The presentation will give an idea about the measured soil physical characteristics with examples for four soil profiles in triplicate representative for the four studied CZOs (i) initial stages of soil development on crystalline bedrock; (ii) productive soils managed for intensive forestry; (iii) highly productive soils managed as arable land and (iv) heavily impacted soils during centuries through intensive grazing and farming, under severe risk of desertification.



S13.04-P -5

FATE OF ANTROPOGENIC PB STORED IN CENTRAL EUROPEAN FOREST SOILS DURING THE PEAK POLLUTION PERIOD

Novak Martin^[1], Stepanova Marketa^[1], Fottova Daniela^[1], Zemanova Leona^[1], Chrastny Vladislav^[1], Kram Pavel^[1]

^[1]Czech Geological Survey ~ geochemistry ~ Prague ~ Czech Republic

Due to a high affinity of Pb to organic matter, over 90 % of all atmospheric Pb entering forest ecosystems is retained in the soil, mainly in the topmost organic-rich horizons. Because of the relatively large Pb pools in temperate forest soils across industrialized countries, many studies concluded that the mean residence time of pollutant Pb in soil may be rather long, often exceeding 500 years. Bleeding of old pollutant Pb from forested catchments via surface runoff is extremely slow. We monitored temporal trends in Pb input-output mass balances at 11 headwater catchments in the Czech Republic for a period of 13 years. In the Central European region, most environmental Pb during the 20th century was released from coal combustion and the use of leaded petrol. Lead emissions from both pollution sources started to decrease in the 1980s. Atmospheric deposition of Pb into the studied catchments decreased dramatically over the observation period (1996-2008), reflecting lower industrial Pb emission rates. Surprisingly, however, easing pollution was accompanied by a significant decrease in Pb export via stream water. It appears that some of the deposited Pb was quickly exported from the ecosystems instead of being bound/adsorbed in the humus layer. Lead export is not correlated with DOC, and decreased despite increasing mean annual temperatures.



S13.04-P -6

HYDROCHEMICAL DYNAMICS IN RECHARGE-DISCHARGE TRANSECTS AT THE CZO KINDLA

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Interactions between soil properties and transient water flow along hillslopes from recharge to discharge areas change the chemical composition of soil and through flowing waters. Long term monitoring data are necessary to understand the mechanisms responsible for these changes and the magnitude of short- and long-term variability. In this study, performed during 2004 to 2010 in the critical zone observatory (CZO) Kindla in Sweden, soil and groundwater was sampled in transects along the catchment hillslopes. Sampling sites range from drier upslope percolation locations over deeper soils with groundwater flows to downslope wet soils in discharge areas. The Kindla CZO is included in the international cooperative programme on integrated monitoring of air pollution effects on ecosystems (ICP IM) within the Convention on Long-Range Transboundary Air Pollution (CLRTAP). It was also included in the 2006 EU BioSoil investigations. CZO Kindla is located on till soils between 312 and 415 m.a.m.s.l. above the highest coastline in the uplands of south-central Sweden. The long-term averages for precipitation and runoff are 900 and 450 mm, respectively, and the mean annual temperature is +4.2 °C. The results from the recharge area indicate quantitatively important influences of the podzolization process on shallow groundwater chemistry, while organic matter and mixing with deep, well-buffered groundwater in the discharge area tangibly modify the groundwater chemistry before it enters the stream. Hydrochemical dynamics showed changes in concentrations of, for instance, dissolved organic carbon (DOC), acidity and metals along water flow paths.



S13.04-P -7

MODELING OF SOIL TRANSFORMATIONS IN THE CZECH CRITICAL ZONE OBSERVATORY

Kram Pavel^[1], Hruska Jakub^[1], Lamacova-Bencokova Anna^[1], Oulehle Filip^[1], Blum Wifreid^[2], Lair Georg^[2], Regelink Inge^[3], Kercheva Milena^[4], Shishkov Toma^[4], Svetla Rousseva^[4], Myska Oldrich^[1]

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Three small catchments situated 5-7 km apart, with similar forest cover (Norway spruce), but underlain by geochemically contrasting bedrocks have been chosen as the critical zone observatory of the EU-funded SoilTrEC project. Sites are situated in the Slavkov Forest, close to coal power plants with large S emissions in 1950s-1980s. New version of the MAGIC model (Cosby 2011, Oulehle et al., 2012) with formulations of N and C cycling based on microbial processes was used to simulate soil and water chemistry in 1850-2010. Model parametrization was based mainly on the sampling in 2010. Lysina catchment with area of 27 ha is underlain by leucogranite, soil is mainly podzol 120 cm deep with sandy loam texture. Fine soil (<2 mm) pool at Lysina was 700 kg/m². Information about the two remaining catchments follows: Na Zelenem: 55 ha, amphibolite, cambisol, 100 cm, loam, 700 kg/m²; Pluhuv Bor: 22 ha, serpentinite, stagnosol, 90 cm, silty loam, 1100 kg/m². Simulated soil base saturation declined from 25% to 6% at Lysina, from 61% to 31% at Na Zelenem, and from 95% to 88% at Pluhuv Bor between 1850 and 2010. Streamwater at Lysina was acidified by acid rain to the present values of around pH 4.2. The two remaining catchments were acidified only slightly. Contrasting soil and water compositions resulted mainly from differences in weathering rates. Several climate and atmospheric deposition scenarios for 2012-2070 will be simulated by a hydrologic model and the MAGIC model. Potential acidification recovery of these three catchments will be assessed.



S13.04-P -8

MODELING SOIL ORGANIC CARBON ASSESSMENT FOR THE KOILIARIS CZO BY USING A GEOSTATISTICAL APPROACH

Aksoy Ece^{*[1]}, Panagos Panos^[1], Nikolaidis Nikos^[2], Montanarella Luca^[1]

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^[2]Technical University of Crete ~ Department of Environmental Engineering ~ Crete ~ Greece

The decline in soil organic carbon(SOC) is recognized as one of the eight(8) soil threats expressed in the European Union Thematic Strategy for Soil Protection (COM (2006)231 final). The estimation of SOC in Europe is important for climate change and agricultural policies. In this paper, soil organic carbon content of Koiliaris CZO and its temporal changes between the years 1966 and 2010 have been investigated. Regression-Kriging method has been applied for assessing organic carbon distribution and producing a continuous map. Eight environmental predictors (elevation, slope, aspect, temperature, precipitation, geology, land-cover map, soil map) were used to predict distribution of OC for Koiliaris. Significant correlation between most of the covariates and the organic carbon dependent variable was found (with an $R^2 > 0.60$). Rainfall, geology, WRB soil classification, slope and elevation predictors were found as statistically significant and SOC distribution was best explained by most of these covariates. Koiliaris CZO had medium organic carbon content (2-6 %), similar like around 45% of the European soils. The detection of change in time during the last 50 years is a key issue in this study. Also, the influence of land use change and agricultural/pasture alterations have affected the soil organic carbon distribution in the CZO. The study has focused on a critical mass of multi-disciplinary expertise in order to better predict spatial distribution of organic carbon. The next challenge is to identify the geostatistical rules for upscaling the results found in the CZO to a regional scale (e.g island of Crete).



S13.04-P -9

PEDOGENIC CHARACTERIZATION OF SOILS AT KOILIARIS CZO ALONG A CLIMATIC AND LITHOLOGICAL GRADIENT

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Five soil profiles (K1-K5) were sampled (in triplicate) to put light on the pedogenic processes along a climatic and lithological gradient at Koiliaris CZO representing typical Mediterranean conditions. Two of the soils sampled, K1 and K2, (20 m elevation and 535 mm rainfall) were developed in alluvial sediments and were intensively cultivated with fructiferous crops and olive trees; K3 (550 m elevation and 930 mm rainfall) was developed on metamorphic rocks and it was planted with olive trees conventionally tilled; and K4 (550 m elevation and 930 mm rainfall) and K5 (1030 m elevation and 1330 mm rainfall) soils were developed on platy limestones in terraces with non tilled olive trees and natural vegetation (shrubs), respectively. Mineralogical, physical, and chemical properties including particle size distribution, water stable aggregate (WSA) fractionation, bulk density, soil pH, organic carbon content, XRF analysis on bulk soil, rare earth elements (REE), OSL dating, bulk and clay mineralogy were assessed and the data was subjected to principal component analysis (PCA) to identify groups of soils with identical characteristics. PCA grouped the soils according to decreasing WSA and organic carbon content that was related to the variability of anthropogenic influence. K1, K2, and K3 sites showed identical REE patterns suggesting similar pedogenic origin. K4 and K5 sites had unique REE patterns resulting from limestone de-carbonation. The sum of REE was strongly correlated to the WSA content indicating that it can be efficiently used as indicator to gain insights on soil history and evolution.



S13.04-P -10

RARE EARTH ELEMENTS AS TRACERS OF CHEMICAL TRANSFER PROCESSES IN TROPICAL RAIN FOREST SOILS IN FRENCH GUIANA

Floch Anne-Lise^{*[1]}, Marc Steinmann^[1], Eric Lucot^[1], Vincent Freycon^[2], Pierre-Marie Badot^[1]

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The rare earth elements (REE) have been successfully used in the past to trace weathering and water/rock interaction in lateritic soil systems. In the present study we used the REE to monitor chemical transfer processes in French Guiana along a toposequence within rain forest soils and at the soil/plant interface. This site has been selected because chemical transfer processes in soils and soil/plant systems are highly accelerated under humid tropical climate. Soil, soil water, and vegetation samples have been collected in 5 sampling stations along a toposequence in the Paracou experimental site in Northern French Guiana. The upslope soils were drained by lateral subsurface flow and became progressively waterlogged downslope. Our preliminary results show an enrichment of the heavy REE (HREE, Dy-Lu) from upslope to downslope. This is in contradiction to earlier studies which have suggested that light REE (LREE, La-Sm) are less mobile in soils than HREE. The highest HREE enrichment occurs in soil horizons where soil water logging is most intense. These results suggest that the HREE are preferentially scavenged in waterlogged soils, whereas the LREE remain probably in solution and are thus potentially transferred to surface runoff and vegetation. Soil water and vegetation samples are currently analyzed to verify this hypothesis. With this field approach we expect to identify the mechanisms behind trace metal cycling within the Critical Zone of tropical rain forests and contribute to the evaluation of the vulnerability of these ecosystems to anthropogenic perturbations.



S13.04-P -11

RESPONSE OF SOIL PROPERTIES TO DIFFERENT FARMING PRACTICES – CASE STUDIES IN ICELAND AND AUSTRIA

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Arable land covers approximately one fourth of the global land area, but only half of it can be used efficiently for cultivation to feed the world population. Modern agriculture based on industrial principles has become highly productive but faces numerous environmental challenges. Organic agriculture has expanded as an alternative towards a more sustainable food production. This agricultural practice aims to maintain the key functions and ecosystems services of soils and to keep nutrients in a cycle through crop rotation. It is well known that the composition of soil organic matter (SOM) is altered under different management practices (e.g. tillage, manuring) and its turnover plays a pivotal role in the biogeochemical cycling of nutrients. SOM dynamics are mainly determined by its properties and the presence and physiology of soil organisms. A key to understand and define a sustainable agricultural soil system is to quantify the impact of different land management on soil biogeochemistry, with emphasis on nutrient turnover. In the research presented here we investigate the changes in SOM quantity and its composition as well as soil nutrient status resulting from different farming practices (organic vs. conventional). Further, physicochemical soil properties and soil microbiology characterization are linked to the present soil structure. Soils were selected from a total of eight farms along cultivation age gradients under sub-arctic (Iceland, Andosols) and continental climate (Austria, Chernozems). The gained data will be linked to energy balance and food productivity and will allow for identifying natural indicators for farm sustainability assessments.



S13.04-P -12

SURFACE AND SUB-SURFACE HYDROLOGY AT THE DAMMA GLACIER CRITICAL ZONE OBSERVATORY

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We present an overview of the hydrological research activities being carried out at the Damma Glacier catchment, and the Damma glacier forefield, which constitutes one of the four Critical Zone Observatories of the SoilTrEC project. Located in the Central Swiss Alps, the 10 km² glacio-nival catchment covers altitudes between 1940 and 3630 m a.s.l. We conducted numerous surface and sub-surface hydrological studies, on various scales in time and space; to understand the movement of water between soils, groundwater and the stream. A good understanding of the hydrology of a catchment is fundamental for the prediction of the evolution of soils and of the ecosystem in general. Stream-driven diurnal groundwater level fluctuations were modeled. The calibration of model results against measured data yielded space-averaged hydrological properties for the moraine soils of the forefield. On a wider scale, the response to climate change of the catchment's hydrological regime was quantified by using both an energy-balance and a temperature-index model. The findings suggest that snow-glacier feedbacks require particular attention when predicting future runoff from glacio-nival watersheds. Finally, geophysical measurements in the forefield provided an insight into the structure of the subsurface and will drive future research activities.



S13.04-P -13

UNDERSTANDING THE HYDROLOGICAL PROCESSES IN THE WATERSHED OF DAMMA GLACIER, SWITZERLAND, USING SWAT

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The Soil and Water Assessment Tool (SWAT) has rarely been used for the modelling of glacierised watersheds, where the weathering of freshly exposed rocks leads to the formation of young soils and the melting of ice leads to strong diurnal stream level fluctuations. In this study, SWAT was modified to simulate the hydrology of Damma glacier watershed, Switzerland and assess the impact of climate change on the hydrologic regime. The watershed of Damma glacier is located at the Central Alps, at an altitude between 1950 and 3500 m, and is one of the four main Critical Zone Observatories of the SoilTrEC project, with a soil chronosequence of 150 years. SWAT was calibrated using the stream flow data collected between 2009 and 2011. For assessing the performance of the calibrated model, results were compared with results from ALPINE3D, a spatially distributed model designed for the simulation of surface processes in alpine terrain. Furthermore, an energy based model and a temperature-index model, incorporated within SWAT, were tested. Results indicated that the performance of each model has a seasonal dependence, related to whether run-off comes from the snow melt or glacier melt. The knowledge obtained from this study will be included in the development of the Critical Zone Integrated model.



S13.04-P -14

USEFULNESS OF STABLE ISOTOPES IN CRITICAL ZONE STUDIES: OVERVIEW OF RESULTS FROM THE STRESSED ECOSYSTEMS OF CENTRAL EUROPE

Novak Martin^[1], Fottova Daniela^[1], Jackova Ivana^[1], Chrastny Vladislav^[1], Farkas Juraj^[1], Kram Pavel^[1]

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Over the past 20 years, a number of stable isotopes (C, N, S, O, Pb and Zn) have been used in Central European catchments as diagnostic tools, and as tracers of dispersion pathways of pollutants. We summarize results from a network of 13 headwater catchments in the Czech Republic, monthly monitored since 1994. The monitoring has coincided with a major decrease in industrial emissions, that had peaked in the 1980s, and are now 10 times lower. We documented linkages between the behaviour of C, N and S isotopes in ecosystems. Plant tissues tend to accumulate lighter isotopes of all these elements. In soils, degradation of organic molecules is associated with preferential release of the lighter isotopes of C, N and S. Most acidifying S was stored in the topmost organic soil horizon and is now flushed out of the ecosystem. Soil solutions, taken by lysimeters, contain newly-formed nitrate and sulfate, isotopically different from that in rainfall/canopy throughfall. Sulfate-oxygen isotopes show that throughfall sulfate was mainly formed by heterogeneous oxidation of SO₂, whereas sulfate deposited in open areas was formed by homogeneous oxidation of SO₂. Lead isotopes in tree-rings and peat are useful as archives of past pollution rates and for apportionment of pollution sources (coal burning, traffic, ore smelting).



S13.05-P - TAILORED IMPROVEMENT OF BROWNFIELD REGENERATION IN EUROPE: A DISCUSSION OF STATE-OF-THE-ART APPROACHES, TECHNOLOGIES AND TOOLS, AND COMPARISON WITH INTERNATIONAL CONTEXT

Monday 02 July 2012 from 17:00 to 18:30. Room Poster Areas

S13.05-P -1

APPRAISAL OF MARKET UNCERTAINTIES FOR CONTAMINATED SITES

Stephan Bartke, Leipzig - Germany

S13.05-P -2

COMPARATIVE APPLICATION OF RISK-BASED DSSS FOR BROWNFIELD REHABILITATION: DESYRE AND SADA APPLICATION TO A ROMANIAN CASE STUDY

Ileana-Codruta Stezar, Cluj-Napoca - Romania

S13.05-P -3

DESIGN AND COMPARATIVE EVALUATION OF SUSTAINABLE LAND USE ALTERNATIVES FOR BROWNFIELD REDEVELOPMENT

Sebastian Schaedler, Tuebingen - Germany

S13.05-P -4

REMOVAL OF MIXED CONTAMINANTS FROM SOIL WITH REUSED FOAMS FOR IN-SITU REMEDIATION

Ahmed Mohamed Mahmoud, Besancon - France

S13.05-P -5

RISK-BASED CORRECTIVE ACTION FOR CONTAMINATED SOILS IN AN ABANDONED SITE OF CHLORIDE PRODUCTIONS IN SOUTHWEST CHINA

Guanlin Guo, Beijing - China

S13.05-P -6

TASK – THE CENTRE OF COMPETENCE FOR SOIL, GROUNDWATER AND SITE REVITALISATION

Stephan Bartke, Leipzig - Germany



S13.05-P -7

TIMBRE - INTRODUCING TAILORED IMPROVEMENT FOR BROWNFIELD REGENERATION

Stephan Bartke, Leipzig - Germany

S13.05-P -8

UPTAKE AND FATE OF ORGANIC CONTAMINANTS IN PLANTS OF CONSTRUCTED WETLANDS

Arno Rein , Kgs. Lyngby - Denmark

S13.05-P -9

WASHING PROCEDURE TO MOBILIZE AND EXTRACT CONTAMINANTS FROM SOILS

Ahmed Mohamed Mahmoud, Besancon - France



S13.05-P -1

APPRAISAL OF MARKET UNCERTAINTIES FOR CONTAMINATED SITES

Bartke Stephan*^[1]

^[1]Helmholtz Centre for Environmental Research - UFZ ~ Department of Economics ~ Leipzig ~ Germany

Purpose – This presentation introduces an innovative method to assess value reductions due to risks associated with contaminated properties improving effective management of contaminated sites. This method shall advance the understanding of impacts of contamination on market value and hence liability, creditworthiness and market demand. Design/approach/methodology – Approaches are reviewed that account for market value deductions due to uncertainties caused by the complex nature of impaired sites. Based on a literature review, expert interviews, and a nationwide survey among German professional appraisers a risk scoring methodology is elaborated, presented, and validated applying a case study approach. Findings – Regeneration and reuse of contaminated sites carries many risks and uncertainties impacting market demand for (previously) impaired land. Even though accounting for perceived uncertainties is a legally approved best practice of appraisal, no widely accepted appraisal methodology has prevailed so far. The market based risk scoring methodology introduced concludes that areas being properly decontaminated on average still have a depressed market value of 12.25%. Factors such as location, time and feasibility of passing on risks can be combined in an algorithm to determine absolute value reduction due to perceived uncertainties for a specific property. Good validity of this valuation method was confirmed by the case study evaluation. Originality/value – A novel and comprehensible assessment method of market-perceived uncertainties for (previously) polluted sites is introduced. Its application deepens the understanding of professional appraisers, international investors and portfolio managers for the valuation of risks associated with contaminated land, thereby provoking a reduction of liability and market demand.



S13.05-P -2

**COMPARATIVE APPLICATION OF RISK-BASED DSSS FOR BROWNFIELD REHABILITATION:
DESYRE AND SADA APPLICATION TO A ROMANIAN CASE STUDY**

Stezar Ileana-Codruta^{*[1]}, Ozunu Alexandru^[1], Pizzol Lisa^[2], Critto Andrea^[2], Marcomini Antonio^[2]

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Brownfield rehabilitation is an essential step for sustainable land use planning and management in the European Union. When dealing with brownfield regeneration processes, legacy contamination plays a significant role, firstly because the persistent nature of contamination in soil or groundwater means that problems can occur now, or might occur in the future, as a result of actions which took place many years ago, and secondly, problems from legacy contamination are often more difficult to manage than contamination which might result from new activities. Due to the complexity associated with the management of brownfields, Decision Support Systems (DSSs) have been developed to support experts, local authorities and decision making to deal with all the phases of the rehabilitation process. The current contribution presents a comparative study between two DSSs, SADA (Spatial Analysis and Decision Assistance) and DESYRE (Decision Support System for the Requalification of Contaminated Sites). The main objective was to present the benefits of using DSSs to introduce, process data and disseminate results to different stakeholders involved in the decision making process. For this purpose, a former car manufacturing plant located in Brasov area, central Romania, contaminated with heavy metals and total petroleum hydrocarbons has been selected as case-study to be assessed with the two DSSs. The major results concern the analysis of the functionalities of the two software in order to identify similarities, differences and complementarities and thus, to provide indication on optimized integrations.



S13.05-P -3

DESIGN AND COMPARATIVE EVALUATION OF SUSTAINABLE LAND USE ALTERNATIVES FOR BROWNFIELD REDEVELOPMENT

Schaedler Sebastian^[1], Morio Maximilian^[1], Finkel Michael^[1]

^[1]University of Tuebingen ~ Department of Geosciences ~ Tuebingen ~ Germany

The reduction of land consumption is increasingly seen as a vital aspect of sustainable development. In many countries the redevelopment of brownfields has the potential to significantly contribute to this reduction. Since the redevelopment process is often complicated e.g. by uncertainties regarding the contamination of the site, anticipated costs of required clean-up and by intricate negotiation among stakeholders with differing interests, many of the brownfields to date remain undeveloped. We present a Decision Support System (DSS) that facilitates the design and comparative evaluation of land re-use alternatives for brownfields. In order to support decision makers in assessing and communicating pros and cons of possible alternatives among stakeholders, the system features novel approaches to integrate three of the main aspects of brownfields redevelopment within a spatial planning and assessment framework, (i) costs for clean-up of soil and groundwater required to mitigate existing risks from contamination, (ii) the market value of land including perceived market risks of redevelopment, and (iii) the suitability with respect to sustainable development. The potential of the DSS will be demonstrated by a number of case studies. In particular, it will be shown how re-use options can be systematically assessed with respect to different features and aspects of mixed land use. The studies suggest that sustainable planning alternatives on brownfields are not necessarily costly, and that the identification of both beneficial options and of the key variables by which such options are characterized can be strongly facilitated by the integrated evaluation scheme of the DSS.



S13.05-P -4

REMOVAL OF MIXED CONTAMINANTS FROM SOIL WITH REUSED FOAMS FOR IN-SITU REMEDIATION

Mahmoud Ahmed Mohamed^[1], Nicolas Fatin-Rouge^[1], Anthony Efligenir^[1], Jacques Persello^[2], Jerome Husson^[1], Ioan Bica^[3], Radu Gogu Constantin^[3]

^[1]UTINAM ~ chemistry ~ Besancon ~ France ^[2]LPMC ~ chemistry ~ Nice ~ France ^[3]Faculty of hydrotechnics ~ DEAN ~ Bucharest ~ Romania

The remediation of metals radionuclides and organic compounds contamination, such as Pb, Zn, As, PAHs and BTEX in the Hunedoara (Romania) ECO-SID Site vadose zone is a critical need. Water-based remedial amendments delivery to the deep vadose zone is facing significant technical challenges. Water-based delivery will easily leach out the highly mobile pollutants therefore contaminate the underlying aquifer. Foam has unique transport properties in the vadose that enable mitigation on the mobilization of mobile contaminants and enhance the sweeping over heterogeneous systems. Foam has many advantages over the solutions; 1) This is non-newtonian fluid that achieve high-speed sweeping of the porous media; 2) with a low density, This is less subject to gravity unlike liquid. This reduces the risk of downward extension and it helps the extraction of dense non-aqueous phase liquids (DNAPLs); 3) The high percentage of air (30 to 99%) enables, after the foam destabilization, to reduce significantly the amount of wastewater being treated. However, re-use is required to reduce the costs of treatments and impacts of environments. Under the TIMBRE project, performance of foam technology will be investigated on contaminated soil with a wide range of contaminants such as VOCs, SVOC and metals of ECO-SID site of Hunedoara in Romania, through laboratory scale tests.



S13.05-P -5

RISK-BASED CORRECTIVE ACTION FOR CONTAMINATED SOILS IN AN ABANDONED SITE OF CHLORIDE PRODUCTIONS IN SOUTHWEST CHINA

Guo Guanlin^{*[1]}, Li Fasheng^[1], Critto Andrea^[2], Zhang Chao^[1], Wang Shijie^[1]

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The issue of contaminated site has been aroused increasing public concern in China for its close relation to industrial activities, disposals of waste, or environmental accidents. Abandoned chemical industry plants are considered as potential sources of contamination and can become brownfields if they are not promptly prequalified. The necessity of sound risk assessment methodologies and effective remediation technologies to support the requalification of contaminated sites is of great concern now because of the high residential land demand. In China, environmental risk assessment and remediation of contaminated sites is in the beginning development stage for some inherent problems, such as lacking of legislation, screening values, systematic assessment methods and cost-effective remediation technologies. The objective of this contribution is to describe the work carried out in a typically abandoned chemical plant in southwest China. Three phases including the preliminary site assessment, the site investigation and the remedial investigation had been conducted according to the American Society for Testing of Materials document (ASTM, E 1527-05, 1903-97). Carcinogenic risks and hazard quotient were calculated and their spatial distribution was estimated using multivariate and geostatistical tools. Corrective boundary was determined according to the remediation target generated by the site-specific risk assessment. Contaminated soils were classified and disposed by the combined technologies according to the corresponding regulations in China. The results indicated that risk was controlled by the corrective actions, allowing the residential land use. The whole procedure was selected as demonstration project for the integrated management of post-industrial abandoned sites.



S13.05-P -6

**TASK – THE CENTRE OF COMPETENCE FOR SOIL, GROUNDWATER AND SITE
REVITALISATION**

Sebastian Leschik^[1], Nadine Fütterer^[1], Tino Ihle^[1], Bartke Stephan^{*[1]}

^[1]Helmholtz Centre for Environmental Research - UFZ ~ Groundwater remediation ~ Leipzig ~ Germany

Regeneration of contaminated sites is of particular importance for soil protection. The Terra- Aqua- und Site Remediation Centre of Competence Leipzig (TASK) endeavours to increase and improve the visibility, acceptance and marketability of new innovative technologies and concepts in the fields of soil and groundwater, contaminated site revitalisation and remediation. German and international existing knowledge and experience are to be spread and used more efficiently. TASK cares for the specific application of research results with a high innovation potential. These can be technical processes and methods, models, management concepts, guidelines and standards etc. By the development and realisation of product specific support measures, like technology demonstrations, field demonstrations, product consultancy or trade fair presence TASK supports and strengthens the positioning of products on markets in the German and international field. TASK analyses product specific obstacles that affect product implementation and application and devises solutions to overcome them. At this TASK is supported by a continual network of experienced scientists and representatives of consultancies and administration, industry and politics. With its contribution to the EUROSOIL2012, TASK will present its approach of bridging the gap from research to practice for available state-of-the are research results from technologies to decision support systems.



S13.05-P -7

TIMBRE - INTRODUCING TAILORED IMPROVEMENT FOR BROWNFIELD REGENERATION

Bartke Stephan*^[1]

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Convinced that brownfield regeneration is essential for sustainable land management in European Member States, the project TIMBRE – Tailored Improvement for Brownfield Regeneration in Europe – aims to support end-users in overcoming existing barriers to the revitalisation of large and complexly contaminated sites by developing and providing customised problem- and target-oriented packages of technologies, approaches and management tools for a megasite's reuse planning and remediation. Although, many useful and innovative technologies for site clean-up as well as methods to support decision making processes exist, they are only rarely applied using their entire potential. However, a large number of megasites can be sustainably revitalised if efficient technologies are applied, potential re-use options are assessed holistically, relevant stakeholders are involved, regional and cultural specificities are considered, and if relevant risks are quantified. The EU Seventh Framework Programme's research project TIMBRE endorses tailored megasite regeneration by providing end-users with updated information on state of the art technologies and tools. The project will enhance integrated assessments of regeneration options for particular sites, facilitate contaminated sites portfolio management and fill remaining technological gaps. This presentation is to provide an introduction to this EUROSOIL2012 Session. By summarising TIMBRE's conceptional framework of inter- and transdisciplinary research, individual contributions to the session from project partners and further international experts will be put in a bigger picture. This shall endorse an efficient discussion of state-of-the-art approaches, technologies and tools, and comparison with international context.



S13.05-P -8

UPTAKE AND FATE OF ORGANIC CONTAMINANTS IN PLANTS OF CONSTRUCTED WETLANDS

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^[1]Technical University of Denmark ~ Department of Environmental Engineering ~ Kgs. Lyngby ~ Denmark

Plants can take up and remove contaminants from soil and groundwater. These compounds may be sorbed, translocated to above-surface (from where escape to air may occur), they may be degraded or accumulate. The accumulation of substances in plants is often accompanied by toxic effects. Consequently, uptake, metabolism, accumulation and toxic effects are related. Therefore, the accumulation of compounds in plants following uptake cannot be predicted without knowledge of degradation rates. The knowledge of toxic effects may be required to predict negative feedback mechanisms, such as reduced transpiration, but also to predict the maximum load on plants. In experimental constructed wetlands, a significant stimulation of substance removal (such as benzene and MTBE) has been observed in the presence of plants. Our work was focussing on the clarification of these removal processes. Experiments were conducted and literature values were derived for determining uptake, metabolism, accumulation as well as degradation and toxicity. Mathematical models were further developed and adapted to wetland plants in order to predict contaminant uptake, metabolism and toxicity of organic compounds in wetland plants. Analytical and numerical modeling was carried out, the latter coupling plant uptake equations within a framework using the code MIN3P. The models were parameterized and calibrated in order to predict processes in the constructed wetland.



S13.05-P -9

WASHING PROCEDURE TO MOBILIZE AND EXTRACT CONTAMINANTS FROM SOILS

Mahmoud Ahmed Mohamed^{*[1]}, Nicolas Fatin-Rouge^[1], Anthony Efligenir^[1], Jacques Persello^[2], Jerome Husson^[1], Ioan Bica^[3], Radu Gogu Constantin^[4]

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We have evaluated a laboratory and pilot study to assess the efficiency of aqueous solutions of ligands such as EDTA, IDSA, NTA, EGTA, Quadrol and β methylcyclodextrin to separately extract metals and polycyclic aromatic hydrocarbures (PAHs) from polluted soils. The extraction of such pollutants is achieved effectively after be reused several times the extracting solution. The aqueous washing solution was then regenerated on chelating resins (Amberlite IRC748), grafted silica with DTPA or by precipitation of metals on solid, to provide a cleaned soil and innocuous extract. Column and batch experiments was investigated and the highest level of extraction (80-90%) was achieved with $4.7 \times 10^{-3} \text{ M}$ of EGTA and NTA to extract metals from soils at pH 6, after seven cycles of soil washing. For PAHs, we obtain an efficient removal (96%-98%) after three cycles washing of 0.03 M β methylcyclodextrin at pH 7. A pilot-scale study will carried out on a old iron smelter in Hunedoara in which it will evaluate performance and feasibility of this approach, under TIMBRE Project.

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