5th International Conference of Fire Effects on Soil Properties

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Abstracts for the Oral Talks

Conference Sessions

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Tuesday 14th July

09:30 Keynote Talk: Prof. Susan Page

In the line of fire: The tropical peatlands of SE Asia

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The peatlands of SE Asia store around 69 billion tonnes of carbon, which is 77% of the tropical and 11-14% of the global peatland carbon pool. Over the last two decades, the connected processes of land use change and drainage, driven by logging and land conversion to plantations and agriculture, have contributed to the loss and degradation of peat swamp forest ecosystem and greatly increased the risk of fire. Since the 1997/98 El Niño-induced drought, peatland fires have recurred on an almost annual basis during most dry seasons, causing on-going loss of stored carbon, globally-significant greenhouse gas emissions, local and regional air pollution, heightened tensions between neighbouring countries, a severely reduced biodiversity and loss of local livelihood opportunities. Peat fires tend to be long-lasting, smoldering fires that release both large amounts of greenhouse gases and also fine particulates that have a detrimental impact on air quality, human health and regional economies. Along with an increased extent of fires in recent decades, there has also been a trend for increased frequency. This keynote will address some of the causes and consequences of peatland fires in SE Asia. It will review the current state of knowledge on greenhouse gas emissions from peat fires and address the uncertainties surrounding emissions estimates, since accurate emissions reporting is an essential pre-requisite for the peat-rich countries in SE Asia to meet Monitoring, Reporting and Verification requirements associated with REDD+. It will conclude by considering opportunities to reduce fire frequency and severity.

11:00 – 12:15, Fire Effects on Organic Soils and Carbon Dynamics

11:00
Long–lasting effects of fen fire on soil habitat conditions in Biebrza National Park (Poland)

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1 University of Warsaw

Fens are peat-forming minerotrophic wetland ecosystems dominated by herbaceous vegetation with little tree- and shrub-cover. In the natural conditions fens are not susceptible to deep fires because of high ground water levels. After drainage, however, fens become prone to fires, especially after prolonged drought. Such deep-seated fire took place in 2002 on the drained fen in the Biebrza National Park (NE Poland). Consequences for vegetation were dramatic, inducing shifts in plant community composition, disappearance of rare fen species and severe expansion of willow shrubs into the area.

The aim of this research was to verify if main physical and chemical properties of peat are still affected 11 years after the fire. Peat samples were taken from closely situated unburnt (control) and burnt patches, each sample was divided into the surface (0-30 cm) and deep (30-50 cm) layers. Bulk density, moisture, ash content, pH, concentrations of exchangeable NH_4^+, NO_3^-, K, Na, Ca, P and total N, C, K, Na, Ca, Mg, Fe were measured and results compared between respective variants. Results indicate that the surface layer of the peat burnt in 2002 still differs in the majority of the measured parameters. The most distinct effect was observed for P availability, which increased about sixfold in burnt areas. Impact of fire on peat chemistry was significantly weaker in the deep layer, where only higher phosphorus availability, higher moisture and lower NH_4^+ concentration were observed. Increased P availability should be regarded as a highly adverse effect of fire, because indigenous fen vegetation requires low peat fertility. As long as the effect of increased P concentration lasts, regeneration of fen plant communities is very unlikely. There were only positive effects of the fire: slight increase in peat moisture, which could retard the decomposition of peat, and decrease in N availability, which is however not enough to stop willow encroachment into the area

11:15

Experimental study on the depth of burn and two-dimensional smouldering fire spread in peatlands: the role of moisture content and wind

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Smouldering fire is the slow, low-temperature, flameless burning of porous fuels and the most persistent type of combustion. It is the driving phenomenon of wildfires in peatlands, like those causing haze episodes in Southeast Asia and Northeast Europe, but is poorly understood. In this work, a series of well-controlled experiments were performed to investigate the smouldering fire spread over an Irish moss peat. The bench-scale (20x20x10 cm) peat sample under various moisture contents was ignited by an external ignition to create a uniform two-dimensional (2-D) fire spread in both horizontal and in-depth directions. A small fan was adopted to create various wind levels above the peat top surface. Multiple thermocouples were placed throughout the sample in a matrix in order to monitor the temperature evolution and track the 2-D smouldering front. The Infrared camera was used to measure the evolutions of temperature contours on the top surface and on the side with a glass wall. The "overhang" phenomenon was observed in the wet peat where the smouldering fire couldn't spread on the top surface, but spread beneath it, the depth of which increased with the moisture content. Experimental results showed that spread rates in both lateral and in-depth directions decreased with the depth due to the limited supply of oxygen. The overall spread rate was found to increase with wind spread, and increase faster under a forward wind. In addition, this 2-D spread pattern became more prominent with increasing wind speed, but became weaker with increasing moisture content.

11:30

The use of fire on the peatlands of the Falkland Islands

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The Falkland Islands (52 °S), 12,000km^2 have the highest proportion of land cover of peat in any of the UK overseas territories. They have a cool (2.2°C.-9.4°C), temperate oceanic climate. Rainfall varies between 400-800mm and is lowest in spring. The islands were partially glaciated and acid, organic soils have formed mainly because of low temperature and the impervious clay-rich subsoil creating conditions which favour waterlogging. Histosols and histic soils, upland peat, lowland peat or tussac (coastal) peat cover a large portion of the land surface. In many areas these are shallow, prone to drying out and have low rewetting potential. Vegetation is typically dwarf shrub heath on drier soils and magellanic moorland on wetter soils. Agriculture is confined to extensive sheep farming in large enclosures (89% > c. 2000 ha). Traditionally, large tracts of the native Cortaderia dominant grasslands have been burnt in spring to rejuvenate the grasslands and pasture improvement through reseeding and fertilising was practiced only on a very small scale. Recently the development of pastures with improved grasses and legumes coupled with rotational grazing has received much greater priority than previously. Climate change predictions have indicated a steady temperature rise resulting in an unfavourable precipitation-evapotranspiration balance and there are concerns that this may contribute to the instability of the peatlands. Now and in the future, agricultural management practices such as burning are likely to be critically reviewed in light of the key role they will play in ecosystem services delivery and climate change mitigation in the islands.

In the paper we will review the peatlands of the Falklands and present current estimates of peat extent, type and carbon storage potential. Recent climate change predictions will be aligned with an overview of the practice of burning the pastures in spring to highlight concerns of the effect of fire on biodiversity and the carbon storage potential of these shallow, extensive peatlands.

11:45

Soil pyrogenic organic matter characterization by spectroscopic analysis: a study on combustion and pyrolysis residues

Mastrolonardo, Giovanni[1] (giovanni.mastrolonardo@gmail.com), Francioso, Ornella[2], Di Foggia, Michele[2], Bonora, Sergio[3], Forte, Claudia[4], Certini, Giacomo[5]

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We investigated the pyrogenic organic matter (PyOM) found in soil after the occurrence of a high severity fire in a maritime pine forest in Central Italy. As PyOM forms from a combination of combustion/pyrolysis reactions, we subjected burnt and unburnt soil samples, their alkaline extracts, and natural charcoal to progressive heating under air and nitrogen atmosphere, with the aim of better understanding the role fire plays on PyOM formation and oxidation.

The top 10 cm of mineral soil and the above-lying charcoal particles were collected soon after the fire. Sampling was also performed on an adjacent unburnt portion of the forest. The bulk soil organic matter (SOM), its extractable fraction and charcoal particles were characterized by FT–IR and 13C NMR spectroscopies. They also underwent thermogravimetric analysis under air or N2, stopping the thermal reactions at the end of the first exothermic reaction in the range 350 – 500 °C.

The NMR investigation clearly revealed more aromatic and alkyl C in the burnt soil compared to the unburnt one. However, in spite of the extreme fire severity estimated by vegetation based visual scale, several clues led to hypothesise that SOM did not experienced highly severe heating. In the thermal treatment mimicking fire, charcoal lost much of its mass and carbon content, but at 500 °C it still preserved a significant recalcitrant fraction. Nitrogen concentration in bulk soil samples increased after the heating treatment, particularly under air condition. This relative increase in nitrogen supported the formation in charred materials of stable N containing compounds, prevalently in heterocyclic forms.

We found that a large fraction of charcoal released to soil during fire is sensitive to be oxidised by subsequent fires, although it preserves a recalcitrant fraction of C with possible long residence time in soil. Our results show that PyOM formed under high oxygen availability seems to preserve N in heterocyclic forms. We found a large aliphatic contribution to PyOM, probably due to the peculiar characteristics of sclerophyllous Mediterranean vegetation of the study site. Such an outcome might imply a different behaviour and residence time in soil of this aliphatic-rich PyOM.

14:00 – 15:15, Fire Effects on Soil Properties and its Management

14:00
The wildland fire regime in Ireland and its implications for soil management and conservation

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1 Forest Service, Department of Agriculture, Food and the Marine

Wildfire is a significant threat to upland habitats in Ireland annually, and presents a considerable risk to soil and peat management in key fire prone areas of the country. This paper will examine the background to the wildland fire regime in Ireland, the implications for soil and other conservation values, and key issues relating historic fire management to date in Ireland. The paper will also examine more recent measures aimed at addressing the issue of fire in the uplands, and at mitigating impacts on soils.

14:15

What factors control post-fire ecosystem processes in burned forest? Examining the influences of wildfire severity, forest type, and soil organic matter composition on carbon and nitrogen dynamics

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Fire is an important ecological process in forests around the globe but predictions of increased fire risk, size and severity raise concerns about the ability of forests to recover after fire that is outside of the range of historic fire conditions. The 2011 Pagami Creek wildfire was a record-setting fire in northern Minnesota, USA and affected nearly 40,000 ha of southern boreal forest. The fire burned through a mixture of forest cover types and resulted in a range of soil burn severity levels. To what extent does wildfire severity influence ecosystem recovery? And, how do fire effects on soil processes differ between forest types and across severity levels? We used elemental analysis, 13C NMR, and field and laboratory incubations to investigate the influences of pre-fire forest composition, fire severity and soil organic matter characteristics on carbon (C) and nitrogen (N) stocks in post-fire forest floor (FF) and 0-10 cm mineral soil samples collected between 2011 and 2014, and on carbon and nitrogen mineralization rates using samples collected in 2014. We found that FF depth and C stocks decreased in all fire severity levels, whereas N stocks decreased only in the two highest severity levels relative to unburned control areas, across forest cover types. There were no statistically significant changes in mineral soil C or N stocks across severity levels or cover type. Effects of fire on organic matter composition were more pronounced in the FF layer than in the mineral soil and indicated a loss of carbohydrates and lignin, gain of pyrogenic C, decreased organic matter stability and increased degree of decomposition (represented by lignin:N and alkyl C:O-alkyl C ratios, respectively). Results on C and N mineralization rates will be presented. Our results help to connect visual fire severity estimates with post-fire soil processes. These connections are relevant for efforts to scale up from ground-level wildfire effects to determine much broader ecosystem impacts.

14:30

Changes in soil chemical properties after prescribed fires in Catalonia (Spain)

Alcañiz, Meritxell[1] (m.alcaniz@ub.edu) Francos, Marcos[1], Farguell, Joaquim[1], Úbeda, Xavier[1]

1 University of Barcelona

Since 2000 6 plots burned with prescribed fires which are located in different parts of Catalonia: Tivissa (TV2, TV3, TVA), Reus, Prades (CAP) and Montgrí (MONT) have been monitored. The aim of this study is to quantify changes on soil chemical properties between three sampling moments (before, just after and one year after) as a result of a prescribed fire in order to evaluate the use of prescribed burning as a forest management tool. In each study area was placed a sampling plot with a rectangular 4×18 m structure. The study was carried out with 42 unstructured soil samples which were air-dried and passed through a 2 mm sieve. Soil pH [1:2.5], E.C. [1:2.5], C, N, P2O4, and cations were analyzed. pH increase just after the prescribed fire. In addition, one year after the prescribed burning pH has continued to increase in TV3, TVA, Reus and MONT. However, in TV2 and CAP one year after the fire pH values decreased. Moreover, mean EC increased in all plots studied just after the prescribed fire. After 1-year period, EC normally returned to pre-fire levels due mainly to soil ions leaching or overland flows in areas with a high slope. Total C and total N increased just after the prescribed burning in almost all analyzed plots and decreased one year after. Total N concentration increased owing to the deposition or incorporation of ashes into the soil. In 1-year after period, total N has decreased. Phosphorous also increased after a prescribed fire in some plots (TV3, TVA, CAP, MONT) while in others decreased. Otherwise, one year after the prescribed fire there are different behaviours. TV2 and CAP had still increasing while TV3, TVA and MONT decreased. The inorganic cations behaved similar as phosphorous. Firstly, we found an increment in the concentration because of the low severity of fire, the high volatilization temperatures of these nutrients, the formation of ash from the combustion of organic matter and its incorporation into the soil. Therefore, one year after the prescribed fire, K and Mg concentrations decreased while Ca has still increasing in all plots except CAP. The results of this study demonstrate that there are changes in soil chemical properties after prescribed fires which are evident just after burning. Sometimes, prescribed fires do not allow enough time to soils to be completely recovered but does not imply a loss of functions.

14:45

Hydrophobicity and infiltration capacity in a forest soil after a wildfire and a heavy rainfall

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The aim of this study is to test the hydrophobicity and the infiltration capacity in a forest soil that burnt at 12th November 2013. Thirty soil samples and white and black ashes were collected from a plot 4x18 meters two days after fire. Five days after fire, the 16th of November a high intensity rainfall of 163 mm washed the ashes from the soil surface of the plot. The 18th of November another soil sampling was done. Soil from an adjacent unburnt plot was also sampled to compare the results. The study area is located in Colomers (Baix Empordà). The fire burnt a total of 550 ha of forest and agricultural lands. The method used to measure the hydrophobicity was the WDPT and to measure the infiltration capacity was used a Disco Decagon Infiltrometer. The tests were applied in the laboratory with soil samples sieved at 2mm. Moreover, soil samples from the unburnt soil were burnt in the laboratory in a mufla furnace at 100, 200, 300, 350 and 400ºC for 20 minutes and were test as the same way than the soil samples from the plot. The results show that the burnt soil was slightly hydrophobic (average of 30.13 seconds to infiltrate 180 drops), the soil burnt and washed by the rainfall was not hydrophobic (3.65 seconds) in any of the 30 samples. The unburnt forest soil was slightly hydrophobic (13.6 seconds). The soil burnt at the mufla furnace was severely hydrophobic at 100ºC (613 seconds), 200ºC (1721 seconds), 300ºC (801 seconds), in turn at 350ºC and 400ºC was totally hydrophilic (0.16 and 0.17 seconds respectively). About the infiltration capacity, the samples that were severely hydrophobic did not infiltrate at all. The control had the major infiltration capacity with values higher than 1000 mm/h during the entire test. The soil of the plot recently burnt was the soil with the lower infiltration capacity with an initial rate of 500 mm/h and with an average of 200 mm/h. The two types of ashes have similar values with an initial rate of around 1200 mm/h and a final rate of 200 mm/h, it was the same rate than the soil burnt and washed by the rainfall. The soil burnt at the mufla furnace at 400ºC registered a better infiltration capacity than soil burnt at 350ºC. One of the conclusions is that the soil should burnt around 350 and 400ºC because at less temperature the hydrophobicity should be higher. There were not differences between the two ashes in terms of infiltration capacity.

15:00

Charcoal should receive greater consideration in soil classification systems?

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1 Università degli Studi di Firenze, Firenze, Italy

Charcoal is virtually ubiquitous in forest soils since forests sooner or later undergo burning events. Grasslands and arable soils as well often contain charcoal because of management practices, such as burning the stubble in the fields and biochar addition. However, soil variability in terms of charcoal content is large, ranging from hardly detectable amounts to thick black layers whose characteristics are mainly dictated by the charcoal. Overall, charcoal in soil is expected to increase due to the fact that such material is refractory to decomposition. In spite of its near ubiquity, charcoal seems to have not received the proper consideration in soil classifications, at least in the two most widely used, the World Reference Base for Soil Resources (WRB) and the U.S. Soil Taxonomy (ST). In fact, no diagnostic horizon and suffix symbol specifically dealing with significant charcoal accumulation do occur, although the examples of soils mainly characterized by charcoal-rich horizon are reported all around the world. A unique exception is perhaps the surface "pretic horizon" of the last version (2014) of the WRB, commonly found in the Amazonian Dark Earths, where however the required ≥ 1% charcoal (by volume, by weighted average) may be by-passed by other diagnostic criteria. Charcoal is unmistakable in the field, also when it is fine-grained, because of its total black colour can be mimicked only by some manganese oxides, whose nature is however revealed by a simple field test. By virtue of their peculiar properties, which have significant ramifications on pedogenesis and plant growth, charcoal-rich horizons should be acknowledged with a new suffix symbol as genetic horizon, and perhaps to be diagnostic for some soil classes. A proposal for both cases is presented.

16:00 – 16:45, From Fire Intensity to Fire Severity

16:00
Advances in the study of charcoal using reflected light microscopy

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1 University of Exeter

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Charcoal is a fundamental product of wildfires and its relatively recalcitrant nature means it can provide valuable information about wildfires post-fire through to the historical past. It has also long been noted that charcoal has the ability to reflect light when studied using reflected light microscopy. This reflectance is thought to relate to the ordering of carbon atoms within the charcoal such that the greater the abundance of graphite-like components that the char contains the more reflective it becomes. Previous work has suggested that this increased ordering, and therefore reflectance, of charcoals relates to their temperature of formation. However, this relationship is based on chars created in oxygen-depleted furnaces, in which the wood does not ignite, but simply pyrolyzes due to the imposed heat flux. Moreover, fires are typically measured in terms of their behaviour such as fire intensity (rate of heat release) and not temperature alone. We are therefore currently investigating what aspects of fire give charcoal its reflectance by examining the reflectance of chars created in controlled laboratory fires (using an iCone calorimeter), compared to wildfire-derived chars collected from a modern peatland fire in Ireland. Here we present the findings to date, which represent a preliminary step in elucidating the relationship between the reflective nature of char and fire dynamics.

16:15

Fuel and climate controls on peatland fire severity

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Introduction: Peatland soils in high-latitude regions hold more than 480 GtC, and their degradation will drive an important climate-ecosystem feedback. Peat deposits in U.K. heathlands are usually overlain by bryophytes and plant litter. The moss and litter (M/L) layer is thought to be important in insulating peat from temperature pulses during fire. The structure of the M/L layer may therefore be a critical factor in keeping fire severity low despite high fire intensity. Drought conditions, projected to intensify due to climate change, may lower the moisture content (MC) of the M/L layer below its flammability threshold, leading to a step change in fire behaviour and fire severity that threatens C stores.

Methods: 1. We examined the role of M/L layer structure in temperature penetration by manipulating the M/L layer in 1 x 1 m microplots: it was either left untouched, removed after the fire, or removed before the fire. We monitored fire-induced soil heating and post-fire soil temperature regimes. 2. We investigated M/L layer flammability controls on fire severity by simulating summer drought in 2 x 2 m microplots using rain-out shelters. We monitored fire-induced soil heating.

Results: A substantial increase in fire-induced temperature pulses into the peat was observed where the M/L layer had been removed (4950 °C.s to 12700 °C.s). Burnt microplots, especially where the M/L layer had been removed, had higher daily and seasonal peat temperature fluctuations than unburnt (e.g. summer mean daily temperature fluctuation 8.1°C v 2.2°C). The drought treatment decreased the MC of the M/L layer (e.g. in dry heath, 275 ± 174 % untreated v. 113 ± 70 % with drought). Drought microplots showed higher fire-induced peat temperature pulses than untreated (e.g. 12900 °C.s v 72900 °C.s in dry heath) but effects differed between dry and wet peatland ecosystems.

Conclusion: The M/L layer has a critical ecosystem function by preventing peat from being exposed to high temperature pulses during burning. The increase in fire severity associated with a decrease in the M/L layer MC during drought could have important implications for peat C dynamics and post-fire vegetation regeneration. Variation in fire severity also drives changes in belowground microclimate and could alter soil function dynamics.

16:30

Effect of peat moisture content and bulk density on the self-sustained horizontal propagation of smouldering fires

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The consumption of large areas of peat during smouldering fires is the consequence of self-sustained smouldering fronts that remain actively propagating for weeks. The dynamics of the smouldering fronts during the self-sustained propagation are poorly understood. We analysed the effects of peat moisture content and bulk density on the horizontal propagation of smouldering fires in laboratory-scale experiments. An infrared camera, webcam and thermocouples monitored the smouldering fire propagating in peat samples of 20×18×5cm.

Both moisture content and bulk density had a negative effect on the distance burned and the speed of the fire. Peats at moisture content <100% MC (percentage of mass of water per mass of dry peat) sustained propagation for distances longer than 20cm, at speeds between 2 and 5cm/h. However, wet peats >200% MC sustained smouldering propagation for no more than 8cm and lower spread rates <2cm/h.

The outputs from our research provide a theoretical insight of the behaviour of smouldering fire and can be the base for modelling smouldering fire at larger scales. The spread rates of the horizontal propagation can be used to predict perimeter, area affected and duration of the fire.

Wednesday 15th July

09:30 – 10:30, Fire Effects on Hydrology

09:30

Effects of fire and drainage on the organic geochemistry of tropical peat

Page, Susan[1] (sep5@le.ac.uk), Milner, Leanne[1], Boom, Arnoud[1]

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Future climate change will likely result in increased fire frequency in peatland-dominated areas of the world. Global peatlands currently store about 400-600 Gt carbon (C), i.e. one third of the global soil organic C pool. Disturbance by fire may result in feedbacks on the global C cycle and climate system as well as local changes in physical, chemical and biological properties at the peatland surface which could influence subsequent peat C dynamics. To assess fully the impact of fire on peatland geochemical cycling, an improved understanding is required of how both fire and fire history (e.g. frequency) relate to impacts on peat C stocks. Tropical peatlands store at least 89 Gt C, with most (77%) in the peatlands of SE Asia, but over the last two decades, both fire extent and frequency on these peatlands have increased. In order to better understand fire effects on the peat organic matter (OM) composition, peat samples were obtained from undrained and degraded (drained and burnt) tropical peatland locations in C. Kalimantan, Indonesia and analysed using Pyrolysis-Gas Chromatography/Mass Spectroscopy (Py-GC/MS), allowing for detailed molecular investigation. Results revealed significant compositional differences between burnt and unburnt peat pyrolysates including, dominance of recalcitrant aromatic- and aliphatic-derived compounds in burnt peat, while unburnt/undrained peats contained greater contributions of labile compounds including derivatives of lignin and polysaccharides. In contrast, the peat pyrolysates from a drained unburnt site were dominated by aliphatic components. Thus both fire and drainage result in alteration of peat OM composition, while fire frequency was shown to have no significant influence on peat OM composition. The implications of these results for peatland C cycling and post-fire ecosystem recovery will be discussed briefly.

09:45

Post-fire soil and nutrient losses on hill-slopes under slash-and-burn in the Southern of Brazil

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The use of slash-and-burn agriculture is ongoing in tropical areas. By burning vegetation and warming the soil, farmers can benefit from the release of nutrients and enhanced pH. However, the nutrients gained by burning can be lost rapidly due to erosion, leaching and harvesting. The greatest soil and nutrient losses occur during the cropping period. Therefore, this phase is critical to the sustainability of the system. The objective of this study was to estimate soil and nutrient losses during cropping by comparing the pre- and post-burn nutrient budgets. The measurements of sediment and water losses were done in twelve $1m^2$ erosion microplots. The erosion plots were set up in pairs in two random blocks on slopes of 6º or 11º. Each block was composed of six paired plots. Ash was allowed to remain in one plot of each pair and ash was carefully removed from the other plot. We noticed no effect of ash in reducing surface erosion and we concluded that soil and nutrient losses were not critical during the cropping phase in the slash-and-burn agricultural system. Approximately 70% of nutrient losses occurred during the initial measurements or immediately after the fire. Farmers could use unburned trunks as temporary contour-felled log erosion barriers. This simple, low-cost measure might enhance sediment and nutrient retention in the plot.

10:00

Peatland ecohydrological resilience examined through thermal signatures

Kettridge, Nicholas[1] (n.kettridge@bham.ac.uk), Lukenbach, Max[2], Hokanson, Kelly[2], Devito, Kevin[3], Petrone, Rich[4], Waddington, James M[2]

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Peatland ecosystems are critically important global carbon stores, with three times more carbon locked away within these ecosystems than all tropical rainforests combined. There is increasing concern that such peatlands are vulnerable to projected increases in wildfire severity under a changing climate. Severe fires may exceed peatland ecological resilience resulting in the long term degradation of this carbon store. Evaporation provides the primary mechanisms of water loss from such peatlands and can regulate the ecological stress in the initial years after wildfire. We examine variations in evaporation within a burned peatland after wildfire through the examination of surface temperatures. We observe large spatial variations in surface temperature and associated variations in evaporation that are controlled principally by near surface water repellency. Water repellent peat produced by the fire limits the supply of water to the surface, reducing evaporation and providing a strong negative feedback to disturbance. This previously unidentified feedback promotes high water table positions at a landscape scale which limits the rate of decomposition and likely supports the ecohydrological recovery of peatlands post disturbance.

11:00 – 12:15, Fire Effects on Soil Properties

11:00

Wildfire reduces soil water repellency in eucalypt forest of north-central Portugal?

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Soil water repellency (SWR) refers to the capacity of soil to resist wetting. It has been documented for a wide range of soil and vegetation types, and has been found to vary with soil organic matter (SOM) content and type, soil texture, soil temperature and soil moisture content (SMC). Fire can induce, enhance or destroy SWR. SWR is a dynamic soil property that influences other soil-related properties and processes such as infiltration rate and pattern, (preferential flow paths), soil water retention and soil erodibility. In Portugal, SWR in eucalypt stands has been shown to increase surface runoff under dry antecedent SMCs in both unburnt and burnt sites, and to enhance post-fire soil erosion. Despite the many hydrological implications of SWR, data series with intensive field monitoring of SWR under a wide range of SMCs are still limited, restricting the capacity to understand and predict spatial and temporal patterns of SWR. This work aimed to study the temporal evolution of SWR in which will be helpful for hydrological modelling, and, therefore, for post-fire soil erosion risk assessment. The study area, located in north-central Portugal, was burnt in July 2010. Two burnt eucalypt plantations and one neighbouring, long-unburnt eucalypt stand were selected to monitor SMC and SWR, using the "molarity of an ethanol droplet" (MED) test, during 2 post-fire years at intervals of 1-2 weeks. In addition, rainfall data were collected and SOM content was determined at 3-monthly intervals. The results showed that the soil in the unburnt eucalypt site was consistently more water repellent, and had lower SMCs, than the two burnt stands, suggesting that fire may have reduced SWR directly as well as indirectly. At all 3 sites, very strong to extreme SWR prevailed (80% of measurements ≥ 6 ethanol class) but wettable conditions also occurred (13% of measurements ≤ 2 ethanol class). The temporal SWR behaviour was similar for the two post-fire years. These results indicate that the effect of fire on hydrological modelling may be more complex than previously assumed.

11:15

Surface fire effects on soil microbial properties in a Mediterranean (*Pinus brutia*) area

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The effect of fire on forest ecosystems has drawn considerable interest in last decades in terms of carbon dynamics, especially due to its role in increasing levels of atmospheric CO_2. In addition to the regular coastal area fires, an increase in wildfires in Mediterranean hilly forest ecosystems has started to be observed in recent years possibly because of the climate change. Although there were many researches on crown fire affected ecosystems, there is a lack of information about the effects of surface fires on forest soils. Studying the contribution of ash to soil carbon (as black carbon) and to soil available nutrients content is of great importance in understanding carbon and nutrient dynamics after fires. Combining microbial parameters have been recently used as microbial indexes such as metabolic quotient- (qCO_2), C_{mic}:C_{org}. The aim of this study is to determine the biological soil parameters, microbial indexes and soil productivity after a low severity surface fire. We also aimed to relate the results with the carbon pool of the forest. The ash and mineral soil in two depths were compared. Soil and ash samples were collected from a Turkish red pine (*Pinus brutia*) forest a year after a low severity wildfire in Kahramanmaraş, Turkey. The results showed that the surface fire affected C_{mic} significantly. There were significant differences between ash and mineral soil samples in terms of C_{org}, C_{mic} and CO_2 evaluation and they decreased with depth. We can conclude that microbial soil parameters were not affected from the surface fire and has returned its previous conditions within a year after fire. This suggests that surface fires have limited effects on the microbial properties of the soils of *P. brutia* forests.

11:30

Changes in soil chemical properties after prescribed fire in a mountain area covered by shrubs

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Currently, forest fires are a serious problem in the Mediterranean ecosystems. The abandonment of the rural areas has led to the accumulation of biomass fuel. One of the techniques applied in the management of vegetation in forest areas is the prescribed fire, which aims to reduce the combustible load guaranteeing a reduction of the risk of fire. Its application in strategic areas intends to gradually replace the fires that occur during the summer period for less intense burnings carried through winter. The fire temporarily reduces or eliminates the vegetal covering of the ground and several alterations may occur in the physical, chemical, mineralogical and biological properties of the soil. This work aims to evaluate the temporal evolution of the effect of prescribed low severity fire in mountain areas covered with shrubs in some soils properties. The study took place in Aveleda, within the area of the Montesinho Natural Park, Northeast Portugal, which possesses a surface of about 75000 ha, being approximately one-third occupied by shrubs. Sampling took place in an area with approximately 5 ha, occupied by shrubs, which was subjected to controlled fire. In eleven different locations, randomly scattered, soil samples were collected before the controlled fire at different depths: 0-5 cm, 5-10 cm and 10-20 cm. To monitor the development of the properties in time, soil samples were once again collected in the same places, two months, six months and three years after the prescribed fire. Three years after the prescribed fire, and at depth of 0-5 cm, it turned out that the soil pH values were similar to those seen before the fire. However, the same was not verified with the values of the exchangeable bases, extractable potassium and electric capacity that differ from the observed ones before the fire. It also appears that the controlled fire, affects the chemical properties differently throughout the soil profile.

11:45

Changes in some soil parameters of three periods after a wild fire

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1 University of Barcelona

This study focuses on the effects of the forest fire of November 12th of 2013, that affected, among others, the town of Colomers (Baix Empordà, Girona), where the experimental plot of this study is located. The fire started in the town of Camallera and moved 10 km Southward with a speed of propagation of approximately 12 km/h, helped by a strong wing of Tramontane, that burned about 550 hectares. The first sampling was made on the 15th of November of 2013, after the wildfire. The second sampling was made on the 18th of November of 2013, after a torrential rain event that reached 163 mm of precipitation in 3 days. The third sampling was made on the 3th of October of 2014, about a year after the fire. The aggregate stability was measure by the TDI method (Ten Drop Impacts), subjecting each sample to ten drops of water falling from a meter high. This calculation was made in % of disintegrated ground. The pH in the first sampling was between 9.05 and 7.9 and the average 8.5. In the second sampling the pH was among 8.2 and 7.8 and the average 8. In the third sampling the pH was between 8.73 and 7.69 and the average 8.2. The E.C. in the first sampling was between 2280 and 155.4 and the average 533.9. In the second sampling was among 687 and 146.8 and the average 272.1. In the last sampling the E.C. was between 185.5 and 71.4 and the average 113.7. In the first sampling an average of 3.97% of aggregates disintegrate, in the second a 5.67% and in the third sampling a 9.17% Samples from an unburned control plot have a pH of 7.19, the E.C. was 337 µS/cm and the percent of aggregates disintegrate was 2.42%. Regarding the pH variability, there is a decrease in the second sampling relative to the first one and a slight increase in the third sampling. The results of the last sampling are less homogeneous than the previous sampling because the rain swept most of the ashes and left the soil uncovered. The E.C. decreases in the second sampling and is more homogeneous, the reason can be also the factor ashes at the first sampling. In the third sampling the values decrease and are more homogeneous than the previous sampling. The aggregate stability increases in the second sampling and in the third sampling too. To conclude, this work observed that the pH has stabilized, the conductivity has returned to the average unburnt values and has been homogenized and aggregate stability has declined specially in the last sampling.

12:00

Effect of fire on soil and biologic characteristics of forests: A case study Neka- Zalemroud forests - Iran

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This research was done to investigate the fire effects on soil and biologic characteristics of District Three of Neka-Zalemroud forests. Soil characteristics include soil moisture and soil ingredient percent and biologic characteristics include leaf litter moisture and depth, grass coverage percent and fallen trees. 70 samples of soil and leaf litter were gathered in burned and unburned (evidence) areas. Soil and leaf litter sampling was done using random-selecting method in burned and unburned areas. Moisture of soil and leaf litter samples and also ingredient percent of soil was determined in soil-science laboratory. Finally average of soil moisture, soil ingredient percent, leaf litter moisture and depth were obtained. Then these averages were considered as final characteristic of each factor in each sample point. Data was classified to fire inside and fire outside. Thus average comparison of two societies was used. Lon test was used to investigate the equality of variances. Results showed that a significant relation between average of soil moisture, clay percent, sand percent, leaf litter moisture, leaf litter depth and grass coverage percent in the burned and unburned areas. Further there is not a significant relation between silt percent and also fallen trees in the burned and unburned areas.

14:00 Keynote Talk: Dr David Goodrich

The Automated Geospatial Watershed Assessment (AGWA) for Rapid Post-Fire Watershed Assessments

Dr David Goodrich[1] , Guertin, P.[2], Burns, S.[2], Unkrich C.[1], Sheppard, S.[2], Sidman, G[3], Barlow, J.[2]

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Burned Area Emergency Response (BAER) teams in the United States are responsible for rapid assessments of post-fire impacts on a variety of resources (e.g. structures, archeology sites, reservoirs, etc.) both within the fire boundary and downstream of the fire affected area. To minimize post-fire impacts to these resources and protect soil health by controlling erosion the BAER teams recommend deployment of mitigation and rehabilitation resources under budgetary constraints. Prioritizing placement of mitigation resources is an inherently complex decision that is spatial in nature. It is therefore best addressed within a Geographic Information System (GIS) environment using distributed watershed models coupled with extensive field observations. Substantial data requirements and the task of building input parameter files have presented obstacles to the timely and effective use of complex distributed rainfall-runoff and erosion models by BAER teams and resource managers. Geospatial tools and readily available digital sources of pre-fire land cover, topography, and soils combined with rainfall-runoff and erosion models can expedite assessments when combined with a post-fire burn-severity map. The AGWA (Automated Geospatial Watershed Assessment) tool, coupled with the KINEROS2 and SWAT watershed models was developed for this purpose. It was developed to utilize nationally available U.S. spatial data sets but also enables the input of local observations and data. AGWA can difference results from pre- and post-fire model simulations and display the change on the modeled watershed. This allows managers to identify potential problem areas where mitigation activities can be focused. This presentation will provide an overview of AGWA, the research behind post-fire parameter selection, its application to several large wildfires, and discuss limitations of the KINEROS2 and SWAT watershed models.

16:00 – 17:00,

Computational and Novel Methods for Experimental Data

16:00
Combining computational methods and field data to quantify wildfire ash distribution in a post-fire landscape

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Ash, the burnt residue from combustion of vegetation, litter and surface soil, covers the soil after every wildfire. The effects of wildfire ash on the soil are very diverse. For example, it can increase the pH and nutrient contents in the soil, which can promote vegetation recovery. It can also protect the bare soil from rain splash erosion and act as an adsorbent layer, preventing or delaying post-fire water erosion by runoff.

Research evaluating the intrinsic properties of ash has been carried out for a range of fire types and ecosystems; however the eco-hydro-geomorphic effects of ash on the post-fire landscape are still poorly quantified. A fundamental step in that direction is the understanding of ash production and distribution at the landscape scale. To obtain information about ash quantity and characteristics at this scale (i.e. fire-affected catchments, whole fire ground areas, etc) would allow drawing wider conclusions in the overall effects of wildfires and to incorporate ash as a new parameter into post-fire risk models and assessments.

Here we present a new method to model the spatial distribution of ash loads in the post-fire landscape. Based on a severe wildfire that burnt ~13,000 ha of dry eucalyptus forest in October 2013 (SW Sydney, Australia), we developed a spectral index to reflect ash loads: the normalized wildfire ash index (NWAI) using Landsat imagery. The relationship between NWAI and ash loads measured in the field under a range of fire severities was determined using a simple polynomial regression. A spatially applied model was then produced to illustrate the distribution of ash across the fire ground. Approximately 200,000 tons of wildfire ash were produced with specific loads increasing with fire severity. This new tool to model wildfire ash load distribution can inform decisions about post-fire land management in future wildfires in the region and be adapted for its application in other fire-prone environments.

16:15

Peat fires: Combining an in-depth spread model with laboratory experiments

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Smouldering fire is the slow, low-temperature, flameless burning of porous fuels and the most persistent type of combustion. It is the driving phenomenon of wildfires in peatlands, like those causing haze episodes in Southeast Asia and Northeast Europe, but is poorly understood. Based on the micro-scale thermogravimetric experiment, the smouldering chemistry, includes the drying, thermal and oxidative degradations, can be modelled by the multi-step reactions, deepening the physical understanding on the smouldering propensity of organic soils. In order to model smouldering peat fires, a comprehensive one-dimensional model of a reactive porous media has been developed, solving the conservation equations and heterogeneous chemical reactions. The modelling results confirm the experimental smouldering thresholds, relating to the critical moisture and inorganic contents, in the literature for a wide range of peat types and organic soils. Afterwards, this model has been optimized to investigate the in-depth spread of peat fire into layers of heterogeneous profiles of moisture, mineral and density. Modelling results reveal that smouldering combustion can spread over peat layers of very high moisture (MC > 250%), and the critical moisture for extinction can be much higher than that for ignition. The predicted critical moisture values and depths of burn show a good agreement with the experimental measurements for field peat samples in the literature. This is the first time that the in-depth spread of peat fires is systemically studied based on a computational model to bridge the experimental data in the last decades, thus helping to understand this important natural and widespread phenomenon.

Wed, 16:00 – 17:00 Computational and Novel Methods for Experimental Data

16:30

Effects of relative humidity on soil water repellency and on contact angle measurements on a pre-heated soil: A laboratory approach.

Jiménez Pinilla, Patricia[1] (pjimenez@umh.es), Doerr, Stefan[2], Ahn, Sujung[2], Lozano-Guardiola, Elena[1], Mataix-Solera, Jorge[1], Arcenegui, Victoria[1], Zavala, Lorena[3], Jordán, Antonio[3]

1 University Miguel Hernández
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3 University of Sevilla

Soil water repellency (SWR) is a common feature in unburnt and particularly in fire-affected soils, and is thought to enhance the risk of runoff, erosion and mass movement. It can be affected by many factors such as soil heating, particle size moisture content and relative ambient humidity (RH). The purpose of this study was to explore how ambient relative humidity affects on SWR and on contact angle (CA) of burned soils under laboratory conditions. Soil samples were taken from under fire-prone, but long unburned *Pinus halepensis* and various shrub sites in SE Spain. In order to simulate different severities of forest fire, samples were heated for 20 minutes at different temperatures (50, 100, 150, 200, 250, 300 and 350 ºC) in a pre-heated muffle furnace. Samples were then equilibrated at different relative humidity levels (30, 50, 70 and 95%) for 48 hours in a sealed climate chamber of a constant temperature. The water drop penetration time (WDPT) test, molarity of ethanol droplet (MED) test, and contact angle (CA) measurements were performed inside the sealed climate chamber to assess SWR for each sample and treatment. The results showed that SWR increased with the heating temperature, and also with RH level. The WDPT test showed that the soils under pine were water repellent at the lowest heating temperature and became strongly water repellent at 300 °C and 350 °C (at 95% RH). Soil samples taken from a shrub land were mostly wettable at the onset and remained so at every RH level studied except being slightly water repellent for the samples burned at 250 °C and at 300 °C (at 95% RH). A similar trend was shown from the MED tests and CA measurements.

16:45

Fire effect on soil organic matter bulk and compound specific isotopes (d13C, dD, IRMS & PY-CSIA)

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The effect of a wildfire in the soil organic matter (SOM) isotopic signature was analysed in a comparative manner in fire-affected and nearby non-affected Arenosol from the Doñana National Park (Andalusia, SW Spain). The main vegetation was cork oak (*Quercus suber*) and the fire event occurred in the summer of 2012.

Carbon and hydrogen stable isotopic analysis (δ13C and δD IRMS) was done in bulk (whole soil and particle-size fractions). In addition a detailed compound specific isotopic analysis of carbon (δ13C) and hydrogen (δD) using direct pyrolysis (Py-CSIA) was also conducted in the same soil size fractions.

Heat caused SOM dD and d13C fractionation both, in the bulk soil samples and in pyrolysis released specific compounds from different biogenic origin i.e. non-specific aromatics (alkylbenzenes and alkylphenols), fatty acids, lignin-derived methoxyphenols, N-bearing compounds from peptides and polysaccharide-derived structures. Particularly informative about the passage of fire where conspicuous shifts found in the isotopic signatures of hydrocarbon series (n-alkanes) with 14 to 28 carbon atoms chain length.

The results will be discussed in relation to the meaning of the differences found in relation to SOM evolution and to the potential use of stable isotope fractionation as proxies to study the effect of fire in SOM.

Friday, 17th July

09:30 Keynote Talk: Dr Matt Davies

Ground fuels are the key to understanding peatland wildfire severity

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2 Centre for Ecology and Hydrology, UK
3 Forest Sciences Centre of Catalonia
4 University of Glasgow

Fire is an important component of temperate peatland ecosystems and managed burning can help provide a range of important ecosystem services. Wildfires, however, can have dramatic effects re-structuring ecosystems and potentially releasing large quantities of ancient carbon. Recent research has been focusing on trying to understand the step-changes that seem to occur in peatland fire. The effects of managed burns, and some wildfires, are often transient but, on some, occasions can be devastating. Intense fire behaviour in shrub and grass fuels has distracted attention from what now appears to be a critical issue – the flammability of ground fuels such as moss and peat. Increasing evidence suggests that it is the moisture content and depth of these layers that are the principle factors governing both the risk of accidental wildfires and their environmental impacts. Early results show that we can relate fuel flammability to fuel consumption and on to fire impacts on soil microclimates and carbon dynamics. Our data show that fires lead to increased average soil temperatures and diurnal soil temperature fluctuations and altered fluxes of CO_2 and CH_4. A key finding is that there is very extensive variation in severity both within and between individual fires and this has substantial implications for future field and modeling research.

11:00 – 12:15, Fire Effects on Organic Soil and Carbon Dynamics

11:00
Charring temperature drives organic soil transformations during a boreal forest fire

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The transformations soil organic matter undergoes during vegetation fires have been examined under numerous laboratory and experimental studies. However, the inferred relationships between heating and changes in organic matter characteristics have remained largely untested for wildfires due to the difficulties in obtaining pre-fire samples and in-fire temperature data. Here we study the transformations of the organic soil layer during a high-intensity experimental wildfire in a boreal forest (June 2012, NWT, Canada). We relate these transformations to the specific fire temperatures and durations recorded with thermocouples at 17 sampling points. From the initial organic soil stock (4.1±1.2 kg m^{-2}), a major fraction was not affected by the fire (2.6±0.9 kg m^{-2}), with the rest having been either transformed into a charred layer (0.4±0.2 kg m^{-2}) or completely consumed (i.e. emitted). The charred layer, which included both pyrogenic organic matter and mineral residues, had overall higher carbon concentrations and carbon:nitrogen ratios, and a greater thermal recalcitrance and aromaticity than the pre-fire organic layer. Significant positive relationships were detected between the maximum charring temperature and the carbon content and thermal recalcitrance of the charred organic soil. The implications of our findings will be discussed in a wider context considering that i) the forest floor/organic soil layer is the fuel component generally most affected by fire in boreal forests, ii) fire impacts in the boreal biome are already increasing under the current changing climate and iii) the enhanced recalcitrance of the fire-derived pyrogenic organic matter is likely to increase the residence time of the soil carbon pool.

11:15

Pyrogenic changes of soils and soil organic matter in boreal forests of the northern part of European Russia

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1 Institute of biology KomiSC UrD RAS

The Komi Republic is known as a region in the north-western part of European Russia with abundant forest resources and so was taken as a study material. In this work, we analyzed fire-covered areas in the Komi Republic, summarized data on soils from 10 plots with coniferous (spruce, pine) forests after different fire types and different time gone from fire accident (from 50 days to 16 years) with reference to corresponding background plots. Morphological pyrogenic soil signs depend on fire type, intensity and time gone after fire accident. The greatest changes occur in pine and spruce forests in case of intensive fires which fully disturb forest litter and largely destroy tree stand. In pine forests with dwarf shrubs and green mosses, forest litter is disturbed only partly. Bogged pine forests have only an upper layer of forest litter burnt away. Normally, pyrogenic soil changes are visual before depth of 20-30 cm and mean an increased content of ash, coals and pyrogenic mobile organic matter, as well as cementing illuvial horizons. There are no essential changes in total carbon stock after fires. Usually, there is an increase in carbon content in mineral soil horizons and its decrease in litters. Qualitative composition of soil organic matter undergoes more serious changes. Burning of litter and tree waste components largely transforms organic matter. In the first after-fire months, soil organic matter becomes more hydrophobic with an increased concentration of hydrophilic fractions. In several years, composition of labile organic matter is similar to that at background plots. In the first after-fire years, we observe an increased content of fire-produced organic matter that migrates down to mineral horizons. High carbon content in upper mineral horizons is related to organic matter in fractions of free and occluded organic matter. Pyrogenic soils were estimated for an increased share of carcinogenic polyaromatic hydrocarbons.

11:30

Fire as a main forming factor of a polygenetic soil in a charcoal kiln in Tuscany, Italy

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The soil of an abandoned charcoal kiln in a beech forest of Tuscany, Italy, was described, sampled, and analysed for several chemical and physico-chemical properties. The polygenetic nature of this soil was evident from simple observation of the soil profile, which revealed alternating events of charcoal and mineral soil accumulation. The occurrence of two top A horizons with different shades of black suggested two phases of charcoal production and, as a consequence, of forest exploitation, the second of which perhaps more intensive than the first one. These horizons were part of a soil sequum comprising an underlying B horizon disrupted by a thin charcoal line, most probably indicator of some major unrecorded wildfire. The whole sequum formed on colluvic parent material, maybe moved from higher locations during cold periods, when the area was virtually barren. The underlying, buried sequum was an A-B-BC sequence of horizons, where the role of fire as a soil-forming factor was less manifest.

The chemical analyses, carried out on the bulk soil showed that charcoal deeply affected the most important soil features as aggregates stability, carbon and nitrogen content, exchange cations capacity and macronutrients availability.

The bulk soil from each horizon was fractionated on a density basis by using Na-polytungstate, to obtain three different soil organic matter (SOM) pools: free SOM, SOM occluded in aggregates, and SOM strongly bonded to the mineral matrix. Each fraction was analysed for total C and N, and the charcoal content. The data so obtained were functional to reconstruct the pedogenic history of this site and to detect the interactions that charcoal had established with the mineral phase of soil.

11:45

Post-fire impacts on losses of soil organic matter and its composition in Mediterranean eucalypt stand

Faria, Silvia Regina[1] (silviaregina@ua.pt), De la Rosa, José María[2]

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Wildfires use to increase soil erosion due vegetation destruction and changes in the soil organic matter (SOM) quantity and quality. This fact is especially dramatic on Mediterranean ecosystems. Therefore, the major goal of the present study is to achieve a better understanding of the short–to mid–term effects of wildfire on topsoil organic matter (OM) quantity and quality of burnt Mediterranean eucalypt plantations in north-central Portugal (FIRECNUTS project (PTDC/AGR-CFL/104559/2008). For the present study, two neighbouring eucalypt plantations were selected; one burnt slope (EU) and unburnt slope (EB) and were instrumented with a sediment fence (SF). In both sites, topsoil samples and sediments samples were collected with roughly 6–monthly intervals, starting immediately after a wildfire in August 2010 and analyzed by Pyrolysis-gas chromatography–mass spectrometry (Py–GC/MS).

The results of this study indicated that the wildfire caused a marked impact on slope-scale sediment losses, almost 30 times higher in the burnt site than in the unburnt site over the first 25 months after the fire.

Analytical pyrolysis analyses indicate that fire also produced noticeable changes in the molecular composition of SOM. They included enrichment in: aromatic compounds, nitrogenated (N) compounds, lignin–derived compounds and polysaccharides, which probably are due to the input of charcoal and partially charred OM, ash and the decay of died plants. The thermal transformation of SOM produced the thermal breakdown and cracking of n-alkanes compounds, which were revealed by the increase in ratios of short-to-long and the alteration of the typical odd-to-even carbon predominance indexes. Specific biomarkers of vegetation and, in particular, Eucalyptus globulus, such as the terpenoids eucalyptol and globulol decreased drastically or even disappeared from the pyrolysates of burnt topsoils. These changes in OM quality between the eroded sediments and burnt topsoil were maintained during the whole 25 months studied. In general, the Py–GC/MS results pointed out that during the two subsequent years after the fire the recovery of the topsoil OM quality was practically negligible.

14:00 – 14:45, Ash Properties and Effects on Soils

14:00
Morphology and micromorphology of postpyrogenic soils in Russia

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Postpyrogenic soil formation is an interesting model of studying elementary processes of soil formation in case of extreme temperature conditions. For this reason this research is dedicated to investigation of macro-, meso- and micromorphology in the course of rehabilitation of soils which were affected by spontaneous forest fires particularly near Togljatty city (Samara region, Russia) where it has been especially difficult fire situation. Three soil plots were studied for investigation of soil morphology changes under the forest fire affect: a place of surface forest fire, a crown forest fire site and control plot. Investigated pyrogenic soils characterizes by formation of specific charcoal horizon with increased portion of postfire organic matter. The postfire soils investigated were identified as Sod sandy textured soils with weak features of eluviation. Mature soils profiles consist of АУ-АС-С horizons, while the postfire soil has АУpir layer instead of humus horizon. This horizon is different from those in mature (control) soils in chemical and physical properties and biological circle of elements. The ash in appearance is looked like a mixture of mineral soil particles, burned plant residues and small slices of dirty-gray charcoal (ash is illuviated in the mineral soil horizons).
Some years after wildfires essential changes in layer morphology, surface erosion and transportation of a burned material and a dark colored material illuviation down on a profile were quite expressed.
Mineral composition of all the soils studied is presented by quartz, feldspar (orthoclase); in case of surface forest fire there is a lot of mica (muscovite); calcium carbonates appear in case of crown forest fire. The type of plasma is humus-clay. Investigation conducted has revealed essential postfire changes in soil morphology after the intensive and catastrophic wildfires effect.

This study was a contribution to the Russian foundation for basic research, project No.14-04-32132.

14:15

Ground cover, ash colour, and fire severity assessment in the immediate period after a grassland fire in Lithuania

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The objective of this work was to study the mobility of ash by measuring the changes in ash colour after a grassland fire in Lithuania on two slopes with different aspects, an east-facing (slope A) and west-facing (slope B), 3 and 10 days after a the fire, before the first rainfall. Ash colour was measured at 404 sample points in each plot per sampling date using the Munsell colour chart. Fire severity was assessed by assigning a value to each sample according to the colour of the litter or ash. Values were brownish litter (0), black ash (1), dark grey ash (3), light grey ash (5), white ash (7) and bare soil (9). The results showed that 3 days after the fire on slope A, the majority of the area was covered by black ash (50%), followed by dark grey ash (16%), brownish litter (13%), light grey ash (11%) and white ash and bare soil (5%). On slope B, black ash (48%) was the most common, followed by dark and light grey ash (17%), brownish litter (9%), white ash (7%) and bare soil (1%). Ten days after the fire, on slope A only areas with black ash (58%), brownish litter (30%) and bare soil (12%) were identified. The same pattern was observed on slope B. Black ash (57%) covered the majority of the plot followed by brownish litter (32%) and bare soil (11%). These results are evidence that during the study period dark grey, light grey and white ash were transported by the wind and (re)distributed and mixed. Another key point is that the proportion of the area covered by brownish litter increased. These unburned patches are an important protective ground cover in areas affected by fire. The proportion of bare soil also increased, leaving the soil unprotected in those patches. Three days after the fire, according to the proportions of ash colour, the severity was significantly higher ($p<0.001$) on slope B (2.47±2.16) than on slope A (2.47±2.16). Ten days after no significant differences ($p>0.05$) were observed between slope A (1.67±2.77) and B (1.57±2.67). On both slopes, fire severity was significantly ($p<0.001$) higher 3 days compared to 10 days after the fire.

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The sensitivity of glomalin to the presence of ash after a wildfire

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Glomalin Related Soil Protein (GRSP) is a glycoprotein (known as Glomalin) produced by Arbuscular Mycorrhizal Fungi (AMF). Pools of GRSP are sensitive, even in the short-term, to ecosystem perturbations such as warming and agricultural management practices. In this study the sensitivity of GRSP to the presence of ash after a wildfire has been tested. The study was carried out in Gorga (Alicante, Spain). The area was affected by a wildfire (48 ha.) in July 2011. Immediately after the fire, plots of 2x1 m (n=9) under Pinus halepensis canopies were installed to control the evolution of different soil properties in the burnt area. Three different treatments after the wildfire have been tested: 1) ash layer was kept intact over soil surface (BC), 2) ash layer was removed from soil (simulating a strong wind erosion (BwA) and 3) an initial water entry into soil profile (10 l/m^2) simulating a rainfall that favours a better incorporation of ash into the soil profile, (BR). GRSP concentrations were measured immediately after fire and a year later. GRSP measured was the easily extractable glomalin. The lowest concentrations in 2012 soil sampling were obtained in the BwA plots. ANOVA-test showed significant differences between BwA and the other two treatments. No significant differences were found between BR and BC. Results suggest that the presence of ashes in soil influences the GRSP stocks. GRSP mineralization could be higher in the absence of ash. Ash not only supplies soil with mineral nutrients but also with semipirolized organic material, which is easier to degrade than GRSP. In fact, significant correlations with Soil Organic Matter were found precisely in the BwA treatment (r= 0.801*). The presence of ash would help to restore the soil microbial community (including AMF) and in turn to maintain the GRSP production (AMF activity). These results indicate that GRSP is sensitive to soil conditions after wildfires and thus, it could be useful as an indicator of the recovery.

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