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Mid-latitude forest ecosystems have been proposed as a "missing sink"today. The role of soils (including wetlands) in this proposed sink is a very important unknown. In order to make estimates of future climate change effects on carbon storage, we can examine past wetland carbon sequestration. How did past climate change affect net wetland carbon storage? We present long-term data from existing wetland sites used for paleoclimate reconstruction to assess the net carbon storage in wetland over the last 15,000 years. During times of colder and wetter climate, many mid-latitude sites show increases in carbon storage, while past warmer, drier climates produced decreases in storage. Comparisons among bog, fen, swamp, and tidal marsh are demonstrated for the Hudson Valley region.

B51C-10 1115h

On Farm Management and its Effect on Carbon Sequestration

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The interest in carbon sequestration in soils is increasing and how different farm management practices affect carbon is of interest to farmers and land managers. Much of the work in the past has been done on experimental plots and not in fields with the management found on producing or working farms. This work reports on studies on farms under normal management and not on research plots. Sites were studied in the grasslands of the central U.S. that were converted to CRP to look at the effect of various management practices on soil carbon. The effects of no-till were evaluated under a variety of management regimes in several different climatic zones. Native, no-till and conventional tilled sites on the same soil series were sampled in Ohio (long term no-till), Nebraska (irrigated fields) and Kansas (hog manure application both dryland and irrigated). Soils were sampled in 2-meter deep pits and laboratory measurements were made of the chemical and physical properties of the soil. Aggregate stability was one of the measured properties that was indicative of a improved soil structure and it clearly demonstrates that the aggregate stability improved rapidly under both CRP and also when no-till was used.

B51C-11 1130h

The Impact of Disturbance on Carbon Source and Sinks in Colorado Ecosystems

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During the past several decades, focus on terrestrial carbon sinks has been associated with forest regrowth and soil sequestration. The recent fire in the west (2000-2002) raises the question of what are the net losses of carbon due to combustion losses, and the effect on the net biome carbon balance between fire events. Analysis of fire return intervals and changes in net ecosystem exchange during the succeeding years to evaluate the net uptake of carbon over these episodes of fire disturbances. Comparison of the forest net carbon exchange will be compared to agricultural soil sequestration to compare the net sink potentials and the implications of disturbance and agricultural management regimes. We will be making these assessments using a modified version of the DayCent model. This model allows us to combine the slow responses of earth system components associated with forest growth and soil organic matter development with the fast processes associated with daily and diurnal scales. The role of land management, agricultural prior disturbance and land use history, nutrient limitation, chronic and acute stress all feature prominently as mechanisms in recent US-wide estimates of carbon fluxes.

B51C-12 1145h

Effects of soil thermal dynamics on carbon cycling in extratropical terrestrial ecosystems of the Northern Hemisphere

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Evidence from a variety of analyses and sources confirms that the terrestrial biosphere became a larger carbon sink in the 1990s as compared to the 1980s. This recent sink can be largely attributed to the Northern extratropical areas (30oN 90oN), roughly split between North America and Eurasia. However, there are considerable uncertainties as to the magnitude of the sink in different regions and the contribution of different mechanisms. Here we used the Terrestrial Ecosystem Model (TEM 5.0) to estimate the influence of soil thermal dynamics, including permafrost dynamics, on carbon storage in the Northern extratropics by coupling the simulation of TEM with a Model of Atmosphere Transport Chemistry (MATCH), we found that the simulated seasonal atmospheric CO2 concentrations match both the amplitude and timing of the observations at the monitoring stations of NOAA/CMDL network. We found that the TEM simulations generally captured the greening trend in the Northern extratropics as found by remote sensing data. We estimated that only 0.55 and 0.90 Pg C yr-1 were stored in Northern extratropical ecosystems during the 1980s and the early 1990s, respectively. These values are lower than comparable estimates from inverse model calculations, remote sensing and forest inventory data. In the 1980s, this storage was almost equally distributed between North America and Eurasia. However, in the early 1990s, carbon sequestration was striking different with 0.27 and 0.63 P g C yr-1 stored in North America and Eurasia, respectively. Overall, the study suggested that, in addition to the soil thermal dynamics, other mechanisms, such as nitrogen deposition, air pollution, might also be responsible for these regional differences of terrestrial carbon storage in the Northern extratropics.

B52A MCC: Hall C Friday 1330h

Mechanisms of Carbon Stabilization and Loss in Soils II Posters *(joint with GC)*

Presiding: **J Harden,** U.S. Geological Survey**; K O'Neill,** USDA Forest Service

B52A-0730 1330h POSTER

Nitrogen Retention by Buried Coarse Woody Debris in Lowland Coniferous Forests of Olympic National Park, Washington

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The N retention mechanisms and capacities of old-growth forests are poorly understood and generally underestimated. We characterized the types of immobilization abiotic vs. microbial that occur during the winter in soils of an old-growth coniferous forest on the western Olympic Peninsula, Washington. In addition, we investigated the effect of substrate type on N-retention capacity and efficiency. Large carbon accumulations in old-growth forests, in the form of a thick forest floor and buried coarse woody debris (BCWD), can provide a significant energy source for microbial utilization and may provide a buffer against N saturation by creating zones where the microbial community is N limited. In the forest studied, BWCD was nearly 15% of the total soil volume. Buried coarse woody debris was chemically and physically distinct from fine litter and mineral soil and may be different from surface coarse woody debris. Despite this, BCWD is customarily excluded from studies of soil N cycling. In this study, BCWD was a significant sink for added inorganic N under cold temperatures, and the microbial community in BCWD utilized C and N in different ratios than in either mineral soil or fine litter.

B52A-0731 1330h POSTER

The Potential use of Soil-C Isotope Analyses to Evaluate Paleoclimate

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Soil profiles were sampled by horizon to about 2m depth from 12 native grassland sites extending along and across the US Great Plains. Ring samples of aboveground plant material were clipped and related to their own and to the 13C and 12C isotope ratios (expressed as delta 13C) of the soil organic carbon (SOC) for present-day frigid, mesic, and thermic soil temperature regime soils. We make the assumptions that: (1) the delta 13C of SOC with horizon age (using 14C dating) was directly related to the mixture of warm and cool season plants growing during the prehistoric time period during which that earlier SOC was sequestered, and (2) the ratio of warm to cool season species that existed prehistorically was related to soil temperature regimes in the same way that we observed for the present time. Carbon isotope analyses, determined by soil horizon, were evaluate by their 13C and 12C ratios to determine the possible temperature regimes that may have existed with increasing 14C ages ranging back to as long 13 thousand years before present (YBP) for each native grassland site. These data indicate that, especially within the present day mesic temperature zone, much cooler soil temperature regimes existed 8 to 12 thousand YBP, but had warmed by 2 thousand YBP. Also, older and younger soil horizons may have been intermixed during prehistoric times by soil erosion and deposition processes at several locations including in MT, MN, and TX.

B52A-0732 1330h POSTER

The Role of Woody Debris in Boreal Forest Carbon Sequestration

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Boreal regions contain 30-40% of the global terrestrial carbon, the majority of which is found within organic and mineral soil horizons. High plant production rates, low annual temperatures, and high moisture regimes contribute to this long-term carbon storage. Fire also plays a key role in regulating this system's carbon dynamics, by altering both carbon loss (e.g., fire emissions, changes in respiration rates) and carbon sequestration (by providing large amounts of material that can be transferred into long-term carbon storage). One important source of this material is fire-killed trees, or woody debris. Long-term soil carbon models have shown woody debris to be an important term for understanding a boreal forest's carbon budget. To better quantify this term, we have inventoried the amount of woody debris within two fire-killed, black spruce (*Picea mariana* (Mill.) BSP) chronosequences. One set of sites, located in central Alaska, is predominately located within well-drained ecosystems. Our second location, Manitoba, Canada, has plots within both well- and poorly-drained landscapes. Our data will be used to estimate the amount of woody debris (kg/ha) in these forests and its rate of decay. These data will also be used to parameterize a mass-balance model of carbon dynamics and test the sensitivity of long-term soil carbon storage to inputs from woody debris. Results will be used to examine transfers between above- and below-ground carbon, factors that control this transfer, and the impact of climate change on this important source of soil carbon.

B52A-0733 1330h POSTER

Initial Decomposition and Humification Dynamics of Ponderosa Pine Fine Roots and Needles

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To understand the influence of litter chemistry and microclimate on the long-term stabilization of plant inputs, it is essential to better understand biological and chemical regulation of the conversion of litter to stable soil organic matter (SOM). We present first-year results from a 3-year field study examining the fate of 13C- and 15N- labeled Pinus ponderosa in an 80-year-old conifer forest in the Sierra Nevada, CA on an Ultic Haploxeralf. Our objectives are to assess the effects of litter type (fine roots vs. needles) and substrate placement depth (O vs. A horizon) on rates of C and N mineralization, immobilization into microbial biomass and specific microbial groups, and stabilization into SOM fractions. Data will be presented on recovery of 13C and 15N in soil microbial, mineral and SOM fractions after 152 d and C respiration over the initial 300 d. In situ litter decomposition, as estimated by 13C respiration, of needles exceeded that of roots by 270% at 61 d, by 140% at 152 d and was similar for the two substrates at 221 d. Comparing the effect of soil depth, pine needles had greater 13C respiration in the O horizon than in the A horizon through 152 d, while the rate of fine root decay was not significantly different between soil depths through 221 d.

B52A-0734 1330h POSTER

Radiocarbon of Respired CO_2 Following Fire in Alaskan Boreal Forest: Can Disturbance Release Old Soil Carbon to the Atmosphere?

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Fire in the boreal forest releases carbon stored in vegetation and soil to the atmosphere. Following fire, microbial decomposition is stimulated by inputs of plant detritus and changes in soil microclimate, which can result in large losses of carbon. Furthermore, warmer summer soil temperatures and deeper thaw depths in burned ecosystems may make carbon that was previously climatically protected by low soil temperatures susceptible to decomposition. We used radiocarbon measurements to estimate the age of carbon released by soil respiration following fire in two black spruce (Picea mariana) forests in interior Alaska that burned during the summer of 1999. To isolate soil respiration, we established manipulated plots where vegetation was prevented from recolonizing, and paired control plots in nearby unburned forest. Soil respiration radiocarbon signatures in the burned manipulation ranged from $+112^{o}/_{oo}$to $+192^{o}/_{oo}$and differed significantly from the unburned controls that ranged from $+100^{o}/_{oo}$to $+130^{o}/_{oo}$. Burned plots appear to respire older carbon than unburned forest, which could either be due to the stimulation of decomposition of intermediate age soil organic matter pools, to the lack of plant respiration that reflects the atmospheric radiocarbon signature of $+92^{o}/_{oo}$, or both. At least during the initial phase following fire, these data suggest that carbon fluxes from soil are dominated by soil organic matter pools with decadal scale turnover times.

B52A-0735 1330h POSTER

The dynamics of DOC in the hydrological process in a forested watershed in Japan

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This study clarified the dynamics of dissolved organic carbon (DOC) in several elemental hydrological processes in a drainage system in the Kiryu Experimental Watershed, in central Japan. The DOC concentration and the UV absorbance:DOC ratio were measured along the flow path from precipitation to stream water via soil solution and groundwater, and both decreased with depth. There was vertical variation in the rate of decrease in the DOC concentration, which we postulated to result from two different mechanisms in the infiltration process. In the upper mineral soil layer, the relationships between DOC and Al and Fe indicated that organically complexed Al and Fe contributed to decreasing the DOC concentration. In the lower mineral soil layer, no significant fluctuation in DOC concentration was found, although the DOC adsorption efficiency seemed to be homogeneous from the upper to lower soil layers. These results indicated that the easily adsorbed DOC fraction had been removed, and that decomposition contributed to decreasing the DOC concentration in the lower mineral soil layer. Based on these findings, we compared the DOC removal rate with other formed C (soil C, dissolved inorganic carbon (DIC), and CO2 gas) in soil. In the upper mineral soil layer, only 0.8% of soil C was retained from DOC annually. In the lower mineral soil layer, only 6.7% of the total production of inorganic C (DIC and CO2 gas) was derived from DOC. We concluded that the DOC removal rate was much smaller than the soil C storage or DIC and CO2 gas production rates, but 11% of the net ecosystem production (NEP) was stored in soil via the dissolved form, suggesting that the DOC dynamics are not negligible when considering soil C storage in forest ecosystems.

B52A-0736 1330h POSTER

Quantification of Soil Organic Carbon Using Mid- and Near-DRIFT Spectroscopy

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New, rapid techniques to quantify different pools of soil organic matter (SOM) are needed to improve our understanding of the dynamics and spatio-temporal variability of SOM in terrestrial ecosystems. In this study, total organic carbon (TOC) and oxidizable organic-carbon (OC) fraction were predicted by mid- and near-IR spectroscopy in combination with partial least squares (PLS) regression. Oxidizable organic-carbon content was also quantified by a modified Walkley-Black method, and total organic carbon was measured by carbon analyzer. The TOC and OC was quantified using mid- and near-IR spectroscopy for a floodplain, forest soil and a Blackland Prairie soil. The floodplain soil is mainly composed of quartz and kaolinite, whereas Blackland Prairie soils contain high concentrations of smectitic clays and low to high concentrations of carbonate minerals. The total organic carbon of 68 soil samples from two Texas sites varied between 1.9 and 43.6 g kg-1 C, and the oxidizable organic carbon of 26 samples from floodplain soils was in the range of 0.5 to 13.3 g kg-1 C. TOC and OC of soil were successfully calibrated and predicted by the PLS regression method using mid- and near-IR spectroscopy. The correlation using mid-IR spectra for TOC (r = 0.96, RMSEV = 0.32 for calibration; r = 0.93, RMSEP = 0.44 for prediction) was about the same as the near-IR result (r = 0.95, RMSEV = 0.37; r = 0.93, RMSEP = 0.42). PLS1 regression model for quantification of OC with mid-IR region (r =0.97, RMSEV = 0.08; r = 0.92, RMSEP = 0.12) was slightly better than the result with near-IR region spectra (r = 0.95, RMSEV = 0.10; r = 0.90, RMSEP = 0.14). PLS model with spectral data showed better correlation than the univariate least square regression method (r = 0.88, RMSEC: 0.15; r = 0.83, RMSEP = 0.18) with TOC measured by the carbon analyzer. This study shows that the partial least squares method using mid- and near-IR spectra of neat soil samples can be used to predict both total organic carbon and oxidizable organic-carbon fraction as a fast and routine quantitative method.

B

B52A-0737 1330h POSTER

Springtime Transition in CO_2 and Total Hydrocarbon Exchange of a Subarctic Mire

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Net ecosystem exchange of CO_2 and total hydrocarbons (HC) was measured with automated clear static chambers during the thaw period of the Stordalen Mire, a peatland complex in northwest Sweden (68^{o}20 N, 19^{o}02 E) whose microtopography and surface hydrology is largely determined by underlying discontinuous permafrost. Collapse and drainage areas are more minerotrophic than the higher, well drained palsa-like features. Each type supports a distinct biological community structure. Data from a high dry ombrotrophic site (dry) and a wetter lower mesic site (wet) are compared.

There was a slow but steady daily efflux of both gases during the frozen period as spring advanced and a diurnal variation in CO_2 exchange was observed from the beginning. The diurnal range abruptly increased on day 110 when surface temperatures at all of the chambers changed from frozen to melted conditions. Effluxes of both CO_2 and HC were enhanced for a period of 5 days after the principal thaw day most notably in the HC flux from the wet sites (24.0 to 34.6 mg CH_4 m^{-2} d^{-1}) and the CO_2 flux from the dry site (as high as 1.2 μmols CO_2 m^{-2} d^{-1}). The daily minimum in the CO_2 exchange was higher in all sites compared to prior and post periods perhaps due to degassing rather than increased respiration.

There was a consistent, weak emission of CO_2 of 0.01 to 0.12 μmols CO_2 m^{-2} d^{-1} during the late frozen period from both sites. Diurnal cycles as large as 0.71 to -0.21 (dry) and 0.41 to -0.25 (wet) were observed. Uptake occurred during the day at all sites and daily minima tended to be lowest in the wet sites indicating biological uptake even during cold, snow covered periods. Emissions of HC were greater than 95% CH_4 and were observed throughout the frozen period. Daily averaged effluxes from the wet sites (7.2 to 14.6 mg HC as CH_4 m^{-2} d^{-1}) were an order of magnitude greater than those from the dry sites (0.6 to 2.1 mg HC as CH_4 m^{-2} d^{-1}).

After the thaw, daily CO_2 fluxes in both sites fell to values near zero and below as the plants started to grow. At the same time the daily range in the fluxes increased. HC fluxes on the other hand, fell slightly in the wet sites to steady daily averages around 15. In the dry sites, HC fluxes dropped to rates near 1.0 mg m^{-2} d^{-1}.

By the end of the observation period of 62 days, the wet sites had accumulated 310 mg C m^{-2} and had lost 620 mg C m^{-2} as HCs. The dry sites lost 3900 mg C m^{-2} of which 45 mg C m^{-2} was HCs. Most of the dry site emission was during the thaw because between day

117 and 145 the vegetation in the dry site had accumulated about 1000 mg C m^{-2}. High temporal density in sampling specific subhabitats using automated systems is required to determine differences in the exchange dynamics of CO_2 and CH_4 (measured here as HC) as the mire melts.

B52A-0738 1330h POSTER

Carbon Accumulation and Storage in Mineral Subsoil Beneath Peat

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It is well established that northern peatlands contain large amounts (>50 kg m-2) of organic C in the surface organic layers. Analysis of the mineral subsoil beneath peatlands in Finland revealed that they contain an average of 6 kg C m-2, 50% more than in adjacent forest upland soils. We examined the properties of sandy soils beneath upland forest and paludified peatland in Lakkasuo, Finland and Ramsey Lake, Michigan. Upland mineral soils contained an average of 3.3 kg C m-2, and the peatland mineral soils 7.0 kg C m-2. The extractable Fe in the upland soils was lost beneath the peat, whereas the extractable Al was retained. C content was strongly related to extractable Al content. A DOC sorption experiment showed that null-point concentration was higher in the peat subsoils than in the upland soils and correlated with extractable Al and C content, suggesting that the sorption capacity is being reached. We suggest that the mineral subsoil beneath peatlands is a significant sink of C, arising from the paludification of upland podzol soils, the loss of Fe under reducing conditions and the sorption of peat-water DOC on Al, with its preservation under anoxic conditions.

B52A-0739 1330h POSTER

Greenhouse Gas Fluxes from a Semi-Arid Riparian Soil Experiencing Extremes in Moisture Input

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We are studying environmental influences on soil fluxes of greenhouse gases (CO_2, N_2O and CH_4) in vegetation communities along the San Pedro River Riparian Area in southeastern Arizona. Precipitation in this semi-arid area averages 300mm per year, 60% currently falls in the monsoon season of July-September. Vegetation types being studied are: mesquite (*Prosopis* spp.), an invasive N-fixing legume; and grassland sites without mesquite, the first dominated by sacaton (*Sporobolus* spp.), a coarse perennial grass; and the second by annual grasses and forbs. Preliminary analysis prior to the 2002 monsoon rains showed that trace gas fluxes were negligible at all three sites. Since the first pulses of monsoon moisture in July 2002, nitrous oxide emissions from the mesquite soils (1.0 μmol m^{-2} day^{-1}) average 2-5 times higher than in either of the grassland areas. Nitrous oxide emissions were strongly correlated (r = 0.99) with pre-monsoon nitrate-N contents, which were 8-10 times higher in the mesquite soils. Nitrous oxide emissions were also positively correlated with soil moisture content and soil temperature. The average soil CH_4 consumption in the annual grassland (-3.5 μmol m^{-2} day^{-1}) was twice that of the mesquite and sacaton soils. CO_2 emissions were highly variable, but averages are consistent between the three sites. This work, when coupled with C and N inventories of the plants, soils and the delta ^{13}C isotope ratio of the CO_2 respired, will help determine the impact of semi-arid ecosystems on potential climate change.

B52A-0740 1330h POSTER

Interactive effects of nitrogen deposition and insect herbivory on carbon and nitrogen dynamics: Results from CENTURY

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The direct effects of nitrogen deposition on nutrient availability in ecosystems have been well studied, however, little is known about the indirect effects of nitrogen deposition on insect herbivory and subsequent changes to ecosystem processes. Numerous empirical studies have demonstrated that host plant nitrogen concentration can strongly affect individual insect consumption rates and population dynamics. We used the CENTURY ecosystem model to explore how interactions between nitrogen deposition and insect herbivory might affect plant production and the pools and fluxes of carbon and nitrogen in an old field community. We modified the preexisting CENTURY mammalian grazing functions to reflect patterns of insect herbivory. Vegetative tissue loss to herbivores was modeled as a dynamic function based on the carbon to nitrogen ratio of aboveground vegetation. Parameterization of the plant response to nitrogen and herbivory was based on field data collected on *Ambrosia artemisiifolia* (common ragweed, Asteraceae). The modeled response to nitrogen deposition included a strong increase in plant production, decreased plant C:N ratios, and increased soil organic carbon pools. Insect herbivory alone generally caused depressed aboveground production, decreased soil organic carbon pools, and decreased nitrogen mineralization rates. These relationships broke down, however, under moderate nitrogen deposition loads (over 30 kg N ha^{-1} yr^{-1}) in simulations where insect herbivory increased in response to declining plant C:N. In these cases, herbivory acted to depress the positive influence of nitrogen deposition on carbon storage in soil and vegetative pools and caused strong increases in nitrogen mineralization rates. The results of these simulations suggest that herbivory may play an increasingly important role in affecting ecosystem processes under conditions of high nitrogen deposition. Including effects of herbivory in ecosystem analyses, particularly in systems where rates of herbivory are high and linked to plant C:N, may be important in generating accurate predictions of the effects of atmospheric nitrogen deposition on ecosystem carbon storage.

B52A-0741 1330h POSTER

Elevated CO2 and Soil Nitrogen Cycling

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Although forests can be large terrestrial carbon sinks, soil fertility can limit carbon sequestration in response to increased atmospheric CO_2. During five years of CO_2 fertilization (ambient + 200ppm) at the Duke Free-Air CO_2 Enrichment (FACE) site, net primary production increased significantly by an average of 25% in treatment plots. Total nitrogen in the foliar canopy increased by 16%, requiring an additional 1.3 g N $m^{-2} yr^{-1}$ to be taken up from soils under elevated CO_2. Mechanisms supporting increased nitrogen acquisition have not been identified. Here we report on biological N-fixation rates, using the acetylene reduction assay, in litter and mineral soil during three years of the CO_2 enrichment experiment. Lack of a significant CO_2 treatment effect on acetylene reduction indicates that carbon is not directly limiting biological N fixation. Nutrient addition experiments using a complete block design with glucose, Fe, Mo and P indicate biological N fixation is co-limited by molybdenum and carbon. These results suggest even if elevated atmospheric CO_2 enhances below-ground carbon availability via root exudation, biological nitrogen fixation may not be stimulated due to micronutrient limitations. Assessment of future carbon sequestration by forest stands must consider limitations imposed by site fertility, including micronutrients.

B52A-0742 1330h POSTER

Recycled Graphitic Carbon: Presence and Distribution off the Washington Coast

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We applied stable carbon isotope and radiocarbon analyses to graphitic black carbon (GBC) and peroxide-resistant carbon (PRC) fractions isolated from ocean sediments from a transect off the Washington Coast. Concentrations of GBC ranged from 0.0136-0.0773 weight % and 0.99-6.53% of total organic carbon (TOC), with concentrations increasing roughly linearly with distance offshore. PRC concentrations were of a similar magnitude, between 0.0196-0.0865 weight % and 0.80-4.12% of TOC, and showed a similar trend. Deposition rates of both GBC and PRC decreased with increasing distance offshore, indicating a predominantly terrestrial source. $\delta^{13}C$ values for the GBC fraction cluster between -19.4$^o/_{oo}$ and -21.3$^o/_{oo}$, and PRC values are between -19.8$^o/_{oo}$ and -23.0$^o/_{oo}$. All of these values fall roughly in the range of marine plankton. Age-corrected $\Delta^{14}C$ values range from -893.8$^o/_{oo}$ to -989.1$^o/_{oo}$ for GBC and -496.9$^o/_{oo}$ and -953.2$^o/_{oo}$ for PRC, with the most enriched values nearshore. These numbers correspond to radiocarbon ages of up to 37,000 years. These extreme values suggest that the GBC and PRC fractions consist almost entirely of radiocarbon-dead fossil carbon. Because the preparation method for GBC isolates only very graphitic material, and sediment horizons were deep enough to avoid the presence of fossil fuel-derived soot, we conclude that the GBC fraction is dominated by petrogenic graphite in the sediments off the Washington Coast. This conclusion is consistent with a terrestrial source and both sets of isotopic values (graphite may have a wide range of $\delta^{13}C$ values). The PRC method isolates kerogen as well as graphitic materials, so the PRC fraction may consist of both petrogenic graphite and kerogen.

It appears that some fraction of the terrestrial graphite pool is weathered from rocks, carried to the ocean and deposited in sediment without significant chemical alteration, amounting to a closed loop in the carbon cycle. Additionally, a considerable fraction of sedimentary carbon is radiocarbon-dead graphitic carbon, which could significantly affect radiocarbon measurements of both bulk and non-hydrolyzable organic carbon. Finally, reports of black carbon concentrations and fluxes in open-ocean sediments may have included petrogenic graphite in addition to combustion-derived black carbon (BC), leading to overestimates of BC derived from biomass burning.

B52A-0743 1330h POSTER

Sensitivity of Soil Carbon Stock Estimates to Soil Spatial Patterns

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Detailed soil characterization databases, which record the results of sampling soil pedons in the field, represent a basis for computing soil organic carbon stocks, and modeling how soil carbon fluxes may change in response to disturbance. The pedon data may be used in conjunction with digital soil maps to compute the total carbon stocks on the landscape. For the Arctic Slope of Alaska, north of the Brooks Range, we estimate a stock of 7.87 Pg C on a land area of 138,447 km^2, for an average of 56,842 g C m^{-2}, using the total soil profile. We illustrate the elements of the carbon calculation for each horizon in a pedon, and compute the carbon contents to 30 cm and 100 cm depths, for the active layer, the permafrost layers, and the organic layers. We show the sensitivity of the carbon stock estimates to the method of spatial linkage, and illustrate the contribution of each pedon to the areal estimate. This may provide guidance for where additional soil sampling would be most desirable for improving the estimates.

B52A-0744 1330h POSTER

Respiration and Dissolved Organic Carbon Dynamics in an Area Undergoing Permafrost Degradation

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Permafrost degradation in Tanana Flats, Fairbanks, AK has resulted in the conversion of paper birch (Betula papyrifera) and black spruce (Picea mariana) forests to fens and bogs. Increased organic matter accumulation in the wetlands has been documented, but effects of the shift from forests to wetlands on carbon cycle processes have been largely unexplored. Soils were collected from 10-25 cm from four different landscape types within Tanana Flats to investigate respiration rates and dissolved organic carbon (DOC) quantity and quality. The sites included a bog (B-Bog) and a fen (B-Fen) that were formerly birch forest, a black spruce forest with permafrost (S-Forest), and a bog (S-Bog) within the black spruce forest. Soils were incubated at field moisture for 11 weeks at 5°C and 17°C. Respiration was measured five times during the incubation period. Twenty-four hours after each respiration measurement, soils were saturated with water (50 ml) and allowed to drain for one hour. The water was filtered and analyzed for DOC concentration and ultraviolet (UV) absorbance at 254 nm. Respiration generally decreased with time for all soils, and the relative rates of respiration (normalized for grams soil) followed the pattern: S-Bog<B-Bog<S-Forest<B-Fen, at both temperatures. Respiration rates were approximately two times greater at 17°C than 5°C for all soils. Soil leachate DOC concentrations generally decreased with time, and specific UV absorbance (SUVA; absorbance/DOC concentration) generally increased with time for all soils. DOC concentrations were not significantly different at the two temperatures. DOC concentrations (normalized for grams soil) generally followed the pattern: B-Fen<S-Bog<B-Bog<S-Forest at both temperatures. SUVA, an indicator of DOC aromatic carbon content, exhibited the opposite trend. Strong positive linear relationships between respiration and DOC concentration were exhibited for all soils at 17°C (R^2=0.61 to 0.99), but only for B-Fen at 5°C. The slopes were nearly identical for B-Fen and B-Bog (0.69, 0.66) and similar for S-Forest and S-Bog (0.22, 0.34). Respiration from the bog and fen soils at 17°C was negatively correlated with DOC SUVA (R^2=0.72 to 0.92), and again the slopes for B-Fen and B-bog were identical (-287). These results indicate that DOC is an important source for microbial activity in the black spruce forest and the collapse wetlands, and that the relationship between soil respiration and DOC is retained to some extent when a forest becomes a wetland due to permafrost melting.

B52A-0745 1330h POSTER

Carbon and Nitrogen Cycling in Land-use Systems Experiencing Extremes in Moisture Inputs

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Changes in the C and N cycling are pronounced when an invasive legume species such as mesquite (Prosopis spp.) inputs N into a previously N limited grassland or riparian area. This work documents vegetation inputs and soil C and N inventories from different vegetation communities in a semi-arid environment in southeastern Arizona. The C and N balance of the mesquite C and N litter input into sacaton (Sporobolus spp.) grasslands includes analyzing the different plant tissues for C and N content and isotope signatures, and documentation of the carbohydrates, amino acids, phenolic acids, lipid and lignin composition and content. The litter horizon and the soil to a depth of 60 cm under the different vegetation were also analyzed in a similar manner. Mesquite invasion into grasslands resulted in input of mesquite N that impacted soil C content, C isotope values and carbohydrate and amino acid content compared with noninvaded grasslands. The yearly pulse of mesquite N to the grassland increased grass productivity per bunch from 148 g (n = 3) in an isolated noninvaded grassland to 550 g (n = 3) in grasses in the understory of mesquite community. Cool season litter (2.9% N) collection (October 2001 to March 2002) recovered of 66 g mesquite C and 4.5 g mesquite N m^{-2}. The litter input was correlated with tree size (r = 0.94) and when compared with the litter remaining in the understory, approximately 3 to 8 years of plant litter remained on the soil surface. Soil cores were removed from within the riparian mesquite community, returned to the lab and incubated at constant moisture potentials, determined CO2-C was linearly respired for up to 80 d. The disconnect between litter fall and moisture conditions present in the ecosystem allows the build-up of high quality plant litter in the ecosystem understory. Measurement of the surface litter amounts present in the different riparian plant communities found under mesquite-grass vegetation about 750 g litter m^{-2}, under mesquite about 598 g litter m^{-2} and in an open area dominated by annuals and forbs about 160 g litter m^{-2}. Increased net plant productivity in mesquite-populated sites compared to grasslands can result in higher soil C and N contents in the litter and surface soil.

B52A-0746 1330h POSTER

Assessing Methyl Bromide Flux in a Freshwater Peatland

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Freshwater peatlands are a source of atmospheric methyl bromide (CH_3Br), the most abundant bromine containing gas in the troposphere and a significant ozone depleting substance in the stratosphere. Previous measurements made by our laboratory indicate that peatlands release approximately 4.6 Gg of CH_3Br per year. Factors that control the variability and magnitude of this net flux are not fully known, however. Measurements of CH_3Br surface-atmosphere exchange in a New Hampshire peatland using static enclosures indicate a correlation between CH_3Br emission and water level and temperature . Net fluxes for 1998-2000 ranged from -42 nmol/m^2/day to 40 nmol/m^2/day (negative values indicate CH_3Br consumption). Concentration profiles within these chambers over the sampling time show an initial increase in CH_3Br followed by a decrease. This suggests that static enclosures may alter surface-exchange conditions and result in underestimates of net flux in these ecosystems. We describe the development of a clear dynamic chamber sampling system to more accurately determine net CH_3Br flux. Net fluxes measured with these enclosures range from -10 nmol/m^2/day to 46 nmol/m^2/day. This system is currently being applied in a vegetation study to determine the effect of plants on peatland CH_3Br exchange.

B52A-0747 1330h POSTER

Investigating Soil Carbon Dynamics Using N-15

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The carbon and nitrogen cycles in soil are intimately linked. Past research has often focused on using carbon-to-nitrogen ratios as directors of them ineralization-immobilization reaction of both elements. This close relationship is useful for researchers studying the carbon cycle, because detectable changes in the size of stored carbon pools are often slow to occur and difficult to detect. Nitrogen, in contrast, cycles quickly in soils and has at least three easily monitored pools, total nitrogen,ammonium-nitrogen, and nitrate-nitrogen. The N-15 pool dilution technique,entails the application of small quantities of highly enriched mineral sources of N-15 (from potassium nitrate or ammonium sulphate) to known volumes of soil and 24 h later the dilution of the applied N-15 with the more prevalent N-14 is measured. This procedure was conducted in three plots of a tallgrass prairie restoration chronosequence (farmland restored to tallgrass prairie in 1979, farmland restored to prairie in 1993, and farmland still in production with row crops) and in two loblolly pine plantation research plots (fertilized and never fertilized). At the prairie site, the farmed soil had significantly higher rates of all transformations(mineralization, ammonium consumption, nitrification, nitrate consumption)than did the restored prairies. We were able to use these nitrogen transformation rates to calculate estimates of C dynamics in these soils. For example, we estimate that the microbial biomass turnover rate in the non-fertilized loblolly pine soil was 44 d, but in the fertilized plot it was 9 d. We also interrogate these rates with other data collected on the soils to estimate the amount of C that could potentially be lost from or stored in these soils under the conditions investigated

B52A-0748 1330h POSTER

Oxygen Effects on Carbon Trace Gas Production in Wet, Tropical Forest Soils

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The flux and carbon isotope composition of CH_4 emitted from wet tropical forests are strongly affected by fluctuations in redox conditions. Quantifying these effects is crucial for evaluating the role that tropical environments play in the global CH_4 budget. This study explores the effects of soil O_2 variations on the balance between methanogenesis, methane oxidation and the $\delta^{13}C$ value of the CH_4 emitted to the atmosphere across natural gradients of soil O_2 in the Luquillo Experimental Forest in Puerto Rico. Sources and sinks of CH_4 in both the soil profile and across the landscape were identified through the analyses of soil gas concentrations, flux rates and stable isotope distributions. Above atmospheric concentrations of CH_4 were measured at depths of >40 cm in all plots, while near-atmospheric or below atmospheric levels of CH_4 were observed in the 0-15 cm depth. Increases in soil CH_4 with depth was associated with a decline in both soil O_2 concentrations and in the $\delta^{13}C$ values of CH_4. Decreases in soil CH_4 in the 0-15 cm depth was coincident with increases in O_2 concentrations and ^{13}C enrichment in the $\delta^{13}C$ value of soil CH_4. These trends suggest that methanogenesis outpaces methane oxidation deeper in the soil, while CH_4 oxidation increases near the soil surface. At the whole-ecosystem scale, the lower O_2 plots were net sources of CH_4 to the atmosphere, and the more aerobic plots were either very weak sources, sinks or at net balance. Isotope mass balance calculations suggest that more than 86% of the methane produced at depth was oxidized in surface soil horizons. Follow-up studies in the laboratory were conducted with intact soils exposed to a range of O_2 partial pressures, to explore the effect of oxygen variations on rates of gross methanogenesis. Difluoromethane was applied to inhibit methane oxidation. Incubations of soils collected from the same plots had similar rates of methanogenesis, regardless of oxygen partial pressures. Rates of methanogenesis were similar for soils collected from both the 0-15 cm and 40-60 cm horizons within the same plot. This suggests that net CH_4 flux is probably regulated by changes in rates of CH_4 oxidation rather than by fluctuations in rates of methanogenesis.

B52A-0749 1330h POSTER

CO_2 Exchange and CH_4 Flux in a California Rice Paddy

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We present results from a study aimed at quantifying CH_4 and CO_2 exchange from a California rice paddy. CO_2 exchange was measured using the eddy covariance technique over a two year period. Vertical profiles of CH_4 and CO_2 have been measured on an hourly basis, semi-continuously since November 2001. By combining these measurements, we have calculated CH_4 fluxes at crucial stages of the growing and post-harvest season using the flux gradient approach. We compare the CH_4 fluxes obtained by the micrometeorological techniques to weekly chamber measurements. We discuss the implications of nighttime inversions on the vertical gradients of CH_4 and CO_2 and the turbulent exchange of these gases. Finally, we compare the ratio of CO_2 exchange to CH_4 flux at short (daily), medium (2-4 weekly) and annual timescales to quantify the role of CH_4 in the carbon cycling of rice paddies.

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B52A-0750 1330h POSTER

Soil moisture and soil respiration across an Alaskan peatland-forest ecotone

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Soil respiration rates (SRR) were measured during the growing season across six peatland-forest ecotones on Mitkof Island (56N, 132W) in southeastern Alaska. Rates were highest at forest interior and forest edge sites and lower at peatland sites less than 10 m from the edge. At forest interior sites, SRR averaged 1.00 ± 0.09 g CO_2 m^{-2} h^{-1} with a maximum of 1.66 g CO_2 m^{-2} h^{-1} in late August. At other sites (bog interior, bog edge, forest edge), seasonal differences were less apparent and average SRR were low (0.19-0.28 g CO_2 m^{-2} h^{-1}). Diurnal patterns were most clearly expressed in the forest interior, but these patterns were only evident during relatively warm and dry conditions. During relatively cold and wet periods, we could detect no diurnal variation in SRR or soil temperature at any site. The diurnal amplitude of soil temperature was lowest in the forest interior. A model incorporating water levels, site, and type of day explained more than half of the variance in SRR. Soil temperature was not a significant predictor of SRR. In this region, soil moisture appears to be a major control of SRR across space and time.

B52A-0751 1330h POSTER

Isotope Based Inference of Organic Carbon Storage and Turnover Rates in Buried Sediments.

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Lakes and reservoirs play significant role in the global carbon cycle as sites of rapid accumulation and preservation for carbon (C). Lakes and reservoirs have been estimated to remove up to 5.5 percent from the 5.5 x 1015 g C yr-1 that is anthropologically released to the atmosphere. As a result of increased erosion and sedimentation many of the 68,000 reservoirs in the United States are approaching the end of their useful lifetime, less than 100 years after they were built. We studied sediments from Searsville Reservoir, California (with almost 100% sediment trapping efficiency) to elucidate the fate of eroded soil organic carbon (SOC) after sedimentation and its potential preservation after burial in lacustrine environments. Assuming fluvially regulated sediment-bound-nutrient flux in the riverine system was in dynamic equilibrium, the stocks of soil organic and inorganic C, the carbon to nitrogen (N) ratio (C/N), and the stable isotope signatures of C and N (13C and 15N) of the reservoir sediments were correlated to the reservoir's sedimentation history (derived from 137Cs, 210Pb). We found that sediments in the deep-water portions of the reservoir resist mineralization whereas episodically drained sediments in the delta portions of the reservoir initially exhibit significant mineralization until the C gets protected with subsequent sedimentation. From dated C sedimentation profiles, we infer that turnover rate of C decreases with depth (i.e. time since deposition). This empirical analysis of the fate of eroded SOC after terrestrial sedimentation provides a mechanistic explanation of the spatial and temporal variability of buried-C storage and role of reservoirs as C sinks.

B52A-0752 1330h POSTER

The Role of Mineralogy on the Turnover Time of Organic Carbon in a Volcanic Soil in the Southern Cascades, CA

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Laboratory separation of whole soil is an important component of soil carbon turnover studies, yet isolating ecologically meaningful complexes poses a longstanding challenge. Here, to evaluate the role of mineralogy on soil organic matter turnover, we use density as a proxy for mineral species, and separate whole soil into 12 organo-mineral fractions of defined densities. A and B horizons of a temperate forest basalt Alfisol were separated using biologically neutral sodium polytungstate, and resulting complexes were characterized using X-Ray diffraction (minerals), and total C, total N, 13C , 15N and AMS 14C (organic matter). In both horizons, total C, total N, 13C and 15N measurements indicate that soil organic matter forms a continuum from less- to more- decomposed as density increases from <1.0 to 2.6 g/cc (at which point the trend reverses slightly). XRD analyses indicate that soil mineralogy changes significantly, though gradually, across density fractions. In both horizons, over 25% of the C inventory is in the 2.5 -2.6 g/cc halloysite-dominated fraction, with most of the remaining C in either the 1.4-1.6 g/cc noncomplexed fraction (A horizon) or the >3.2 g/cc goethite/hematite fraction (B horizon). AMS analyses of naturally occurring 14C on these three fractions indicate that from the A horizon to the B horizon there is an order of magnitude increase in the mean residence time of organic carbon and a reversal in the relative mean residence time of carbon associated with halloysite vs. goethite/hematite. We conclude that this method was successful in separating 3 ecologically meaningful 'C-pools' and that it holds promise for investigating C dynamics in and across many soils.

B52A-0753 1330h POSTER

Modelling Factors That Control Peat Accumulation Over Different Timescales

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Net carbon accumulation or loss from peat soils reflect the balance between plant productivity at the surface and decomposition throughout the peat profile. This balance is affected by environmental parameters (water table depth, oxygen availability, pH, and soil temperature) that moderate biological processes such as productivity, root dynamics, and decomposition. Given the same environmental conditions, individual peatland litters differ in their susceptibility to decay, reflecting differences in organic matter composition and nutrient content. The relative importance of these internal and external controls on peat accumulation is presently only poorly understood.

In this study, simulation modelling was used to examine factors that control peat accumulation over timescales from years to millennia. The model used recognizes three organic matter fractions that differ in their susceptibility to decay. Litter quality-related parameters (nutrient availability and previous decay history) have different effects on turnover rates for the different organic matter fractions, whereas external controls (temperature, pH, and oxygen availability) affect all fractions equally. Sensitivity analysis of the model shows that the relative ability of different input parameters to affect peat accumulation depends on the timescale of reference. Peat nitrogen content affected organic matter accumulation mainly within the first decade. Total NPP and several litter-quality dependent parameters were important throughout, but their effect peaked between 500 and 1000 years. A third group of parameters (including oxic:anoxic decay ratios and pH) had no or steadily increasing effects on accumulated mass over the first 1000 years. Subsequently, their effect remained constant or continued to increase.

Patterns of organic matter accumulation in nine peatland types were modelled over 8,000 years, with peatland types differing in both environmental boundary conditions and the chemical quality of dominant litters. Over 8,000 years, rich fens accumulated less organic matter than other peatland types with similar water table depths. At high and medium water tables, bogs / poor fens accumulated most peat, whereas transitional fens showed highest long-term peat accumulation at low water tables. In several instances, the relative peat accumulation potential of different community types changed over time.

While the specific results of this study reflect the structure of the decay model chosen, they stress the importance of defining a timescale of reference when examining organic matter accumulation. They further point towards litter-quality related parameters as important controls over organic matter dynamics in peatlands.

B52A-0754 1330h POSTER

Mechanisms of Carbon Transport and Stabilization in Temperate Forest Soils

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Mechanisms contributing to the carbon balance in soils are numerous and often complex. I examined soil carbon transport and retention in lodgepole pine and trembling aspen forests in Colorado to determine the primary controls on carbon transport and stabilization. This study was the result of field lysimeter sampling, batch DOC sorption isotherm determination, and laboratory soil incubations. Both biological and physicochemical mechanisms were determined to influence the flux of CO_2 and DOC. Consistent with other studies, the flux of DOC from organic soil was strongly related to the rate of heterotrophic respiration, which in turn was clearly dependent upon initial soil C status. Soil organic matter quality (i.e., C:N) was not a significant predictor of respiration rate and in fact, lodgepole pine soils with higher C:N than aspen soils were found to have a greater total flux of carbon during incubations and yield greater *in situ* DOC lysimeter concentrations. The physicochemical properties of these soils were important in explaining the stabilization of carbon for these forests. In particular, pedogenic iron and aluminum play a significant role in the stabilization of soil carbon for these forests, indicating the importance of sorption processes to soil development and stabilization of SOM. Many of the patterns were significant across both forest types allowing for improved analysis at landscape scales.

B52A-0755 1330h POSTER

Radiocarbon in an integrated approach to understanding controls on soil carbon sequestration

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The residence time of soil organic matter is controlled by mineral transformations, plant communities, climate, topography, and land management. To understand the effects of climate change, it is necessary to understand the mechanisms that control the soil carbon system. However, bulk soil radiocarbon measurements cannot untangle the complexity of this system alone. Understanding the controls on soil carbon turnover rates requires a more integrated approach, combining radiocarbon measurements of multiple carbon pools with mineralogical, ecological, and other analytical tools (such as 13C NMR). The California marine terraces provide a unique opportunity to study the effect of the dissolution of primary minerals and precipitation of secondary minerals, as well as differing climate regimes, on carbon sequestration. We will discuss the design of this field site and present results for the 2001-2002 field season.

B52A-0756 1330h POSTER

Identifying Interactions Between Rhizosphere Activity and Leaf Litter Decomposition - a Novel Approach

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Forest soils have received considerable interest due to their potential of storing for the long term carbon fixed by the vegetation above-ground. However, soil processes are complex, and investigations into the interactions between different soil compartments, i.e. roots, litter, and soil organic matter (SOM) are critical to the understanding of carbon stabilisation within forest soils. Recently, forest girdling was successfully applied to stop autotrophic respiration within the soil, thus leaving the heterotrophic CO_2 production as the only remaining flux (Högberg et al. 2001, *Nature* 411, 789-792). The difference in abundance of stable carbon isotopes in litter and soil provides a further opportunity to partition the fluxes measured at the soil surface.

In April 2002, a new girdling experiment has been started in two spruce stands in Germany (young and old). Within this larger experiment, we focussed on the hypothesis that rhizosphere activity in forest soils influence leaf litter respiration. Native litter was replaced with ^{13}C-labelled spruce needle-litter in three soil collars located in the experimentally girdled plots and in three collars located in the control plots (non-girdled) of the younger stand (25-years). Reference collars with no litter were established close to the labelled-litter collars for each treatment. Starting four weeks after girdling (May 2002), the soil CO_2 efflux within each collar as well as the δ^{13}C of the CO_2 emitted from the forest floor were measured at monthly intervals. Owing to the difference in isotopic composition between the litter and the soil, we were able to identify the flux components originating from these two compartments.

Preliminary results show that the difference in CO_2 flux from collars with litter is much higher in the non-girdled plots, indicating an enhancement of litter respiration in the presence of a functional rhizosphere. Isotopic analyses of the soil respired CO_2 show that the additional respiration caused by litter placement originates from two isotopically distinct sources: (a) the needle-litter itself and (b) roots and/or SOM. These results indicate complex interactions between roots, litter and SOM. While root activity stimulates litter respiration, the litter, in turn, seems to stimulate root respiration. Roots and litter together, but not litter alone, may also increase SOM respiration. An isotopic analysis of the soil beneath the collars at the end of the labelled litter experiment (October 2002) will provide further information on the incorporation of litter derived carbon into SOM.

B52A-0757 1330h POSTER

Organic Carbon Export From a Mixed Land Use Watershed

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Changes in land cover and land use for the purpose of agricultural production have long been implicated as significant contributors of nonpoint source pollution and subsequent local and regional water quality problems. In addition to changes in sediment and nutrient export from disturbed ecosystems, carbon export can also be influenced by such changes in land use and land cover. In order to gain insight into the influence of land use on organic carbon export we have initiated a molecular and stable carbon isotope study of dissolved, colloidal and particulate organic matter collected monthly and during storm events from locations in Big Pine Creek watershed, a mixed land use watershed located in West-Central Indiana. Water samples were separated into coarse particulate organic matter, colloidal organic matter, and dissolved organic matter with glass fiber filters and cross flow ultrafiltration. The organic matter from these samples is being characterized by molecular and stable isotope techniques to determine regional source by the use diagnostic lignin monomer distributions extracted via alkaline cupric oxide oxidation and tetramethylammonium hydroxide thermochemolysis. Ongoing analysis will investigate how differences in land use and/or land management practices may influence the extent and nature of carbon export from terrestrial systems.

B52A-0758 1330h POSTER

Sustainability of Carbon Sequestration in Terrestrial Ecosystems: Theoretical Framework and a Case Study

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A sound understanding of the sustainability of terrestrial carbon (C) sequestration is critical for the success of any policies geared to stabilize atmospheric greenhouse concentrations. This includes the controversial Kyoto Protocol and/or other greenhouse strategies by individual countries. However, the sustainability of C sinks and pools has not been carefully studied with either empirical or theoretical approaches. This study establishes a theoretical framework to define the sustainability based on C influx and residence time (t). Ecosystem C influx is determined by canopy photosynthetic capacity, which is regulated by leaf photosynthetic capacity and leaf area index. The residence time represents the capacity of an ecosystem to store C in plant and soil pools (i.e., the C-storage capacity). The C-sequestration capacity in an ecosystem is jointly determined by the canopy photosynthetic capacity and the C-storage capacity. The C-sequestration capacity is maintained in a future global change scenario only if neither the canopy photosynthetic capacity nor the C-storage capacity is up-or down-regulated. In that case, the future rate of terrestrial C sequestration is primarily determined by environmental forcing functions. The forcing functions could be the rising of atmospheric CO2 concentration, forest regrowth, woody plant encroachment, and nitrogen deposition.

We applied this framework to the Free-Air CO2 Enrichment (FACE) experiment in Duke Forest, North Carolina, USA. We estimated C influx with a mechanistic canopy model and residence time via inverse analysis of multiple data sets. Our results indicated that neither canopy photosynthetic capacity nor the C-storage capacity was altered by elevated CO2 at this forest site Thus, the current evidence from both experimental observations and inverse analysis suggests that C sequestration in the ecosystem will increase gradually as Ca gradually increases. Nonetheless, the increased C sequestration in terrestrial ecosystems accounts for only a small fraction of anthropogenic C emission.

B52A-0759 1330h POSTER

Sensitivity of Decomposition Rates and Long-term Carbon Sequestration to Modeled Disturbance Scenarios: Implications for National Monitoring Efforts

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Soil systems are central to carbon, water, and nutrient cycles and play a key role in regulating CO2 exchange in terrestrial systems. While recent advances have been made for measuring plant production, the mechanisms that control the loss of carbon from land are masked by difficulties in detecting and scaling belowground processes. National and international reporting requirements have placed increased emphasis on the development of spatially explicit soil carbon inventories based on monitoring changes in major soil reservoirs. Although this inventory approach provides critical baseline information, the ecological significance of this soil carbon ultimately depends upon the level of chemical and physical protection, the response of the soil system to disturbance, and the temporal and spatial scales of interest.

In this paper, we model the sensitivity of carbon storage estimates to differing assumptions of decomposition and disturbance response using data from the USDA Forest Services Forest Inventory and Analysis (FIA) Program. The FIA soil indicator program represents the only nationally consistent source of forest soil monitoring data in the United States and forms the basis for national reporting on the Montreal Process Criteria and Indicators of Sustainable Management. A mass-balance model of long term soil carbon dynamics is used to address the following questions: (1) how sensitive are soil carbon inventories to current assumptions of inputs, turnover, and disturbance response; (2) which soil processes have the greatest influence on C storage over the time scales relevant to land use policies and how can we best monitor these processes; (3) what are the critical data gaps limiting the use of inventory data in regional and global carbon models.

B52B MCC: 132 Friday 1330h

Merging Molecular Techniques and Genomics With Biogeochemistry II

(joint with H, OS)

Presiding: **M E Dolan,** Oregon State University**; A Reysenbach,** Portland State University

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B52B-01 1335h INVITED

Applications of Synchrotron X-ray Absorption Spectroscopy to Biogeochemical Speciation, Fate, and Remediation of Metal and Metalloid Contaminants in Natural Settings

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Synchrotron X-ray characterization methods, particularly X-ray absorption and diffraction methods, are valuable tools for the analysis of contaminated materials and offer opportunities for designed remediation. These techniques have moved beyond the analysis of model systems alone and can be used to characterize element speciation in solid and aqueous natural samples. Studies of redox-sensitive elements subject to biotically induced changes in oxidation state are particularly amenable to analysis by XAS. XANES and EXAFS can aid in identifying the redox state and chemical speciation of metal and metalloid contaminants, which determines their bioavailability, toxicity, and mobility in the environment. As such, these spectroscopic methods can be integrated with established chemical and physical analyses to contribute to the overall understanding of reaction and transport in contaminated systems, and used to design intelligent remediation strategies. A particular challenge in applying XAS to real systems lies in the identification and quantification of particular species or phases within complex mixtures such as soils, sediments, and reactive barriers. With proper theoretical and experimental calibration, spectral analyses can yield insight into molecular biogeochemical processes that control contaminant uptake and release. Examples from recent studies include elucidation of coupled changes in arsenic, iron, and sulfur speciation responsible for the natural attenuation of high levels of arsenic in a shallow aquifer, and identification of reaction products in experiments designed to assess remediation and removal methods for arsenic in groundwater using zero-valent iron. Integration of XAS and other synchrotron methods with molecular biology approaches such as nucleotide probes directed against r-RNA targets hold promise for probing spatial relationships and chemical gradients in microbial-mineral systems that control contaminant cycling.

B52B-02 1350h INVITED

Compound Specific Isotope Analysis: A Novel Method of Assessment and Quantification of In Situ Remediation Potential

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Compound Specific Isotope Analysis (CSIA), or the characterization of stable carbon and hydrogen isotope compositions of individual contaminant compounds dissolved in groundwater, provides a novel method for investigation of degradation and remediation potential at contaminated sites. For organic contaminants such as chlorinated solvents and petroleum hydrocarbons, degradation can involve large and reproducible kinetic isotope effects, producing systematic changes in the delta 13C and 2H values of the residual contaminant. Examples from recent field applications will demonstrate that during both biological and chemical