as the channel floor. South of Haverstraw Bay, deposition is limited to a local region in a sharp channel bend, and to areas of anthropogenic disturbance. Erosion in the Lower Estuary dominates the broad, shallow western marginal flats in Tappan Zee and Piermont. Manmade and natural obstructions to river flow, such as a relic oyster bed that outcrops on the river bottom in Haverstraw Bay, create local erosional areas. Dynamic environments, incorporating both erosion and deposition, occur where sediment is actively moving through the estuary. Flow-perpendicular sediment waves dominate the channel floor and walls of the Lower Estuary. Dynamic sediment drifts and scouring are associated with man-made constructions, such as the Tappan Zee Bridge and a pipeline crossing the river south of Piermont Pier. Information from sub-bottom seismics and sediment coring provide evidence that sedimentary environments have changed through time. A delta deposit approx. 3-km wide, 7-km long with an average thickness of 3.5-m, sourced from the Sparkill Creek, dominates the marginal flats south of the Tappan Zee Bridge. Radiocarbon dates indicate that the delta was actively depositing between 3370 and 2520 cal yr B.P., but the modern delta surface is eroded with no evidence of recent deposition. Relic oyster beds are imaged in this stretch of the estuary, buried by sediment and outcropping on the river bottom. Existing shell dates suggest that oysters grew during distinct periods in the past but disappeared 500-800 cal yr B.P. Although modern salinities could support oysters, environmental factors such as cooler temperatures during the Little Ice Age and increased storminess may have prevented populations from thriving as they did in the past. These data provide a detailed view of estuarine processes and variability within the Hudson River system and continue to improve our understanding of long-term estuary evolution.

B33A-04 1330h POSTER

Late Holocene Environment in the Lower Hudson Valley, New York: Medieval Warming, Little Ice Age, and European Impact

Dee C Pederson[1] (dcp@ldeo.columbia.edu)

Dorothy M Peteet[1,2] (peteet@ldeo.columbia.edu)

Dot Kurdyla[3] (kurdyla1@llnl.gov)

Tom Guilderson[3]

[1]Lamont-Doherty Earth Observatory, 61 Rte. 9W, Palisades, NY 10964, United States

[2]NASA/Goddard Institute for Space Studies, 2880 Broadway, New York, NY 10025, United States

[3]Lawrence Livermore National Laboratory Center for Accelerated Mass Spectrometry, 7000 East Ave. L-403, Livermore, CA 94550, United States

Two sediment cores from Piermont Marsh, located in the southern Hudson River Valley, provide a well-dated bi-decadal record of vegetation, climate, land use, and fire frequency. The classic Medieval Warm Period is evident through striking increases in charcoal and *Pinus* dominance from A.D.800-1350, paralleling records southward along the Atlantic seaboard. Higher inputs of inorganic sediment during this interval suggest increased watershed erosion during drought conditions. Increases in *Picea* and *Tsuga* with corresponding decreases in *Liquidambar*, coupled with increasing organic percentages due to cooler, moister conditions indicate the presence of the Little Ice Age. European impact is manifested by increased weedy plant cover (i.e., *Ambrosia, Plantago*, and *Rumex*), decline in arboreal pollen due to land clearance, and increase in inorganic particles to the watershed. Radionuclide dating using Cs-137 and Pb-210 from the southern end of the marsh shows that little disturbance of sediments has occurred, adding validity to the high resolution results and supporting the sedimentation rates obtained using radiocarbon dating. Comparison with other marsh records in the Hudson River estuary shows general agreement in chronology with interesting differences in species changes and sedimentation rates.

B33B CC: 220 C-E Wednesday 1330h

BOREAS +10 Posters

Presiding: **M Litvak,** University of Texas at Austin**; A McGuire,** University of Alaska, Fairbanks

B33B-01 1330h POSTER

Carbon Turnover in Organic Soils of Central Saskatchewan: Insights From a Core-Based Decomposition Study

Ilka E. Bauer[1] (780-435-7300; ibauer@nrcan.gc.ca)

Jagtar S. Bhatti[1] (jbhatti@nrcan.gc.ca)

Patrick A. Hurdle[1] (rhurdle@nrcan.gc.ca)

[1]Natural Resources Canada , Northern Forestry Centre, 5320 122 Street, Edmonton, AB T6H 3S5, Canada

Field-based decomposition studies that examine several site types tend to use one of two approaches: Either the decay of one (or more) standard litters is examined in all sites, or litters native to each site type are incubated in the environment they came from. The first of these approaches examines effects of environment on decay, whereas the latter determines rates of mass loss characteristic of each site type. Both methods are usually restricted to a limited number of litters, and neither allows for a direct estimate of ecosystem-level parameters (e.g. heterotrophic respiration). In order to examine changes in total organic matter turnover along forest - peatland gradients in central Saskatchewan, we measured mass loss of native peat samples from six different depths (surface to 50 cm) over one year. Samples were obtained by sectioning short peat cores, and cores and samples were returned to their original position after determining the initial weight of each sample. A standard litter (birch popsicle sticks) was included at each depth, and water tables and soil temperature were monitored over the growing season. After one year, average mass loss in surface peat samples was similar to published values from litter bag studies, ranging from 12 to 21 percent in the environments examined. Native peat mass loss showed few systematic differences between sites or along the forest - peatland gradient, with over 60 percent of the total variability explained by depth alone. Mass loss of standard litter samples was highly variable, with high values in areas at the transition between upland and peatland that may have experienced recent disturbance. In combination, these results suggest strong litter-based control over natural rates of organic matter turnover. Estimates of heterotrophic respiration calculated from the mass loss data are higher than values obtained by eddy covariance or static chamber techniques, probably reflecting loss of material during the handling of samples or increased mass loss from manipulated profiles. Nevertheless, the core-based method is a useful tool in examining carbon dynamics of organic soils, since it provides a good relative index of organic matter turnover, and allows for separate examination of environmental and litter-based effects.

B33B-02 1330h POSTER

Simulating Carbon Dynamics at Landscape Level:A Case Study for Lake Abitibi Model Forest in Ontario, Canada

Xiaolu Zhou[1,2] ((514)987-3000ext3041; xiaolu.zhou@sympatico.ca)

Changhui Peng[2] ((514)987-3000ext1056; peng.changhui@uqam.ca)

Dong Hua[1,2] ((514)987-3000ext3041; c2050@er.uqam.ca)

Jianbo Cui[1,2] ((514)987-3000ext3041; jianbocui09@hotmail.com)

Qing-Lai Dang[1] ((807)3438278; qinglaidang@hotmail.com)

[1]Lakehead University, Faculty of Forestry and the Forest Environment, Lakehead University, 955 Olive Road, Thunder Bay, ON P7B 5E1, Canada

[2]Université du Québec àMontréal, Institut des sciences de l'environnement, Université du Québec àMontréal, Case postale 8888, Succursale Centre-Ville, Montreal, QC H3C 3P8, Canada

This study assessed the temporal and spatial variability of carbon storage at landscape level, and estimated the carbon budget at a regional scale in the boreal ecosystems of Lake Abitibi Model Forest (LAMF, Ontario, Canada). We simulated the stand-level forest growth and carbon dynamics using TRIPLEX1.0, a process-based forest growth and carbon dynamics model, and GIS (Geographical Information System). The simulated carbon storage (net primary productivity (NPP), forest biomass and soil carbon) was compared with field data and the results of remote sensing analysis. The model simulation of biomass carbon was highly correlated with field measurements (r^2 ranged from 0.73 to 0.89). The simulated NPP ranged from 3.26 to 3.34 tC $ha^{-1}yr^{-1}$ at regional scale, and was sensitive to the changes in annual temperature and precipitation. The estimation of the net carbon balance suggests that the forest ecosystems in LAMF were a carbon sink in the 1990s. The results of this study can be used by local forest managers to develop ecological and carbon-based indicators and to monitor the sustainability of the boreal forest ecosystem under the changing environment. **Key words:** ecosystem simulation, carbon modeling, TRIPLEX model, boreal forest, GIS application.

B33B-03 1330h POSTER

Solid-Phase Characterization of Sediments From 100 Boreal Forest Lakes

Denis G Rancourt[1] (dgr@physics.uottawa.ca)

Beena A George[1] (Beena.George@science.uottawa.ca)

Mei-Zhen Dang[1] (dang@physics.uottawa.ca)

Kevin Telmer[2] (ktelmer@uvic.ca)

[1]University of Ottawa, Department of Physics, Ottawa, ON K1N 6N5, Canada

[2]University of Victoria, School of Earth and Ocean Sciences, Victoria, BC V8W 3P5, Canada

We report some first results of the Lake Sediment Structure and Evolution (LSSE) project (www.science.uottawa.ca/LSSE) in which sediments [collected by the Geological Survey of Canada, under its Metals in the Environment (MITE) program] from 100 boreal forest lakes have been analysed by several complementary solid phase measurement methods including: room temperature and cryogenic Fe-57 Mossbauer spectroscopy, powder X-ray diffraction, light element analysis (C, H, N, S) gas chromatography, X-ray fluorescence spectroscopy, mineral magnetometry, and nuclear magnetic resonance. This allows one to develop a baseline for the depth wise and lake to lake distributions in quantitative solid phase compositions of recent boreal forest lake sediments, including the organic matter, inorganic crystalline (i.e., mineral, usually detrital) and inorganic amorphous or nanophase (usually diagenetic) compartments. In particular, this is the first such broad Mössbauer study, covering lakes with diverse characteristics (pH 4-9, sediment organic matter contents 5-80%) and from diverse settings (dominant vegetation type, catchment area rock type, various distances from a metal smelter point source, etc.). In general, the dominant authigenic Fe phases (nanogoethite, ferrihydrite) and total solid-Fe ferric/ferrous abundancies are not distributed according to monotonic diagenetic redox depth profiles.

URL: http://www.science.uottawa.ca/LSSE

B33B-04 1330h POSTER

Factors Controlling Carbon Storage in Black Spruce Boreal Forests: A Comparison Between Canada and Alaska

Kristen L Manies[1] (650-329-5010; kmanies@usgs.gov)

Jennifer W. Harden[1] (jharden@usgs.gov)

Katherine P. O' Neill[2] (katherine.oneill@ars.usda.gov)

[1]U.S. Geological Survey, 345 Middlefield Rd., Menlo Park, CA 94025, United States

[2]U.S.D.A. Agricultural Research Service, Appalachian Farming Systems Research Center, Beaver, WV 25813, United States

Many factors affect carbon (C) storage within the boreal forest, including soil drainage, stand age, and fire behavior. We examined the influence of these factors across the boreal region of North America by studying black spruce (*Picea mariana* (Mill.) BSP) stands that vary in soil drainage and stand age in both Alaska and Canada. Our first study region was located near the Northern Study Area of BOREAS, in Manitoba, Canada. Stands ranging from four to approximately 150 years old were examined in both moderately well- and poorly-drained ecosystems. Our second study area, which consisted of well- to moderately well-drained ecosystems, was located in central Alaska. These stands ranged from one to >100 years. While the Alaskan sites were slightly warmer than the Canadian ones (mean annual temperatures of 2.6 versus 0.8 degrees Celsius, respectively), mean annual precipitation

was twice as high in Canada. Despite these climatic differences, we found that sites with similar soil drainage had similar C stocks and post-burn C recovery. Additionally, at both study areas, as soil drainage became progressively drier we saw lower burn severities, slower C recovery over time, and lower overall C stocks.

B33C CC: 524 A Wednesday 1330h

Dissolved Organic Carbon in the Biogeochemical Functioning of Systems III *(joint with H, GC)*

Presiding: **T Moore,** McGill University**; K Bishop,** Swedish University of Agricultural Sciences

B33C-01 1330h INVITED

DOC Lability Across Aquatic Ecosystems and its Link to in Situ Bacterial Carbon Metabolism

Paul A del Giorgio[1] (1-514-987-3000; del_giorgio@uqam.ca)

Michael L Pace[2] (1-845-677-5343; pacem@ecostudies.org)

[1]Paul A. del Giorgio, Dépt des sciences biologiques, Université du Québec à Montréal, Montréal, QC H3C 3P8, Canada

[2]Michael L. Pace, Institute of Ecosystem Studies Box AB, Millbrook, NY 12545, United States

The biological reactivity or lability of organic matter is a key aspect of the carbon cycling in all aquatic ecosystems. Dissolved organic carbon (DOC) lability is an operational term that defines the proportion of the dissolved C pool that can be utilized by aquatic microbes within a given period of time. Lability is generally determined using bioassays that follow the changes in DOC concentration with time, typically days to weeks, in the absence of light and of any new sources of DOC or nutrients. This in vitro DOC consumption thus represents the minimum level of microbial metabolism that can be supported by the ambient DOC pool. In the past, comparisons of DOC lability reported by different studies have been hampered by differences in approaches, so it is unclear how the amount of labile DOC varies among aquatic ecosystems. Here we compare DOC lability measurements from estuaries and salt marshes, rivers and lakes, determined with similar protocols, and we compare these data with the actual in situ bacterial carbon metabolism. We show that in most freshwater systems surveyed, the in vitro rates of DOC consumption rates are low and fall within a relatively narrow range, in spite of large variations in total DOC, chlorophyll, and nutrient concentrations among systems. In most freshwater ecosystems, the proportion of labile DOC is below 3%, and this labile pool generally represents a small fraction of the measured in situ rate of bacterial respiration, suggesting that these freshwater lability bioassays only capture a remnant pool of organic matter and not the pool that fuels most of the heterotrophic microbial metabolism. The proportion of labile DOC is on average much higher in estuarine and marsh ecosystems, and also represents a larger proportion of the total in situ microbial metabolism. These results point to fundamental differences in the patterns of DOC sources and cycling between brackish and estuarine systems on the one hand, and lakes and rivers on the other. Although the metabolism supported by the remnant DOC pool is small in most freshwaters, it can nevertheless play an important role in determining the baseline microbial respiration, particularly in the more unproductive aquatic systems. This baseline respiration may in turn determine the role of freshwaters as sources or sinks of CO2.

B33C-02 1350h

Seasonal Variation of CO_2 in the Gulf of Bothnia: Indications for Net Heterotrophy

Grete Algesten[1] (grete.algesten@eg.umu.se)

Johan Wikner[2] (johan.wikner@umf.umu.se)

Sebastian Sobek[3] (sebastian.sobek@ebc.uu.se)

Lars J. Tranvik[3] (lars.tranvik@ebc.uu.se)

Mats Jansson[1] (mats.jansson@eg.umu.se)

[1]Dept. of Ecology and Environmental Science, UmeåUniversity, Umeå901 87, Sweden

[2]UmeåMarine Sciences Centre, UmeåUniversity, Norrbyn, Hörnefors 910 20, Sweden

[3]Department of Limnology, Evolutionary Biology Centre, Uppsala University, Norbyvägen 20, Uppsala 752 36, Sweden

Marine systems have been considered to be in carbon balance with the atmosphere, which means that primary production equals total respiration within the system. However, recent studies indicate that large parts of the ocean, especially oligotrophic marine systems, are net heterotrophic and, thus, a source of CO_2 to the atmosphere. Net heterotrophy implies that organic carbon is transported to low-productive areas, either by redistribution of organic carbon (OC) from more productive marine zones or by input of terrestrial OC via rivers. This study was conducted in the Gulf of Bothnia, which is situated between Sweden and Finland in northern Europe. It is a brackish water body with two major basins (Bothnian Bay and Bothnian Sea). The Gulf receives a high input of OC from Swedish and Finnish rivers, but also from the adjacent more productive water body of the Baltic Proper. Previous studies on carbon balance in the Gulf of Bothnia have indicated that the system is net heterotrophic. We therefore employed, for the first time, direct estimates of CO_2 saturation to assess the net ecosystem exchange in the two major basins of the Gulf of Bothnia during one year. Primary and bacterial production (PP and BP) was also measured in order to calculate the respiration-production balance in the Gulf of Bothnia. On an annual basis the surface water was supersaturated with CO_2, indicating net heterotrophy. The Gulf of Bothnia oscillated between being a sink and a source of CO_2 over the studied period, largely decided by the temporal variation in bacterial respiration (BR) and primary production in the water column above the pycnocline. Calculated annual respiration-production balance (BR-PP) was very similar to the estimated CO_2 emission from the Gulf of Bothnia, indicating that these processes were the major determinants of the exchange of CO_2 between water and atmosphere. The southern basin (Bothnian Sea) had a lower net release of CO_2 to the atmosphere than the northern Bothnian Bay (7.1 and 9.7 mmol C m^{-2} d^{-1}), due to higher primary production, which to a larger extent balanced the respiration in this basin. In conclusion, net flux of CO_2 is very sensitive to changes in climatic conditions such as freshwater inflow, currents from the Baltic Proper, or changes in primary production within the system. Even moderate changes in the catchment, or within the Gulf of Bothnia can have considerable effects on the carbon balance, and on the role of the system as a source or a sink of atmospheric CO_2.

B33C-03 1405h

Hot Stuff: Lability of Forest Floor DOM to Aerobic Degradation

Richard A. Bourbonniere[1,2] (1-905-336-4547; rick.bourbon@ec.gc.ca)

Irena F. Creed[2] (1-519-661-4265; icreed@uwo.ca)

Rajan Kapila[2] (rkapila@uwo.ca)

Jill Collins[2] (collins_jill@durham.edu.on.ca)

[1]Environment Canada, National Water Research Institute, 867 Lakeshore Rd., Box 5050, Burlington, ON L7R 4A6, Canada

[2]University of Western Ontario, Department of Biology, Biology and Geology Bldg., London, ON N6A 5B7, Canada

The hypothesis that the lability of DOM to aerobic microbial degradation to CO_2 is related to its age and character is tested in an incubation study conducted using an assemblage of soil bacteria in their natural state. Extracts (WF) of leaf and forest floor material characterized by different degrees of degradation: green leaves, fresh fallen leaves, litter (one year weathering), fibric matter, hemic matter and peat were used in this study. The working hypothesis is that these extracts represent a chronosequence of degradation and DOM extracted from them might also represent a similar lability sequence. As well aliquots of the WF extracts were processed to remove DOM fractions. Thus a fulvic acid (FA) fraction was made by precipitating and removing humic acid, and a hydrophilic fraction (HPI) by removing hydrophobics from the FA using XAD-8 resin. Incubations were carried out on all three DOM solutions from each extract to determine if there were differences in lability among the fractions. When comparing the WF solutions for CO_2 production, the green leaves, litter, fibric and hemic extracts showed approximately the same CO_2 yield, on an equal C basis, and the fresh fallen leaves and peat produced less. For five of the six extracts the respective WF and HPI solutions yielded nearly the same quantity of CO_2 per mg C suggesting that the HPI component contributes almost all the lability. Furthermore the magnitudes of the C-normalized CO_2 yield for these solutions are similar to that for glucose, which fractionates as HPI. For the same five extracts the FA solution yielded lower quantities of CO_2, on an equal C basis, than WF and HPI suggesting that the hydrophobic content of the extracts may inhibit aerobic degradation. The peat extract solutions yielded a different CO_2 production distribution with the HPI only slightly higher than the FA which in turn was much greater than WF. The material from which this extract was made is much older and contains significant HA, suggesting that the hydrophobics in peat do not inhibit aerobic degradation, but the humic acid does. These preliminary results suggest that lability to aerobic degradation of DOM extracted from forest floor organic matter differs somewhat with age but more with DOM character. These results indicate that the humic and hydrophobic fractions of DOM are more refractory to aerobic microbial activity, degrading more slowly than hydrophilic DOM. As well preliminary results suggest that refractory DOM may have an inhibitory effect on the degradation rate of the labile DOM.

B33C-04 1420h

Identifying Sources and Controls of Dissolved Organic Carbon Losses in Northern Hardwood Forest Ecosystems Under Elevated Nitrogen Deposition

Kurt A Smemo[1] (734-647-9808; smemo@umich.edu)

Donald R Zak[1] (drzak@umich.edu)

[1]University of Michigan, SNRE 430 E. University Ave., Ann Arbor, MI 48109, United States

Anthropogenic nitrogen (N) deposition in northern hardwood forest ecosystems has modified soil carbon cycling, resulting in the substantial leaching of dissolved organic carbon (DOC). Despite the significance of this finding, the exact source of this DOC has not been found and a mechanistic explanation has been lacking. In order to identify sources of and mechanisms for this apparent N stimulation of DOC leaching, we conducted a controlled laboratory leaching experiment using soil and fresh litterfall from a previously-studied northern hardwood forest stand in northern Lower Michigan. This stand has received 10 years of both ambient and experimental (3 times ambient) atmospheric NO3- deposition. Three replicate soil and litter samples were collected from 3 plots receiving ambient and 3 plots receiving experimental NO_3- deposition. Our laboratory experiment used soil and litter collected from each plot to understand if fresh leaf litter was the source of increased DOC leaching in plots receiving experimental NO3- deposition. In laboratory incubations, we investigated microbial respiration and DOC production from: 1) soil from each plot, 2) litter and soil from each plot, and 3) litter from each plot placed over sterile sand. This combination of treatments enabled us to determine the contribution of soil organic matter, fresh leaf litter, and both to DOC production. Results showed that N deposition had no significant effect on microbial respiration, but that treatment differences were significant. Most of the DOC production (75%) was associated with leaching from fresh litter. Soil was a significant sink for litter-derived DOC across the treatments, but less so in the fertilized plots where 30% more DOC was leached on average compared to un-fertilized plots. These results suggest that N deposition might not influence the production of DOC in soil and litter, but the ability of the soil to physically adsorb or the microbial population to sequester DOC inputs. Therefore, changes in soil physical characteristics and/or soil microbial communities may explain the patterns of DOC export seen in past studies and represent an unexpected ecosystem consequence of increased anthropogenic N deposition.

B33C-05 1435h

Risk Analysis of UVB Exposure in Canadian Inland Waters

Lewis A Molot[1] (416-736-2100, 22613; lmolot@yorku.ca); W Keller[2] (bkeller@vianet.ca); Peter R Leavitt[3] (leavitt@uregina.ca); R D Robarts[4] (richard.robarts@ec.gc.ca); M J Waiser[4] (marley.waiser@ec.gc.ca); M T Arts[5] (michael.arts@ec.gc.ca); T A Clair[6] (tom.clair@ec.gc.ca); R Pienitz[7] (reinhard.pienitz@cen.laval.ca); N D Yan[8] (nyan@yorku.ca); D K McNicol[9] (don.mcnicol@ec.gc.ca); Y Prairie[10] (prairie.yves@uqam.ca); P J Dillon[11] (pdillon@trentu.ca); M. Macrae[12] (machr1813@mach1.wlu.ca); R Bello[13] (bello@yorku.ca); R N Nordin[14] (nordin@uvic.ca); P J Curtis[15] (jcurtis@ouc.bc.ca)

[1]Faculty of Environmental Studies, York University, 4700 Keele Street, Toronto, ON M3J 1P3, Canada

[2]Cooperative Freshwater Ecology Unit, Laurentian University, Ramsay Lake Road, Sudbury, ON P3E 2C6, Canada

[3]Department of Biology, University of Regina, 3737 Wascana Parkway, Regina, SK S4S 0A2, Canada