from 0.35 to 0.17 and δ^{65}Cu from -0.13 to 0.18) than in sediments. Cu and Zn isotopic signatures of sediments show a clear trend of lighter isotopes removal from the MTZ seaward with δ^{66}Zn varying from 0.21 at 2 psu to 1.11 per mil at 33 psu (and δ^{65}Cu = -0.37 to 0.24). In contrast, Zn isotopic compositions in SPM are more homogeneous with average δ^{66}Zn of 0.24 $\pm$ 0.18 over all the transect. Cu isotopic composition in SPM are very constant downstream of the MTZ with average δ^{65}Cu =-0.06 $\pm$ 0.08 but become more scattered within MTZ (varying from -0.04 to 0.18). These preliminary results pinpoint important variations in Cu and Zn isotopic compositions within estuarine systems and contrasted isotopic signatures in Cu and Zn between SPM and sediments. Results suggest the important role of early diagenesis in the isotope geochemistry of heavy metals in estuarine environment. This study provides a stepping stone for further investigation of interacting processes involved in controlling the cycling of metals in the Scheldt estuary. (1) Zhu et al., *Earth Planet. Sci. Lett.* 200 (2002), 47-62
(2) Pichat et al., *Earth Planet. Sci. Lett.* 6598 (2003), 1-12
(3) Maréchal et al., *Geochem. Geophys. Geosyt.*, 1 (2000), GC000029

B51A-08 0830h POSTER

What Carbon Sources Support Groundwater Microbial Activity in Riparian Forests?

Noel P Gurwick[1] (607 255-2606; npg1@cornell.edu); Peter M Groffman[2] (845 677-7600 x128; groffmanp@ecostudies.org); Daniel C McCorkle[3] (508-289-2949; dmccorkle@whoi.edu); Mark H Stolt[4] (401-874-2915; mstolt@uri.edu); Dorothy Q Kellogg[4] (401-874-7532; qkellogg@uri.edu); Arthur J Gold[4] (401-874-2903; agold@uri.edu)

[1]Cornell University, Program in Biogeochemistry Fernow Hall, Ithaca, NY 14853, United States

[2]Institute of Ecosystem Studies, Box AB, Millbrook, NY 12545, United States

[3]Woods Hole Oceanographic Institution, Department of Geology Mailstop 8, Woods Hole, MA 02543, United States

[4]University of Rhode Island, Department of Natural Resources Science One Greenhouse Road, Kingston, RI 02881, United States

A major question in riparian research is the source of energy to support subsurface microbial denitrification activity. The supply of microbially-available carbon frequently limits microbial activity in the subsurface. Therefore, identifying the relative importance of carbon sources in the riparian subsurface helps explain the sustainability and spatial heterogeneity of denitrification rates. We have investigated the importance of buried, carbon-rich soil horizons, deep roots and dissolved organic carbon as potential carbon sources to support groundwater denitrification in riparian forests in Rhode Island. We used field observations, laboratory incubations and in-situ experiments to evaluate these sources at four sites in different geomorphic settings. In particular, we measured the ^{14}C-DIC signature and DIC concentration of ambient groundwater and groundwater that had been degassed, re-introduced into the well, and incubated in-situ. Buried horizons appear to be an important source of carbon in the subsurface, as shown by active respiration in laboratory incubations; greater microbial biomass in buried carbon-rich soils compared to surrounding carbon-poor soils; and the presence of very old carbon (>1,000 ybp) in DIC 225 cm beneath the surface. DIC collected from shallower wells showed no clear evidence of ancient carbon. Roots also appear to be important, creating hotspots of carbon availability and denitrification in the generally carbon poor subsurface matrix. Dissolved organic carbon did not stimulate denitrification in aquifer microcosms in the laboratory, suggesting that this was not an important carbon source for denitrification in our sites. Determining which carbon source is fueling denitrification has practical implications. Where buried horizons are the key source, surface management of the riparian zone will likely have little direct influence on groundwater denitrification. Where roots are the key source, changes in the plant community are likely to influence denitrification capacity in the subsurface.

B51A-09 0830h POSTER

Microbial Reworking Organic Matter in the Hauraki Gulf, New Zealand: Evidence from the Stable Isotopic Composition of Sedimentary D- and L-Amino Acids

Maria E Uhle[1] (865 974-0402; muhle@utk.edu)

Elisabeth L Sikes[2] (732-932-6555ext518; sikes@imcs.marine.rutgers.edu)

Scott D Nodder[3] (s.nodder@niwa.cri.nz)

Melissa M Hage[1] (mhage@utk.edu)

Meg E Howard[1] (mhoward@utk.edu)

[1]Department of Earth and Planetary Sciences, University of Tennessee 1412 Circle Drive 306 EPS Bldg, Knoxville, TN 37996, United States

[2]Institute of Marine and Coastal Sciences, Rutgers University 71 Dudley Rd, New Brunswick, NJ 08901, United States

[3]National Institute for Water and Atmospheric Research, 301 Evans Bay Parade Kilbirnie, Wellington, New Zealand

Amino acids are one of the more labile classes of organic matter in marine sediments. These compounds are the structural components of proteins and constitute the largest reservoir of organic nitrogen in most organisms. Their distribution and abundance have been used to assess diagenetic status of organic matter and their isotopic compositions have been linked to organic matter source identification. Organic matter in marine environments is derived from both allochthonous and autochthonous sources. Detailed source apportionment is difficult using bulk chemical characterization owing to the contribution of organic matter from multiple sources. Chemical and isotopic characterization of individual organic compounds, however, can yield detailed information on organic matter sources in complex systems. Sediment samples were recovered in 1999 from the Hauraki Gulf of New Zealand aboard the HMS Tangaroa. Near-shore and shelf environments were sampled along major currents to investigate the source and distribution of organic matter in the gulf. Amino acids were isolated from sediments by acid hydrolysis and quantified by gas chromatography/mass spectrometry following derivatization to their respective N-TFA-isopropyl esters. Isotopic compositions of the stereoisomers were determined by gas chromatography/isotope ratio mass spectrometry. Amino acid distributions from several sites throughout the gulf show a predominance of D- over L-amino acids, which reflects microbial input of amino acids in these sediments. At the Firth of Thames, the concentration of L-amino acids is greater than the D- isomers, which may be due to input of fresh algal material at this site. The isotopic compositions of many amino acids at this site reflect a marine source, which is consistent with the stereoisomer distributions. The carbon isotopic compositions of glycine and leucine at all sites are significantly depleted in 13C relative to typical values for marine and terrestrial sources and appear to be a good indicator of microbial reworking of the sediments.

B51A-10 0830h POSTER

Constraints on Ca/Sr as a Proxy for Calcium in Forest Ecosystems

Claire J. Hoff[1] (603-862-3876; choff@cisunix.unh.edu)

Erik A. Hobbie[2] (603-862-3581; erik.hobbie@unh.edu)

Rich Hallett[3] (603-868-7657; rah@unh.edu)

Jan Colpaert[4] (jan.colpaert@luc.ac.be)

Julie G. Bryce[1] (603-862-3139; julie.bryce@unh.edu)

[1]UNH Dept. of Earth Sciences, James Hall, Durham, NH 03824, United States

[2]UNH Complex Systems Research Center, Morse Hall, Durham, NH 03824, United States

[3]USDA Northeastern Forest Experiment Station, PO Box 640, Durham, NH 03824, United States

[4]Limburgs Universitair Centrum, Environmental Biology Universitaire Campus B-3590 Diepenbeek, Belgium

Calcium is a key plant nutrient and important base cation in ecosystems. Our current efforts to quantify Ca cycling in ecosystems rely on indirect proxies, e.g., Ca/Sr or Sr isotopic systems (1). An important assumption in these applications is that the elemental ratio of calcium to strontium faithfully represents calcium cycling and that little fractionation occurs through biogeochemical and physiological processes. However, several researchers have reported variations in Ca/Sr, e.g. among different tree tissues (2) and during weathering processes (3), raising doubts about the suitability of the proxy. To address the question of reliability, we measured Ca/Sr values in a culture study in which Scots pines were grown at low or high nutrient supply rates (3% per day or 5% per day). Because mycorrhizal fungi are intimately involved in plant nutrient supply, plants were also grown either uncolonized or colonized with one of two different species of mycorrhizal fungi (Suillus luteus and Thelephora terrestris). Our preliminary results indicate that Ca/Sr values differ between high and low nutrient treatments, root and foliage, and mycorrhizal treatments. In individual seedlings, roots have lower Ca/Sr than foliage by absolute factors of 2-5. The magnitude of the effect is apparently determined by a combination of environmental factors including both the nutrient and mycorrhizal treatments. These results indicate that Ca and Sr are partitioned differently between nutrient and mycorrhizal treatments and between plant fractions despite the common nutrient broth and substrate. Thus, Ca/Sr values alone are not reliable tracers of Ca within an ecosystem because of partitioning of Ca and Sr during nutrient transport within the plant-mycorrhizal system. We are presently refining analytical techniques and conducting leachate experiments to improve the quantification of this Ca/Sr fractionation. We are also exploring the use of isotopic tracers to study calcium biogeochemical cycling in forest ecosystems. (1) Blum, J.D., et al. 2002. Nature 417: 729-731. (2) Bailey, S.W., et al. 1996. Water Resources Research 32: 707-719. (3) Vitousek, P.M., et al. 1999. Oecologia 121: 255- 259.

B51A-11 0830h POSTER

Stable Isotopic Studies and Ecosystem Research in Asia

Jeffrey S Owen[1] (owenje@earth.sinica.edu.tw)

Ming Kuang Wang[2] (mkwang@ccms.ntu.edu.tw)

Hen Biau King[3] (hbking@serv.tfri.gov.tw)

Shuh Ji Kao[1] (sjkao@earth.sinica.edu.tw)

[1]Environmental Change Research Center, Academia Sinica, Taipei 115, Taiwan

[2]Department of Agricultural Chemistry, National Taiwan University, Taipei 106, Taiwan

[3]Taiwan Forestry Research Institute, Council of Agriculture, Taipei 100, Taiwan

Stable isotope studies could contribute much to our understanding of ecosystem nutrient cycling, fate and transport of pollutants, and human impacts on the environment in Asia. As examples of ongoing studies within the Asian region that utilize stable isotopic techniques, results from two studies investigating relationships among patterns in δ^{15}N and net rates of nitrogen transformations in forest ecosystems in Taiwan are shown. In an evergreen hardwood forest in northeastern Taiwan (24°34 N, 121°34 E), soil δ^{15}N values in the forest floor ranged from -1.8 to 1.8$^{o}/_{oo}$. Mineral soils had higher δ^{15}N values (4.1 to 6.0$^{o}/_{oo}$). Foliage δ^{15}N values for overstory trees ranged from -6.6 to -2.0$^{o}/_{oo}$). In a montane ecosystem in central Taiwan (23°28 N, 120°48 E)we found that net rates of N mineralization were related to soil C:N ratios. In this mixed grassland-forest system, foliar δ^{15}N values of the dominant species ranged from -6 to -3$^{o}/_{oo}$. Surface soil δ^{15}N values were between -1 and 3$^{o}/_{oo}$ with a greater difference between foliar and soil values in grassland soils. Our results illustrate the need for more information regarding fundamental patterns in rates of ecosystem nitrogen cycling in Asia, especially as related to wider scale patterns in nutrient cycling within the region, to demonstrate potential insights from these kinds of studies.

B

B51B CC: 220 C-E Friday 0830h

Measurement and Modeling of Carbon, Water, and Energy Exchange in Northern Ecosystems III Posters

Presiding: **H Margolis,** Universit Laval**; C Coursolle,** Universit Laval

B51B-01 0830h POSTER

A comparison of soil profile CO_2 production dynamics across adjacent intact, clearcut and partial cut forests

Amy Myette[1] (902-867-5073; amyette@stfx.ca)

Lisa Kellman[1] (902-867-5086; lisa@stfx.ca)

Hugo Beltrami[1] (902-867-2326; hugo@stfx.ca)

David Risk[1] (902-867-3667; drisk@stfx.ca)

[1]Environmental Earth Sciences Laboratory, St. Francis Xavier University, P.O. Box 5000, Antigonish, NS B2G2W5, Canada

Changes in soil vegetation cover alter a suite of factors that control the balance of carbon stored in soil profiles including the heat balance, hydrological regime, physical properties and input and turnover of organic matter in soils. Altering these factors will change the absolute quantity of soil respiration but may also shift the relative proportions of deep versus shallow CO_2 production. Although studies have investigated net changes in soil surface respiration resulting

from major landuse changes, there is limited information about how the dynamics are altered through the soil profile. In this study we compare soil CO_2 production through the profiles of three sites of contrasting forest management in a mixed forest typical of Atlantic Canada. The sites include an intact mixed, a clearcut and a partial cut forest. We control for soil, climate and topography by selecting adjacent sites on a similar sand textured soil. Observed variations between sites are thus expected to be a result of alterations in landuse management and associated vegetation cover. Detailed profile measurements of CO_2 concentration, temperature and moisture have been collected at each site to a depth of approximately 1 meter weekly or biweekly since the summer of 2003. Detailed subsurface CO_2 profile concentrations are used to predict soil CO_2 production within individual layers by estimating fluxes between layers and modeling diffusivity. Preliminary results point to clear differences in the relative importance of shallow versus deep CO_2 production across the study sites.

B51B-02 0830h POSTER

A new technique for in-situ soil gas diffusivity measurement

David Risk[1] (902-867-3667; drisk@stfx.ca)

Lisa Kellman[1] (902-867-5086; lisa@stfx.ca)

Hugo Beltrami[1] (902-867-2326; hugo@stfx.ca)

[1]Environmental Earth Sciences Laboratory, St. Francis Xavier University, P. O. Box 5000, Antigonish, NS B2G 2W5, Canada

Subsurface approaches to soil CO_2 monitoring are becoming increasingly popular. While subsurface measurements are substantially more equipment-intensive than surface flux data and limited in terms of spatial coverage, they offer significant advantages for process studies, including excellent vertical resolution of CO_2 dynamics in the layered soil system, and the ability to estimate instantaneous CO_2 production at several depths. Carbon dioxide production estimates are helping to clarify the physical controls on soil respiration processes on short time scales when measured surface fluxes may often lag well behind actual CO_2 production. Since production estimates are derived using a multilayer Fickian diffusion model, it is necessary to tightly constrain rates of diffusive tranport, particularly the parameter of effective gas diffusivity. Many researchers defer to empirically-derived approximations such as the Millington model or improved/hybrid models that require soil specific input parameters. Ideally, however, the prefered solution is direct and accurate diffusivity measurement. This paper outlines the development of a probe and system for in-situ soil gas diffusivity measurements. Initial laboratory tests will be presented in addition to preliminary soil diffusivity-moisture curves obtained from regular in-situ measurements at four sites during a period of slow natural soil hydration. Results suggest that diffusivity models (e.g. Millington or others) may work well for homogenous laboratory cores, but under many field circumstances the measured gaseous diffusion rate can be significantly different than predicted values.

B51B-03 0830h POSTER

Carbon Dioxide Production in Wetland-Pond Complexes in the Western Boreal Plain Under Variable Climatic Conditions

Stephen C Kaufman[1] (kauf9150@wlu.ca)

Richard M Petrone[1] (rpetrone@wlu.ca)

Kevin J Devito[2] (kevin.devito@ualberta.ca)

[1]Department of Geography & Environmental Studies, and Cold Regions Research Centre, Wilfrid Laurier University, 75 University Ave West, Waterloo, ON N2L 3C5, Canada

[2]Department of Biological Sciences, University of Alberta, CW 405 Biological Sciences Centre, Edmonton, AB T6G 2E9, Canada

The wetland-pond complexes that are common within the mosaic of the Western Boreal Plain are significant not only in their roles as wildlife and water fowl habitat and water resources, but also in their role as significant carbon reservoirs. However, given the sub-humid climate of this region these wetland systems are very vulnerable to (natural or anthropogenic) climatic variability. Should climatic variability lead to drier conditions altering the hydrologic regime in this region these systems may dry out and become sources of atmospheric carbon dioxide. For this study, peat cores were removed in August 2003 along a topographical gradient from two pond-wetland complexes in the Utikuma Lake region of Northern Alberta. Each pond-wetland complex was chosen for its hydrological properties, where one has connection to regional groundwater and the other is hydrologically isolated. Collected cores were analysed for physical properties and carbon dioxide production over a range of moisture and temperature conditions. Incubation of peat samples was performed at two temperatures and three moisture regimes for a period of 48 hours. Here we present the results of this analysis with implications for the potential changes to wetland-pond permanence as well as atmospheric carbon dioxide fluxes as a result of increased climate change and human encroachment on these environments.

B51B-04 0830h POSTER

Export of Water and Carbon From the Yukon River Basin to the Bering Sea

Robert Striegl[1] (303 236-4993; rlstriegl@usgs.gov); Mark Dornblaser[1] (303 541 3015; mmdorbl@usgs.gov); Paul Schuster[1] (303 541 3052; pschuste@usgs.gov); Michael Reddy[1] (mmreddy@usgs.gov); Timothy Brabets[2] (907 786 7105; tbrabets@usgs.gov); George Aiken[1] (303 541 3036; graiken@usgs.gov)

[1]U.S. Geological Survey, 3215 Marine Street, Suite E127, Boulder, CO 80303

[2]U.S. Geological Survey, 4230 University Drive, Suite 201, Anchorage, AK 99508

The U.S. Geological Survey is conducting a five-year (2001-2005) study of the water quality of the Yukon River basin (855,000 km^2) from its headwaters in the Yukon Territory of Canada to the Bering Sea. These baseline data are being collected in anticipation of changes in water discharge, sediment load, and water quality in response to a warmer climate in upcoming decades. Continuous discharge is measured at five sites in the Yukon River Basin; Yukon River at Eagle, Alaska, Yukon River at Stevens Village, Yukon River at Pilot Station near the mouth, and on two major tributaries, the Tanana and Porcupine Rivers. The Yukon River discharged approximately 188 km^3 of water and 6.5 Tg of carbon past the Pilot Station gage during Oct 2001 - September 2002. Approximately 65% of this was as dissolved inorganic carbon, 21% as dissolved organic carbon, and 7% each as particulate inorganic and particulate organic carbon. An additional 1.2 Tg of carbon as carbon dioxide was emitted to the atmosphere from the entire river during the year. Water yields from subbasins ranged from 160 to 360 mm per year. Carbon yields per m^2 of watershed were directly proportional to water yields, ranging from 0.37 to 1.0 mole carbon per m^2 of watershed per year.

B51B-05 0830h POSTER

A Comparison of Measured Evaporation at Wet and Mesic Sites to Modeled Evaporation Using BIOME BGC in the Arctic Coastal Plain

Ryan N. Engstrom[1] (rengstro@rohan.sdsu.edu)

Allen S. Hope[1] (hope1@mail.sdsu.edu)

Yoshi Harazano[3] (Y.Harazono@uaf.edu)

Hyojung Kwon[2] (hkwon@sciences.sdsu.edu)

Masayoshi Mano[3] (masayoshimano@hotmail.com)

[1]Department of Geography, San Diego State University, 5500 Campanile Dr., San Diego, CA 92182-4493, United States

[2]Department of Biology, San Diego State University, 5500 Campanile Drive, San Diego, CA 92182, United States

[3]International Arctic Research Center, 930 Koyukuk Drive P.O. Box 757340, Fairbanks, AK 99775-7340, United States

The growing season evaporation process in Arctic ecosystems is affected by the unique characteristics of the region, including non-vascular vegetation, a substantial ground heat sink, low energy inputs, and other factors. These characteristics may be a source of uncertainty in evaporation estimates using models developed for mid-latitude ecosystems. By incorporating these characteristics into evaporation models, the accuracy of model predictions should improve. In this study the ecophysiological model BIOME BGC was adapted to Arctic environments by including a non-vascular vegetation evaporation routine, adding ground heat flux as an input, accounting for ground shading by dead vegetation, developing a new parameter set for tundra vegetation, and by accounting for ponded water evaporation. The purpose of this study was to test the ability of this modified version of BIOME BGC to simulate measured evaporation fluxes at two eddy flux tower locations with contrasting wetness conditions in Arctic coastal plain ecosystems. Model simulations were compared to measured evaporation at two eddy flux towers located within 1 km of each other in Barrow, Alaska with substantially different moisture regimes for the 1999, 2000, and 2001 summer seasons. One tower was located in a marsh area that has standing water while the other tower is located in a drier, mesic tundra location. Results indicated that the model performed well at the wet site however, it tended to over predict evaporation at the drier site. This over prediction is most likely due to the affects of lateral redistribution of water from the drier site not being accounted for in model simulations. Additional results indicated that the modified BIOME BGC model was able to simulate measured leaf area index and inter-annual variations in snowmelt date well.

B51B-06 0830h POSTER

Partitioning Belowground Respiration in a Northern Peatland

Heather E Stewart[1] (514-241-2785; heather.e.stewart@mcgill.ca)

Nigel T Roulet[1,2] ((514) 398-2827; nigel.roulet@mcgill.ca)

Tim Moore[1] (514-398-4961; tim.moore@mcgill.ca)

[1]Department of Geography, McGill Unversity, 805 Sherbrooke St. W., Montreal, QC H3A 2K6, Canada

[2]McGill School of Environment, McGill University, 3545 University Avenue, Montreal, QC H3A 2A7, Canada

Although they cover only 3% of the land surface, northern peatlands store up to one-third of the global soil carbon pool, deeming them a significant carbon sink. However, changes in peatland soil respiration could lead to peatlands becoming carbon sources with consequent feedbacks to climate change. In order to understand the global carbon balance we need to understand respiration processes, but compared to photosynthesis we know very little about respiration, especially belowground. Within soils there are three compartments among which carbon is transferred and respired: roots, rhizosphere and root-free soil. In order to further the understanding of respiration processes of northern peatlands, the relative importance of each type of belowground respiration was determined at two locations at Mer Bleue, a northern peatland located near Ottawa, Ontario. Weekly CO2 flux measurements, using dark chambers and a portable IRGA, were made throughout the growing season of 2003. At both areas there are reference plots to determine total respiration where the vegetation remained in tact. Treatment plots were also installed at both areas where foliage was removed in order to determine SOM (shrub-free) respiration. The shrub foliage was replaced with nylon foliage' in an attempt to maintain soil temperature and moisture conditions. Root respiration was determined by incubating root segments on-site, taking air samples over a one hour period. Rhizosphere respiration was estimated by subtracting SOM, root and above-ground respiration from total respiration, and above-ground respiration was removed from the equation using a calculation from a peatland carbon model.

B51B-07 0830h POSTER

Winter Surface Simulations in Boreal Forests Using the Canadian Land Surface Scheme: Tests of Improved Surface Parameterizations

Paul A Bartlett[1] ((416) 739-4359; Paul.Bartlett@ec.gc.ca)

Murray D MacKay[1] ((416) 739-5710; Murray.MacKay@ec.gc.ca)

Diana L Verseghy[1] ((416) 739-4422; Diana.Verseghy@ec.gc.ca)

[1]Climate Research Branch Meteorological Service of Canada, 4905 Dufferin Street, Toronto, ON M3H5T4, Canada

Boreal forest is the Earth's second largest biome, covering approximately 11 percent of the land surface. Its location, below the tree line in the zone of discontinuous permafrost, makes it especially sensitive to climatic shifts. It is also a potential source of significant feedbacks to the climate system through changes in surface albedo, snow cover, water availability and organic soil climate. Until recently, such processes in the boreal forest have not been well modelled by land surface schemes. Previous versions of the Canadian Land Surface Scheme (CLASS) were tested extensively in boreal forests, and version 3.0, completed in 2003, contains a number of improvements. Canopy conductance now varies with vegetation type, improvements to the treatment of snow processes and snow density in particular have been added, organic soils are now represented, and different surface types within a grid-cell can be represented as patches in a mosaic. The performance of CLASS version 2.7, the previous operational version, and CLASS 3.0, are evaluated using field measurements. Results are presented for off-line simulations in Canadian boreal forests from autumn through spring. The field sites, mature aspen, jack

pine, and black spruce stands, are located in central Saskatchewan, and were instrumented as part of the BERMS (Boreal Ecosystem Research and Monitoring Sites) study. Exchanges of energy and water are examined, with a focus on the simulation of the snow pack and snow processes.

B53A CC: 524 A Friday 1330h

Estuarine Ecosystems and Links to Upland Watersheds

Presiding: **D M Peteet,** NASA Goddard Institute for Space Studies**; P Louchouarn,** Lamont-Doherty Earth Observatory

B53A-01 1330h INVITED

The Global Carbon Sink in Tidal Salt Marshes

Gail L. Chmura (1-514-398-4958; chmura@geog.mcgill.ca)

Dept. of Geography & Centre for Climate and Global Change Research, McGill University 805 Sherbrooke St. W, Montreal, QC H3A 2K6, Canada

For decades researchers have concentrated on proving that C is exported from salt marshes to coastal waters, with limited success. Yet, the C retained in the marsh soils may be equally important. Presumptions that minor amounts of C are stored in salt marsh soils are based upon measurements of low percentages of C in many marshes. Simply measuring the organic matter content of marsh soils provides little indication of the amount or rate of C stored, as this parameter is based upon the percent by mass of the soil. The critical parameter to calculate is C density, derived from percent organic matter and bulk density. (The latter is often neglected in marsh soil studies.) Calculation of C density reveals that minerogenic soils with high bulk densities may have C densities or C storage rates equivalent to more organic soils with low bulk densities. A global average soil C density of $0.055 \pm 0.004 gcm^{-3}$ has been calculated from 107 measurements reported for salt marshes around the world (Gulf of Mexico, NE and NW Atlantic, Mediterranean and NE Pacific). Assuming an average marsh soil depth of 0.5 m and using inventories of marsh area available for Europe, Scandinavia, Africa, Canada and the U.S., the C stored globally in salt marshes is greater than $430 \pm 30 TgC$. The global carbon storage could be twice this as there are no marsh inventories available for Asia or South America. Rates of C storage can be calculated from 96 C density measurements where soil accretion rates also were measured. Globally, marshes sequester an average of $210 gCO_2 m^{-2} yr^{-1}$, an order of magnitude greater than rates reported for peatlands. Salt marsh C storage can have regional importance. At a magnitude of $5 TgC yr^{-1}$, tidal wetlands comprise 1–2 percent of the C sink (300–580 $TgC yr^{-1}$) estimated for the coterminous U.S. In the Bay of Fundy restoration of salt marshes reclaimed for agricultural land could enable sequestration of an additional 240 to 360 $GgC yr^{-1}$, equivalent to 4 to 6 percent of Canada's targeted reduction of 1990-level emissions of CO_2 under the Kyoto Protocol. The C sink in salt marsh soils has advantages over those in freshwater wetlands or terrestrial soils. Presence of abundant sulfate limits release of the potent greenhouse gas, methane, which can be released in substantial quantities from freshwater wetland soils. In salt marshes, turnover of C occurs on time scales of hundreds to thousands of years, whereas the C content of terrestrial soils reaches equilibrium in decades to 100 yr. In many marshes C sequestration will continue or perhaps increase with higher rates of sea level rise accompanying global warming, as soil accretion rates will be greater. However, human impacts on many salt marshes (altering hydrological regimes or displacing sediment supplies), such as those of the Mississippi Delta, limits their sustainability in the face of higher rates of sea level rise and the future of these C sinks is threatened. Future research on C storage in salt marshes must be directed at local controls, for there is as much variability in a single region (e.g., Long Island Sound or the Bay of Fundy) as there is globally. Intensive sampling at multiple elevations in a single marsh reveals C densities to be significantly greater at higher elevations, but rates of C accumulation decline with elevation. Controlling for this variability in elevation reveals that C density decreases with average annual temperature, thus greater understanding of local processes are critical to detect global patterns.

B53A-02 1345h

Marsh Sediment and Species Composition in Hudson River Tidal Marshes: Change over the Last Millennium

Dorothy M. Peteet[1,2] (845-365-8420; peteet@giss.nasa.gov); Dee Cabaniss Pederson[2] (845-365-8709; dcp@ldeo.columbia.edu); Dorothy Kurdyla[3]; Thomas Guilderson[3]; Deborah Kleinstein[2]; Patrick Higgiston[2]

[1]NASA/Goddard Institute, 2880 Broadway, New York, NY 10025, United States

[2]Lamont Doherty Earth Observatory, Route 9W, Palisades, NY 10964, United States

[3]Lawrence Livermore National Lab, 7000 East Ave, L-403, Livermore, CA 94550, United States

Understanding the signature of the Hudson River watershed to changes in the hydrological cycle is possible using marsh archives downriver. A suite of lower Hudson River tidal marshes is examined to identify changes in organic vs. inorganic content in the context of environmental change. Complex vegetational changes in the various marshes, identified by pollen and macrofossil studies, demonstrate the response to natural climate variability as well as human-induced changes of the last four centuries. While Piermont Marsh shows high inorganic content related to drought during the Medieval Warm Period, the subsequent Little Ice Age that followed shows a drop in this input. However, the nineteenth century of landscape disturbance reveals an increase again in upland watershed inorganics, followed by decline in the twentieth century. Jamaica Bay and Staten Island marshes to date show reduced inorganic input to these wetlands from the watershed up to the twentieth century. Jamaica Bay, NY marsh cores indicate increases in organic content in the twentieth century which may be related to dramatic land use changes in the surrounding New York area. An increase in the sand-sized fraction of organics may be attributed to the changes in local marsh plant production, but multiple hypotheses are being tested. Comparisons with adjacent Hackensack Meadowlands marshes demonstrate that local marsh plant production can dramatically alter the organic content and thus the carbon sequestration in the marshes. Species compositional changes in most of the marshes in the twentieth century resulted in a loss of biodiversity with the invasive increase of Typha (cattail) and Phragmites. This loss is linked to eutrophication of the estuary.

B53A-03 1400h

Subsurface Characterization of the San Jacinto Wetland Research Site

Jason Leik[1] (512-684-3124; jleik@trcsolutions.com)

James Bonner[2] (361-825-2646; bonner@cbi.tamucc.edu)

Cheryl Page[3] (cpage@cbi.tamucc.edu)

Robin Autenrieth[4] (r-autenrieth.tamu.edu)

[1]TRC Environmental Corporation, 505 East Huntland Drive, Austin, TX 78752, United States

[2]Conrad Blucher Institute for Surveying and Science, Texas A&M University-Corpus Christi 6300 Ocean Drive, Corpus Christi, TX 78412, United States

[3]Texas Engineering Experiment Station, Texas A&M University System, College Station, TX 77843-3136, United States

[4]Civil Engineering Department, Texas A&M University, College Station, TX 77843-3136, United States

Investigations of surface/groundwater coupling for contaminant flux were conducted for the San Jacinto Wetland Research Facility (SJWRF). The site is located in a four-hectare wetland on the south bank of the San Jacinto River, near Houston, Texas. This groundwater/surface water interaction study was a component of a multiphase petroleum remediation program. To determine the fate of petroleum contamination, the shallow groundwater of a wetland was characterized. The study area consists of a small, tidally-influenced cove surrounded by an intertidal wetland area. It is usually submerged on a diurnal cycle, barring extreme weather or tidal events. A thin layer (20-30 cm) of low-permeability clayey silt typical of low energy deposition overlays well-graded medium-to-fine-grained sand approximately 2.5-3 m thick. This is underlain by highly impermeable clay. A few dispersed clay lenses were encountered at a depth of 1-1.5 m, but were the exception rather than the rule. The site is equipped with an automated data collection system that records weather and water quality data. It also is used to collect surface and groundwater data from the twelve piezometers surrounding the cove, three 3-D groundwater flow sensors, and two surface water depth sensors. The objective of this research was to characterize the hydraulic flow patterns in the shallow subsurface of the wetland, as the data generated from this characterization can be used to predict the movement of contaminants in the subsurface. By determining water quality parameters for the groundwater at the site, significant physical, chemical, and biological processes can be determined. Hydraulic and physical-chemical characterization of the SJWRF site will allow predictions as to the fate and transport of contaminants in the shallow subsurface. Slug Testing was performed in twelve wells located around the perimeter of the site to determine hydraulic conductivity. They were situated in four groups of three wells, with the individual groups in a triangular formation to allow for horizontal gradient calculation. Values obtained by this method agreed with literature values for similar formations. Horizontal flow patterns were then determined by piezometric analysis and confirmed by In-Situ Permeable Flow Sensors. Piezometer response to changes in river stage indicated that the shallow subsurface water is confined from surface water. The average horizontal flow velocity was found to be 2 x 10^{-7} m/s. The average azimuth of all data from the cove was 210 degrees, trending towards the south-southwest in a direction consistent with river basin direction. Since the shallow subsurface water is confined and flow velocities are small, groundwater interaction with surface processes can be eliminated from consideration in developing remediation strategies.

B53A-04 1415h INVITED

Chesapeake Bay Sediments: An Archive of Natural and Anthropogenic Environmental Change

Debra A Willard (703-648-5320; dwillard@usgs.gov)

U.S. Geological Survey, 926A National Center 12201 Sunrise Valley Drive, Reston, VA 20192, United States

Estuarine sediments contain a unique combination of paleoclimatic and environmental proxies, integrating the pollen record of terrestrial ecosystems with a suite of estuarine organisms. Chesapeake Bay sediments provide a particularly detailed record of Holocene ecosystem variability because of high sedimentation rates (0.2 to 1 cm yr^{-1}) that exceed the temporal resolution available in most lacustrine or marine settings. Pollen assemblages from a suite of cores collected in Chesapeake Bay were used to develop a record of Holocene centennial to millennial-scale variability in the mid-Atlantic vegetation. This record indicates that a series of cool, drier events lasting ~300-500 years occurred every 1,400±300 years. The cool events are indicated by significant decreases in pine pollen abundance, interpreted as representing decreases of between 0.2° and 2° C. The timing of these events is correlated with a series of quasi-periodic cold intervals documented by other proxies in Greenland, North Atlantic, and Alaska and with solar minima interpreted from cosmogenic isotope records. These events may represent changes in circumpolar vortex size and configuration in response to intervals of decreased solar activity, which affects jet stream patterns over eastern North America. Changes in pollen assemblages during the cool, dry events likely represent subtle changes in forest composition as well as altered rates of pollen production. These natural compositional changes are minor compared to forest changes in response to Colonial land clearance, which had unprecedented impacts on forest structure, erosion rates within the watershed, sediment influx to the bay, and estuarine water quality. These records contrast the natural long-term variability of system with specific land-use changes of the past 250 years and provide a useful baseline for restoration goals in both the watershed and estuary.

B53A-05 1430h

The Role of Pulse Dynamics and Watershed-Scale Anthropogenic Impacts on Estuarine Cycling of Terrigenous Organic Matter

Patrick Louchouarn[1] ((212) 854-0479; pl2065@columbia.edu)

Stephane Houel[1] ((212) 854-2845; sh2157@columbia.edu)

Marc Lucotte[2] ((514) 987-3000 x3767; lucotte.marc$_{m}ichel@uqam.ca$)

[1]Columbia University, B-16 Hogan Hall 2910 Broadway, MC 4501, New York, NY 10027, United States

[2]University of Quebec in Montreal, GEOTOP C.P. 8888, Succ. Centre Ville, Montreal, PQ H3C 3P8, Canada

There still exists large uncertainties about the role that terrestrial organic matter (TOM) plays in riverine and estuarine bioproductivity and of the few studies that have addressed its dynamics in estuaries, most have failed to capture the range of hydrologic, seasonal, and land cover variability inherent in these systems. Temporal sampling of particulate fluxes in the water column of the St. Lawrence Estuary for example shows a huge contrast in both the quantity and quality

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