with bleached tissue have weakly-defined septal denticles, many appearing rudimentary. Significanly higher trace metal/Ca ratios were found with ICPAES for Ag, As, Cd, and Co between skeletal material associated with bleached and non-bleached tissue. The presence of these differences suggests the processes of skeletogenesis and the uptake and deposition of trace metals in the scleractinian skeleton are affected by bleaching. Such indicators might be observed in the fossil record as indicators of past environmental stress and bleaching in scleractinian corals.

B31A-03 0830h POSTER

Potential of MODIS Ocean Bands for Estimating CO2 Flux from Terrestrial Vegetation: A Novel Approach

Abdullah F Rahman[1] (765-285-1172; faiz@bsu.edu)

Vicente D Cordova[1] (vdcordova@bsu.edu)

John A Gamon[2] (jgamon@calstatela.edu)

Hans P Schmid[3] (hschmid@indiana.edu)

Daniel A Sims[1] (dasims@bsu.edu)

[1]Ball State University, Geography Department Room # CL-425, Muncie, IN 47306, United States

[2]California State University Los Angeles (CSULA), Dept. of Biology 5151 State Univ. Dr., Los Angeles, CA 90032, United States

[3]Indiana University, Geography Department, Bloomington, IN 47405, United States

A physiologically-driven spectral index calculated using two ocean-color bands of MODIS satellite sensor (bands 11 and 12) showed great potential to track seasonally changing photosynthetic light use efficiency (LUE) and stress-induced reduction in net primary productivity (NPP) of terrestrial vegetation. Consequently, we developed a simple model solely based on remotely sensed spectral data, which resulted in a dynamic, per-pixel 'continuous field' approach that could explain 88 percent of variability in flux-tower based daily NPP. These findings highlight the unexplored potential of narrow-band satellite sensors to improve estimates of spatial and temporal distribution in terrestrial carbon flux.

B31A-04 0830h POSTER

Residual Cloud Screening On MODIS LAI Products

mingzhen chen[1] (416-946-7715; chenm@geog.utoronto.ca)

Jing M Chen[1] (416-978-7085; chenj@geog.utoronto.ca)

Feng Deng[1] (416-946-7715; dengf@geog.utoronto.ca)

[1]Dept. of Geography, Univ. of Toronto, 100 St. George St. Room 5047, Toronto, ON M5S 3G3, Canada

Leaf area index (LAI) is a key variable in many ecosystem models and in global models of climate, hydrology, biogeochemistry and ecology, which need to describe the exchange of fluxes of energy and mass (e.g., water and CO2), and momentum between the surface and the atmosphere. The MODIS sensor onboard of Terra has been producing daily global coverages, from which 'cloud-free' composite images every 8 days are being produced. MOD15 is the LAI product of MODIS using the 8-day composite images. In order to use the data series for monitoring and modeling terrestrial ecosystems, additional quality control is necessary. A series of LAI maps of MOD15 over the entire China's landmass are processed. The most challenging issue in using the MOD15 product is the data quality related to the accuracy of LAI in all pixels labeled as 'cloud-free' and the screening of residual clouds. Test pixels of each land cover type are analyzed. The cloud-contaminated pixels labeled in MOD15 as 'significant clouds were present' and 'mixed cloud present on pixel' are excluded from further analysis. Cloudless pixels generally show LAI values in plausible ranges, except those of croplands and grasslands (from the Pack 3 algorithms) which appear to be abnormally high (larger than 6 in many cases). However, the main problem is the large LAI variations among remaining 'cloudless' dates for individual pixels. These are mostly residual cloud effects or errors in atmospheric corrections. Based on the seasonal trajectory of LAI, a cubic spline smoothing and interpolation technique is developed for residual cloud screening through analyzing the temporal variation patterns of a seasonal LAI series. The time series is first fitted using cubic spline smoothing with a curve smoothness controlling parameter, and abnormally low values in the time series are identified and replaced with fitted values. This procedure is repeated until the upper envelope is found. Once the final curve is determined, it is used to interpolate between final selected points to reconstruct the seasonal LAI variation. This approach has been applied to MOD 15 product in the whole year of 2001 over China to demonstrate its effectiveness.

B31B CC: 524 A Wednesday 0830h

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

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

B31B-01 0830h INVITED

How Does the Changing Environment Affect Concentrations, Fluxes and Properties of Dissolved Organic Matter in Soils?

Karsten Kalbitz (49-921-555624; karsten.kalbitz@bitoek.uni-bayreuth.de)

Dept. of Soil Ecology, Bayreuth Institute for Terrestrial Ecosystem Research (BITOEK), University of Bayreuth, Dr.-Hans-Frisch-Str. 1-3, Bayreuth D-95440, Germany

Environmental conditions influencing the release and fate of dissolved organic matter (DOM) in terrestrial and aquatic ecosystems have changed in the past and continue to change in the future. I studied effects of declining acidic deposition on concentrations and fluxes of dissolved organic carbon (DOC) using long-term soil solution data of two forest sites. The response of DOM to increased decomposition of soil organic matter caused by land use change (clear-cutting) and subsequently increased temperature will be examined at one forest site. Effects of an increased or decreased productivity of forests on DOM were studied by experimental manipulation of litter input to two forest soils. The central idea of all experiments carried out in the field was the response of DOM as a key driver in terrestrial and aquatic ecosystems to the changing environment. From the results of these experiments I conclude that accelerated decomposition of organic matter caused by temperature rise or land use changes should result in increasing concentrations and fluxes of DOC from soils into aquatic ecosystems. The larger stability of this additional DOM increases the importance of DOM for C sequestration in soils. The expected increased productivity of forest ecosystems should also result in increased DOC fluxes from soils. On the other hand, declining acidic deposition might result in smaller DOC fluxes into aquatic ecosystem if water passes through well developed soils with the capacity to sorb DOC.

B31B-02 0850h

Responses of Watershed DOC Export to Climatic Fluctuations: Mechanisms and Predictions

Ji-Hyung Park[1] (480-965-8165; jhp@asu.edu)

Myron J. Mitchell[2] (mitchell@mailbox.syr.edu)

[1]Arizona State University, School of Life Sciences, PO Box 874501, Tempe, AZ 85287, United States

[2]SUNY-College of Environmental Science and Forestry, Faculty of Environ. & Forest Biology, Syracuse, NY 13210, United States

Although various biogeochemical processes in forested watersheds have been linked to climatic fluctuations including warming, freezing, and drought, we still lack mechanistic understanding of responses of dissolved organic carbon (DOC) in soils and surface waters to climatic change and their implications for other biogeochemical cycles. We investigated responses of DOC export from a forested watershed in the Adirondack Mountains to climatic fluctuations during winter and spring snowmelt periods using intensive biogeochemical data and the PnET-BGC model. DOC concentrations in stream water draining the watershed showed positive responses to temperature rises and subsequent increases in runoff during snowmelt events from December through April. Concentrations of dissolved organic nitrogen (DON) showed a similar response pattern, while NO3 concentrations peaked before and tapered off during major spring snowmelt. Increased DOC concentrations during snowmelt events usually coincided with decreases in pH, consistent with the idea that DOC could offset increases in surface water pH caused by decreasing acidic deposition. The positive response of DOC and DON concentrations to increases in both temperature and runoff, along with concurrent decreases in ground snow depth, suggested that snowmelt responses to temperature fluctuations during winter and early spring might play a key role in interannual variations in watershed DOC export, as observed for NO3 export from the same watershed. No significant increases in precipitation are projected for this site in the entire 21st century compared to a constant warming trend projected. However, PnET-BGC simulations of runoff and DOC concentrations in steam water showed increases in both parameters from January through April, probably due to significant warming trend for this period. These results highlight the importance of winter and spring snowmelt events in hydrologically mediated responses of watershed DOC export to temperature fluctuations.

B31B-03 0905h

Effects of Catchment Characteristics and Disturbances on Storage and Export of Dissolved Organic Carbon in a Boreal Headwater Stream

Graham R. Hillman[1] (1-780-435-7260; ghillman@nrcan.gc.ca)

Joseph C. Feng[2] (1-780-436-9916)

Cecilia C. Feng[1] (1-780-435-7310; cfeng@nrcan.gc.ca)

Yonghe Wang[1] (1-780-435-7237; ywang@nrcan.gc.ca)

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

[2]Canadian Forest Service, 6303 - 125 Street, Edmonton, AB T6H 3V8, Canada

The transportation of large amounts of dissolved organic carbon (DOC) down a stream within a 15.51-km2 catchment in Alberta, Canada, related directly to events, such as high rainfall and beaver dam failures, that created major disturbances. A 2.3-km section of the stream was drastically altered in June 1994 when a flood wave resulting from a breached beaver dam deposited large amounts of debris and sediment within the section. Results from stream DOC storage analyses, in which a difference method was used, suggest that the organic debris dams created by the failed dam event served as both sources and sinks for DOC. Discharge and DOC measurements at hydrometric stations located at intervals along the stream indicated that storage of DOC in the stream was strongly influenced by the presence of wetlands and beaver (Castor canadensis). Disturbances occurring during periods totalling 28 days in 1994 and 17 days in 1995 accounted for 94% (1374 kgkm-2) and 84% (204 kgkm-2), respectively, of the amount of DOC exported from the catchment during the May-September period. DOC concentrations in the stream were greatest (77.0 mgL-1) near the top of the catchment where a 2-km2 fen served as the primary source of DOC. Stream DOC concentrations decreased progressively downstream to the catchment outlet where the mean concentration was 23.3 mgL-1.

B31B-04 0920h

Landscape Control of Dissolved Organic Matter Concentration and Chemistry in a Northern Michigan Watershed

Scott D. Bridgham[1] (bridgham@uoregon.edu); Paul C. Frost[2] (pfrost@nd.edu); James H. Larson[2] (jlarson1@nd.edu); Carol A. Johnston[3] (CAROL_JOHNSTON@SDSTATE.EDU); Katherine C. Young[4] (kdochert@nd.edu); Christine T. Cherrier[1] (cherrier@uoregon.edu); Gary A. Lamberti[2] (Gary.A.Lamberti.1@nd.edu); Patricia A. Maurice[4] (Patricia.A.Maurice.3@nd.edu); David M. Lodge[2] (Patricia.A.Maurice.3@nd.edu)

[1]University of Oregon, Center for Ecology and Evolutionary Biology, Eugene, OR 974035289, United States

[2]University of Notre Dame, Department of Biological Sciences, Notre Dame, IN 46556, United States

[3]South Dakota State University, Center for Biocomplexity Studies, Brookings, SD 57007, United States

[4]University of Notre Dame, Department of Civil Engineering and Geological Sciences, Notre Dame, IN 46556, United States

Dissolved organic matter (DOM) concentration, average molecular weight (M_w), and molar absorptivity were measured for 60 streams in the Ontonagon River watershed on the upper peninsula of Michigan in September 2002. Thirty-five of these streams have been sampled about every 2 months since. DOC concentration ranged from ~4 to 35 mg C L^{-1} across streams. DOM M_w and molar absorptivity also showed considerable variation among streams and seasons. Drainage density was the best single predictor of stream water DOC concentration ($r = 0.62$) of the landscape features (% of watershed in agriculture, evergreen forest, lake, woody wetland, and herbaceous wetland) and

stream geomorphological variables (stream length, watershed size, drainage density, slope) in the September 2002 sampling. Multiple factor regression and principle component analysis showed strong correlations between DOC concentration and stream drainage density, stream length, watershed area, and mean % slope in the watershed. Streams with higher DOC concentration also had higher DOM M_w and molar absorptivity, but the slope of this relationship changed seasonally. Moreover, DOM M_w and molar absorptivity were negatively correlated with drainage density and the percent of the watershed in open water. Despite the high cover of wetlands in the watershed, our results show that watershed geomorphology and land cover explain more variation in DOM concentration and physiochemistry than the prevalence of wetlands alone. Hydro-geological mechanisms operating in subwatersheds of contrasting geomorphology and land cover composition likely account for these patterns in stream water DOM concentration and physiochemistry.

B31B-05 0935h

Carbon Loss From Peatlands: A UK Perspective

Michael F Billett[1] (+44 (0) 131 445 8585; mbill@ceh.ac.uk)

Julian JC Dawson[2] (+44 (0) 1224 272692; j.j.dawson@abdn.ac.uk)

Diane Hope[3] (480 965 2887; diane.hope@asu.edu)

Sheila M Palmer[4] (315 443 2311; shpalmer@ecs.syr.edu)

[1]Michael Billett, Centre for Ecology and Hydrology, Bush Estate, Penicuik EH26 0QB, United Kingdom

[2]Julian Dawson, School of Biological Sciences, University of Aberdeen, Cruickshank Building, Aberdeen AB24 3UU, United Kingdom

[3]Diane Hope, Center for Environmental Studies, Arizona State University, PO Box 873211, Tempe, AZ 85287-3211, United States

[4]Sheila Palmer, Department of Civil and Environmental Engineering, Syracuse University, 220 Hinds Hall, Syracuse, NY 13244-1190, United States

Carbon budgets in UK peatlands are in the spotlight for two main reasons. Firstly the water supply industry, which in many parts of the country relies heavily on upland water sources, is concerned about increasing water colour, and secondly peatlands account for 50% of the total UK soil carbon store. It is therefore entirely relevant to ask the question whether these important long-term carbon stores are beginning to leak more carbon into surface waters, which at a certain threshold value will switch the mass balance of individual peatlands to net carbon loss. Streams draining UK peatlands are typically DOC-rich and it is not uncommon to measure concentrations and fluxes in excess of 15 mg L^{-1} and 100 kg C ha^{-1} yr^{-1}, respectively. We have recently measured DOC fluxes of 115-270 kg C ha^{-1} yr^{-1} from acidic catchments containing between 35 and 85% peat (Billett et al. 2004; Dawson et al. 2004). A full inventory of downstream carbon loss in streams draining these catchments increases riverine fluxes by 19-50% to values ranging from 137-323 kg C ha^{-1} yr^{-1}. This includes additional measurements of POC, DIC and free CO_2. Estimates of CO_2 lost by evasion from the stream surface in two catchments suggests that significant amounts of carbon (46-141 kg C ha^{-1} yr^{-1}) are lost via the stream-atmosphere pathway. Our work and others therefore shows that riverine fluxes from peatlands can exceed the annual long-term rate of carbon accumulation (200-300 kg C ha^{-1} yr^{-1}). UK peatlands would appear to be prone to increased DOC loss; the potential for disturbance is large, drainage networks are often dense (with good connectivity between the soil-stream system) and climatic variability is an important driver of both seasonal and long-term flux change. At the moment it is not possible to say whether a fundamental change is taking place in UK peatlands or whether we are now simply aware of all the loss terms and measuring each term more accurately. The combination of long-term NEE measurements with a complete inventory of streamwater carbon losses is clearly a powerful way of monitoring changes in the carbon balance of peatlands.
References Billett MF, Palmer SM, Hope D, Deacon C, Storeton-West R, Hargreaves KJ, Flechard C and Fowler D. 2004. Linking land-atmosphere-stream carbon fluxes. Global Biogeochemical Cycles 18, GB1024, doi:10.1029/2003GB002058. Dawson, JJC, Billett MF, Hope D, Palmer, SM and Deacon CM. 2004. Sources and sinks of aquatic carbon linked to a peatland stream continuum. Biogeochemistry (in press).

B31B-06 0950h

Carbon Cycling in a Northern Peatland

Charlotte Lucia Roehm[1,2] ((514) 843 6221; cl_roehm@yahoo.com)

Nigel T Roulet[1] (nigel.roulet@mcgill.ca)

[1]McGill University, 805 Sherbrooke Str. West, Montreal, Qc H3A 2K6, Canada

[2]UQAM, CP 8888, succursale Centre Ville, Montreal, Qc H3C 3P8, Canada

In peatland ecosystems, actual microbial activity is lower than the potential activity as a result of both substrate and nutrient limitations. Extracellular enzymatic hydrolysis is often considered the rate limiting step for the provision of fermentative products. Terminal mineralisation to CO_2 and CH_4 is dependent upon the rate and activity of the fermenting organisms and CH_4 is additionally hindered by the presence of competitive electron accepting processes such as iron and sulphate reduction. The aim of this study is to determine the spatial and temporal patterns of potential CO_2 and CH_4 production, DOC and fatty acid dynamics across a peatland complex. The results of this study show that the history and botanical composition are equally important to the pathway of terminal mineralization of C to CO_2 and CH_4. Under standard conditions, CH_4 contributes a small portion of total C mineralised. The presence of alternative electron accepting processes such as iron reduction were not likely inhibitory and did not contribute a large portion of the CO_2 produced. However, despite small concentrations of SO_4^{2-}, evidence of thiosulfate production and consumption in incubations supports the notion of sulphate recycling, resulting in competitiveness with methanogenesis. The addition of glucose and acetate resulted in a spatially variable response both within sites and between sites. Acetate additions in slurries did not stimulate potential CH4 production in the poorer Bog site. Additions of glucose resulted in the variable accumulation and utilisation of fatty acids. The dynamics of this DOC pool are a reflective of the zone of fluctuation and mean annual water table depth. Microbial populations have a high affinity to labile sources of carbon and are influenced by the presence of alternative processes. Despite small concentrations, SO_4^{2-} can be a potentially large source of CO_2 production and CH_4 limitation in certain peat environments. Fatty acids as intermediates for terminal C mineralization are seen as key players in peatland ecosystems.

B32A CC: 524 A Wednesday 1030h

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

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

B32A-01 1030h INVITED

Coupling of carbon and nitrogen cycles through humic redox reactions in an alpine stream

Diane McKnight[1] (303 492-4687; diane.mcknight@colorado.edu)

Rose Cory[1] (303 735-0819; rose.cory@colorado.edu)

Matt Miller[1] (303 735-2495; matt.miller-1@colorado.edu)

Mark Williams[1] (303 492-7909; mark.williams@colorado.edu)

[1]INSTAAR, 1560 30th St., Boulder, CO 80309, United States

Humic substances are a heterogeneous class of moderate molecular weight, yellow-colored bio-molecules present in all soils, sediments and natural waters. Although humic substances are generally resistant to microbial degradation under anaerobic conditions, some microorganisms in soils and sediments can use quinone moieties in humic substances as electron acceptors or as electron shuttles in the microbial reduction of ferric iron. In turn, ferrous iron can reduce nitrate, facilitating the formation of organic nitrogen moieties. Field studies of humic electron shuttling processes can be carried out by characterizing the oxidation state of quinone moieties in humic substances at natural concentrations using fluorescence spectroscopy. We have used fluorescence spectroscopy to show that humic substances are important in electron transport reactions in coastal marine sediments and in the water columns of ice-covered lakes. Gradients in humic redox state may also occur as stream water is exchanged with water in associated hyporheic zones. We conducted a conservative tracer injection experiment in an alpine stream-wetland system located in the Front Range of the Colorado Rocky Mountains. In this system, concentrations of nitrate and dissolved organic carbon both increase with the onset of snowmelt as nitrate deposited in the snowpack is mobilized and DOC is flushed from upper soil horizons. During the tracer experiment, we sampled wells adjacent to the stream and found that lower nitrate concentrations occurred in wells with slower hyporheic exchange and more reduced dissolved humic substances. These results suggest that humic redox shuttling may be an important process linking carbon, nitrogen and iron cycling in watersheds.

B32A-02 1050h

Redox reactions of dissolved organic matter contribute to anaerobic sulphur cycling in peatland soils

Christian Blodau[1] (49 921552223; christian.blodau@uni-bayreuth.de)

Ranz Margit[1] (49 921 552221; margit.ranz@us.army.mil)

Mayer Bernhard[3] (1 (403) 220 5389; bmayer@ucalgary.ca)

Tim R Moore[2] (1-514-398-4961; moore@felix.geog.mcgill.ca)

[1]Limnological Research Station University of Bayreuth, Universitätsstrasse 30, Bayreuth 95445, Germany

[2]Department of Geography McGill University, 805 Sherbrooke Street West, Montreal, QC H3A2L6, Canada

[3]Applied Geochemistry Group Department of Geology & Geophysics University of Calgary, 2500 University Drive NW, Calgary, Al T2N 1N4, Canada

Sulphate reduction rates in wetland soils typically account for a large fraction of the anaerobic electron flow, despite small pool sizes of sulphate in the pore waters. The studies objective was to test the hypothesis that recycling of sulphur occurs and that redox-reactions of dissolved organic matter (DOM) are involved in the recycling process. To examine the recycling process we used peat mesocosm from two peatlands in Ontario, Canada and subjected them to sulphur deposition and vertical water flow of about 2 mm/day. Depth profiles of DOC and sulphate concentrations were determined and vertical mass balances calculated. In addition we determined 34S sulphate profiles of pore waters. Batch experiments with addition of H2S to solutions of standard peat humic acid (Pahokee Peat, IHSS) were used to determine whether H2S was oxidized by humic acids, and what the reaction products were. Enrichment with 34S at intermediate depths, constant sulphate concentrations with depth and absence of oxygen suggested that sulphate reduction and anaerobic sulphate release concurrently occurred. In the batch experiments two apparent reactions of H2S with DOM were observed. In the fast initial reaction, H2S was oxidized mostly to elemental sulphur and secondarily to sulphate. Production of thiosulfate was not observed. In a slower reaction step H2S was further consumed and the sum of dissolved inorganic forms of sulphur in the pore water decreased. This was interpreted as H2S being incorporated into the organic substance. No systematic relationship between pH and the oxidation process was found. Overall the results suggest that dissolved organic matter is involved in an anaerobic sulphur cycle allowing for high rates of sulphate reduction in sulphate-poor peatlands.
URL: http://www.geo.uni-bayreuth.de/hydrologie/mitarbeiter/index.php?mitid=15&lang=en

B32A-03 1105h

The Flux and Concentration of DOC in Surface Waters in Northern Sweden is Particularly Susceptible to Changes in Winter Conditions

Hjalmar Laudon[1] (+46-90-7866625; Hjalmar.Laudon@sek.slu.se)

Ishi Buffam[1] (+46-90-7866647; Ishi.Buffam@sek.slu.se)

[1]SLU, Sweden, Forest Ecology, Umeå 901 83, Sweden

In the boreal region of northern Sweden, where approximately four weeks of snow melt provides close to 50% of the annual runoff, winter conditions and the transition to spring plays a key role in controlling the flux and concentration of dissolved organic carbon (DOC). Because of the long winters in northern Sweden, with an average snow cover of 170 days per year, changes in the snow cover or amount and timing of snow melt could significantly alter the DOC dynamics during the spring flood period. We report on a study involving fifteen boreal catchments in northern Sweden monitored during the spring flood to examine the DOC variability in relation with catchment characteristics, in combination with a soil frost manipulation study. The results suggests that the amount and timing of snow melt and the extent of soil frost can have large influence on the DOC concentration in small streams and rivers in the region. Because much of the pH decline in northern Sweden during the spring flood is attributed to natural variability in DOC, a further concentration