mass-spectrometer (HPLC-MS) to examine the distribution of intact polar lipids from microbial isolates and surface sediments that are relevant for the study of deep subsurface biospheres. Structural features of bacterial and archaeal-derived polar lipids are identified on the basis of their sequential fragmentation in an ion-trap mass spectrometer upon electrospray ionization. Additional details are obtained from a series of chemical degradations designed to release alkyl units of the polar lipids rendering them analyzable by conventional gas-chromatography-mass-spectrometry (GC-MS). Fingerprints of polar lipids from microbial isolates allow distinction of taxonomically closely related prokaryotes. Moreover, sediments from seep environments in Eel River Basin and Guaymas Basin that host anaerobic methanotrophic communities are both dominated by similar types of glycosyl biphytanyl tetraethers suggestive of a predominant low-diversity archaeal assemblage. First applications of this technique to sediments from the deep subsurface will be presented.

B11B-0746 0830h POSTER

Interaction of *Pseudomonas fluorescens* with Eu(III) and Ce(IV) Desferrioxamine Complexes

Takahiro Yoshida[1] (+81-29-282-5361; yoshida@sparclt.tokai.jaeri.go.jp)

Takuo Ozaki[1] (+81-29-282-5361; tozaki@popsvr.tokai.jaeri.go.jp)

Toshihiko Ohnuki[1] (+81-29-282-5361; ohnuki@sparclt.tokai.jaeri.go.jp)

Arokiasamy Francis[1,2] (631-344-2959; francis1@bnl.gov)

[1]Japan Atomic Energy Research Institute, Advanced Science Research Center, Tokai, Ibaraki 319-1195, Japan

[2]Brookhaven National Laboratory, Environmental Sciences Department, Upton, NY 11973, United States

Naturally occurring chelating agents-, such as siderophores, are able to form complexes with actinides and enhance their solubility and mobility in the environment. Adsorption and/or biodegradation of chelated actinides by microorganisms are important processes which regulate their mobility in the natural environment.

In this study, association of Eu(III), Ce(IV), and Fe(III) desferrioxamine B (DFO) complexes with aerobic bacterium, *Pseudomonas fluorescens* (ATCC 55241), was investigated-, Eu(III) and Ce(IV) were used as analogues to trivalent and tetravalent actinides, respectively. When 20 μM of 1:1 Eu(III) - and Ce(IV) DFO complexes were incubated with *P. fluorescens* in 0.1 M Tris-HCl buffer (pH = 7.3), the metals were removed from solution, with no change in DFO in solution. With decreasing metal/DFO molar ratio from 1 to 0.01, the accumulation of Eu(III) and Ce(IV) by *P. fluorescens* decreased. Kinetics study showed that accumulation of Eu(III) reached the maximum within 30 minutes, and then it decreased slightly with time. On the other hand, Ce(IV) accumulation proceeded in a parabolic process where the kinetics was slower than that of Eu(III) accumulation. In comparison to Eu(III) and Ce(IV), the removal of Fe(III) added as a DFO complex by *P. fluorescens* was not observed. The formation constants (log K) of Eu(III) - DFO and Fe(III) - DFO are reported to be 15 and 30.6, respectively.

These results suggest that Eu(III) DFO complex was dissociated in the presence of bacteria cells and was readily biosorbed.

B11B-0747 0830h POSTER

ATR-FTIR Spectroscopic and Ab-initio Theoretical Studies of the Coordination Geometry of Oxalate Anions at Mineral-Water Interfaces.

Tae Hyun Yoon[1] (taeyoon@stanford.edu)

Gordon E Brown[1,2] (gordon@pangea.stanford.edu)

[1]Stanford University, Surface Aqueous Geochemistry Group, Department of Geological Environmental Sciences, Stanford, CA 94305-2115, United States

[2]Stanford Synchrotron Radiation Laboratory, SLAC, 2575 Sand Hill Rd., MS. 99, Menlo Park, CA 94025, United States

Oxalate is the smallest dicarboxylate ligand and one of the most abundant low-molecular weight organic acids in nature, originating from secretions by plant roots, bacteria and fungi in rhizospheres of plant roots. In addition to its structural simplicity and natural abundance, oxalate also has a strong adsorption affinity for mineral surfaces and is known to catalyze mineral dissolution reactions. We have studied the coordination geometry of oxalate anions adsorbed at boehmite (g-AlOOH)/water and corundum (a-Al2O3)/water interfaces using in-situ ATR-FTIR spectroscopy combined with ab-initio quantum chemical geometry optimizations and IR vibration frequency calculations. To attain a more realistic simulation of the oxalate-aluminum oxide complex, we used an Al8O12 cluster as the adsorption substrate and conducted calculations using HF/6-31+G*(3-21G) basis sets for three possible surface complexation models, including (a) bidentate side-on coordination with 5-membered ring formation, (b) monodentate end-on coordination without ring formation, and (c) bidentate end-on coordination with 4-membered ring formation. Model (a) is energetically preferred to models (b) and (c). It is also preferred to a simplified model of the hydrated aluminum oxide surface, in which one water molecule is bonded to a surface Al atom. Further IR frequency calculations using models (a), (b), and (c) and comparison with the observed data support the above energetic considerations; the predicted frequencies for model (a) match very well with the FTIR spectra of the oxalate-boehmite and oxalate-corundum samples, while those from models (b) and (c) show significant deviations. From this comparison of theoretical experimental results, we conclude that the most probable coordination geometry for individual oxalate anions adsorbed on aluminum-(oxyhydr)oxides is bidentate side-on coordination with 5-membered ring formation. This finding helps explain the strong observed uptake of oxalate on aluminum-(oxyhydr)oxides and its role in the dissolution of metal oxides.

B11B-0748 0830h POSTER

Mechanisms of Eu(III) and Cm(III) Association With *Chlorella Vulgaris*

Takuo Ozaki[1] (+81-29-284-3518; tozaki@popsvr.tokai.jaeri.go.jp)

Takaumi Kimura[1] (+81-29-282-5493; kimura@analchem.tokai.jaeri.go.jp)

Toshihiko Ohnuki[1] (+81-29-282-5361; Ohnuki@sparclt.tokai.jaeri.go.jp)

Arokiasamy J. Francis[1,2] (+1-631-344-4534; francis1@bnl.gov)

[1]Japan Atomic Energy Research Institute, Advanced Science Research Center, Tokai 319-1195, Japan

[2]Brookhaven National Laboratory, Environmental Science Department, Upton, NY 11973, United States

Association of Eu(III) and Cm(III) with *Chlorella vulgaris* and cellulose was studied by a batch method, time-resolved laser-induced fluorescence spectroscopy (TRLFS) and extended X-ray absorption fine structure (EXAFS). The kinetics study performed by a batch method showed that the maximum adsorption of Eu(III) and Cm(III) on *C. vulgaris* was attained within three minutes of contact time, and afterwards the percentage adsorption decreased with time due to exudates released from *C. vulgaris* with affinity for Eu(III) and Cm(III). TRLFS showed that the short-term adsorption of Eu(III) on *C. vulgaris* was attributed to their coordination with the cell wall components comprised of cellulose. TRLFS also demonstrated that Eu(III) coordinated with the functional groups of cellulose very weakly in spite of the large distribution coefficients observed. EXAFS analysis showed the local structure around the Eu(III) adsorbed on cellulose and with *C. vulgaris* was similar. These results indicate that the reactions both at cell surfaces through the adsorption as well as in solution phases through chelation with the exudates are important in estimating the environmental behavior of Eu(III) and Cm(III) in aqueous environments.

B11B-0749 0830h POSTER

Cytochrome c Biogenesis Genes Involved in Arsenate Respiration by Shewanella trabarsenatis ANA-3

Yongqin Jiao (jyq@gps.caltech.edu)

Chad W Saltokov (saltokov@gps.caltech.edu)

Dianne K Newman[1] (dkn@gps.caltech.edu)

[1]California Institute of Technology, Division of Geological and Planetary Sciences Mail Stop 100-23, Pasadena, CA 91125, United States

Arsenate can be used as a terminal electron acceptor in anaerobic respiration by diverse bacteria. The detection of these bacteria in numerous contaminated environments suggests that they are widespread and metabolically active in nature. Arsenate-respiring bacteria have been implicated in the mobilization of arsenic from arsenic-contaminated sediments. However, the enzymatic mechanisms supporting arsenate respiration are largely unknown. Here, we describe c-type cytochromes that are involved in arsenate respiration by the bacterium Shewanella trabarsenatis strain ANA-3, a facultative anaerobe that is able to use a variety of electron acceptors for growth. We performed transposon mutagenesis to study the electron transport pathway in ANA-3 during arsenate respiration. 10 arsenate-respiration deficient mutants were found after screening up to 7,000 mutants, and 4 were shown to have unique transposon insertions through Southern Blot analysis. The physiological properties of these mutants were determined, including characterization of their growth on different electron acceptors. The genes flanking the transposon insertions were sequenced for each mutant, and several were found to encode c-type cytochrome biogenesis genes. UV/VIS spectra and SDS/PAGE were used to confirm the absence of c-type cytochromes in the mutants. Based on these findings, we proposed a model for respiratory electron transport to arsenate.

B11C MCC: Hall C Monday 0830h

Water, Energy, and Carbon Exchange in Forest Systems III Posters *(joint with A, H, GC)*

Presiding: **B Law,** Oregon State University**; P Thornton,** National Center for Atmospheric Research**; D Baldocchi,** University of California, Berkeley

B11C-0750 0830h POSTER

Spatial Variability of Carbon Fluxes and Soil Respiration Within the Understory of a Pacific Northwest Old-Growth Forest

Matthias Falk[1] (530-752-1868; mbfalk@ucdavis.edu)

Kyaw Tha Paw U[1] (ktpawu@ucdavis.edu)

Matt Schroeder[1] (mschroeder@ucdavis.edu)

[1]Atmospheric Science Group / L.A.W.R. University of California, Davis, 131 Hoagland Hall, Davis, CA 95616, United States

We present data and analysis on the spatial heterogeneity of carbon fluxes measured by 2 additional eddy covariance systems in the forest understory at the Wind River Canopy Crane AMERIFLUX site. The Crane is located in a Pacific Northwest Old-growth Forest with trees up to 500 years old and 65 meters tall. A permanent eddy covariance station consisting of a Gill-Solent HS Research sonic anemometer and a LiCor LI6262 closed-path InfraRed Gas Analyzer (IRGA) has been operated for over 4 years at a height of 2.5 meters to complement an identical system measuring total ecosystem exchange at a height of 70 meters. Two additional eddy covariance systems, consisting of Campbell CSAT-3 sonic anemometers and open-path IRGAs (LiCor 7500 and NOAA probe) were located in the understory along a 200 m transect for a period of 13 months. The forest structure is complex with seven gymnosperm and two angiosperm tree species in the 2.3 ha crane circle, large amounts of woody debris on the forest floor, and a diverse understory. Soil respiration is a major contributor to the carbon budget at the site. The long-term understory Eddy-covariance data indicate the release of carbon from the soil to be as large as 11 tC ha^{-1} yr^{-1} with maximum values of 6 to 8 μ mol m^{-1} s^{-1}. The Net ecosystem carbon exchange (NEE) estimated by eddy-covariance ranges from a sink of 1.9 tC ha^{-1} yr^{-1} to a source of 0.5 tC ha^{-1} yr^{-1}. In this study we investigate the spatial and temporal dynamics of carbon fluxes within the canopy understory.

B11C-0751 0830h POSTER

of Horizontal Advection of Carbon Dioxide Within a Forest Canopy

Matt Schroeder[1] (509-427-7216; mschroeder@ucdavis.edu)

Matthias Falk[1] (530-752-1868; mbfalk@ucdavis.edu)

Kyaw Tha Paw U[1] (ktpawu@ucdavis.edu)

[1]Atmospheric Science Group / L.A.W.R. University of California, Davis, 131 Hoagland Hall, Davis, CA 95616, United States

We present methodology, data and analysis on the horizontal advection of Carbon Dioxide within the understory at the Wind River Canopy Crane AMERIFLUX site. The Crane is located in a Pacific Northwest Old-growth Forest with trees up to 500 years old and 65 meters tall. The forest structure is complex with seven gymnosperm and two angiosperm tree species in the 2.3 ha crane circle, large amounts of woody debris on the forest floor, and a diverse understory. Data presented was collected using a 3-dimensional CO2/H2O profile system using LiCor LI6262 and LI7000 closed-path InfraRed Gas Analyzers (IRGA) with a total of

15 intakes distributed on the tower and throughout the canopy. Additional data was acquired using permanent eddy covariance stations consisting of a Gill-Solent HS Research sonic anemometer and a LiCor LI6262 IRGA, which have been operated for over 4 years at a height of 2.5 meters to complement an identical system measuring total ecosystem exchange at a height of 70 meters. Supplementary micro-meteorological data was collected by a vertical profile of 8 stations. Advection of Carbon Dioxide was calculated using horizontal concentration differences and mean wind speed and direction for half-hour periods. The Net ecosystem carbon exchange (NEE) estimated by eddy-covariance ranges from a sink of 1.9 tC ha^{-1} yr^{-1} to a source of 0.5 tC ha^{-1} yr^{-1}. The long-term understory eddy covariance data indicate the release of carbon from the soil to be as large as 11 tC ha^{-1} yr^{-1} with maximum values of 6 to 8 μ mol m^{-1} s^{-1}. Preliminary data show that advection can account for 20% of Carbon Dioxide fluxes measured by eddy covariance.

B11C-0752 0830h POSTER

Carbon exchange and quantum efficiency of ecosystem carbon storage in mature deciduous and old-growth coniferous forest in central New England in 2001

Julian L. Hadley[1] (978-724-3302; jhadley@fas.harvard.edu)

Shawn P. Urbanski[2] (617-495-9624; spu@io.harvard.edu)

[1]Harvard University , Harvard Forest, 324 N. Main St., Petersham, MA 01366, United States

[2]Harvard University, Dept. of Earth and Planetary Sciences, Cambridge, MA 02138, United States

Carbon storage in forests of the northeastern U.S. and adjacent Canada may be a significant carbon sink, as forests and soils in this region have recovered after agricultural abandonment in the 19th century. Data collected during the 1990's showed that an area of 70 to 100 year old deciduous forest on abandoned farmland in central Massachusetts stored an average of 2.0 Mg C/ha/yr in trees and soil. During 2001 we measured carbon exchange and environmental parameters (above-canopy air temperature, atmospheric humidity, photosynthetically active radiation (PAR) and soil temperature) in both the 70-100 year old deciduous forest and in a nearby eastern hemlock (*Tsuga canadensis* L.)-dominated forest with trees up to 220 years old that was never cleared for agricultural use. The deciduous forest stored more than 4 Mg C/ ha in 2001, far higher than in any previous year since measurements started in 1991. Highest monthly deciduous forest carbon storage (1.8 - 1.9 Mg ha^{-1} $month^{-1}$) occurred in July and August. The hemlock forest stored about 3 Mg C/ha, with peak storage in April and May (0.8 - 0.9Mg C ha^{-1} $month^{-1}$), and little or no C storage during August. The differences in carbon storage between the two forests were related to differences in quantum use efficiency. Quantum efficiency of ecosystem carbon storage in the foliated deciduous forest averaged about 0.16 g C /mol PAR and was insensitive to temperature after leaf maturation. In contrast, the average hemlock forest quantum efficiency declined from about 0.10 g C /mol PAR at daily average above-canopy air temperature (T_{avg}) = 5 ^{o}C to zero quantum efficiency (no net carbon storage) at T_{avg} = 23 ^{o}C. Optimum temperatures for carbon storage in the hemlock forest occurred in April. Differences between the two forests are likely due primarily to a higher maximum photosynthetic rate and a more positive temperature response of leaf-level photosynthesis in red oak (the dominant deciduous species) as compared with eastern hemlock. Maintenance of high soil respiration in the hemlock forest during warm dry summer weather may also contribute to declining quantum efficiency of carbon storage in the hemlock forest during the summer.

B11C-0753 0830h POSTER

Canopy Quantum Efficiency in a Northern Hardwood Forest: the contributing roles of direct and diffuse PAR

Adrian V Rocha[1] (614-292-6454; rocha.2@ohio-state.edu)

Peter S Curtis[1] (614-292-0835; curtis.7@ohio-state.edu)

Christoph S Vogel[2] (616-539-8709; csvogel@umich.edu)

Hans Peter Schmid[3] (812-855-6125; hschmid@indiana.edu)

Hong-Bing Su[3] (812-856-5047; hsu@indiana.edu)

[1]The Ohio State University, 1735 Neil Ave., Columbus, OH 43210, United States

[2]University of Michigan Biological Station, 1800 Biological Station Road, Pellston, MI 49769, United States

[3]Indiana University, 120 Student Building, Bloomington, IN 47405, United States

Recent work has shown that the proportion of diffuse and direct photosynthetically active radiation (PAR) has an effect on canopy quantum efficiency (α), and on net ecosystem CO_2 exchange. It is not well known, however, how α under direct (α_r) and diffuse (α_f) PAR respond to changing atmospheric conditions or how these parameters vary across ecosystems. We quantified α_r and α_f in a mixed hardwood forest with an LAI of 3.7 in northern lower Michigan (45° 35$'$ N, 84° 42$'$ W) during the 1999 and 2000 growing seasons from hourly CO_2 flux and global PAR measurements made at the Univ. of Michigan Biological Station Ameriflux facility. Direct and diffuse PAR were calculated using a model that related diffuse PAR to the solar zenith angle (θ), the clearness index (k_t), and hourly global PAR measurements. Quantum efficiencies varied throughout the growing season with α_f being consistently higher than α_r for the two years. Mean α_f and α_r were 0.026/0.033 and 0.015/0.014 for the 1999/2000 seasons, respectively. Maximum α_f and α_r were attained early in the growing season (Julian Day <220) in both years with 2000 having ~10% higher $\alpha_{f(max)}$ and ~40% lower $\alpha_{r(max)}$ than observed in 1999. Our results also indicated that the responses of α_r and α_f to temperature and vpd were different and varied from year to year. This study stresses the importance of separating the direct and diffuse components of PAR in understanding biosphere and atmosphere carbon exchanges.

B11C-0754 0830h POSTER

Carbon Sequestration at the Howland Forest in Maine: Where Does the Carbon go?

Neal A Scott[1] (508-540-9900; nscott@whrc.org); David Y Hollinger[2] (davidh@hypatia.unh.edu); Eric A Davidson[1] (edavidson@whrc.org); Julia B Gaudinski[3] (gaudinsk@cats.ucsc.edu); Susan E Trumbore[4] (setrubmo@uci.edu); Holly Hughes[5] (rpt358@maine.edu); Jon Ranson[6] (jon@ltpmail.gsfc.nasa.gov)

[1]Woods Hole Research Center, PO Box 296, Woods Hole, MA 02543, United States

[2]USDA Forest Service, 271 Mast Road, Durham, NH 03824, United States

[3]Environmental Studies, UC Santa Cruz, 473 Integrated Sciences Building, Santa Cruz, CA 95064, United States

[4]Earth System Science, UC Irvine, 204 Physical Sciences Research Facility,, Irvine, CA 92697, United States

[5]U. Maine, Dept Plant, Soils, Env. Sciences, Env. Sciences Lab Room 201, Orono, ME 04469, United States

[6]Biospheric Sciences Branch, Code 923, NASA GSFC, Greenbelt, MD 20771, United States

Eddy covariance towers provide information on net carbon exchange between terrestrial ecosystems and the atmosphere, but they provide little information on the location of carbon sources and sinks. We measured net ecosystem exchange (NEE) of CO_2 in a mature, old-growth mixed spruce/hemlock/red maple forest at the Howland Forest beginning in 1996. Live biomass at Howland Forest is about 110 Mg C ha^{-1} in the stand with the eddy covariance tower. Between 1996 and 2000, Howland Forest was a net carbon sink, taking up on average about 1.95±0.46 Mg C ha^{-1} y^{-1}. Forest mensurational measurements between 1989 and 1998 indicate that, over this entire time period, carbon storage due to tree growth increased by about 1.65 Mg C ha^{-1} y^{-1}; about 23% of this carbon is stored in roots. However, mortality between 1998-2002 was about 0.28 Mg C ha^{-1} y^{-1}. Soil C storage also contributes to carbon sequestration, ranging from 0.07-0.24 Mg C ha^{-1} y^{-1} in well-drained soils; this does not include changes in soil C storage in poorly-drained soils (roughly 15% of the area). Down-dead wood, measured using the point-relascope method, contains about 4.1 Mg C ha^{-1}. Based on an empirical relationship between temperature and respiration, down-dead wood respires about 0.27 Mg C ha^{-1} y^{-1}, but estimates of input rates over four years suggests a similar rate of down-dead wood production; this pool appears to be neither gaining nor losing significant amounts of carbon. Standing dead wood contains about 10 Mg C ha^{-1}, but its contribution to NEE is poorly understood. Our results suggest that changes in carbon storage in live vegetation and soils contribute the most to carbon sequestration at Howland Forest and, within the estimates of uncertainty, equate to average NEE estimates over a four-year period.

B11C-0755 0830h POSTER

Climate Effects on Carbon and Water Exchange of Young and Intermediate-growth Ponderosa Pine Ecosystems in Central Oregon

Meredith R. Kurpius[1] (541-737-8473; meredith.kurpius@orst.edu)

James Irvine[2] (541-737-8456; james.irvine@orst.edu)

Beverly E. Law[2] (541-737-6111; bev.law@oregonstate.edu)

Michael H. Unsworth[1] (541-737-5428; unswortm@coas.oregonstate.edu)

[1]College of Oceanic and Atmospheric Science, Atmospheric Sciences, 104 Ocean Admin Bldg, Oregon State University, Corvallis, OR 97331-5503, United States

[2]Department of Forest Science, 321 Richardson Hall, Oregon State University, Corvallis, OR 97331-5752, United States

Carbon and water fluxes were measured continuously by eddy covariance above young- and intermediate-aged ponderosa pine (*Pinus ponderosa* Dougl. Ex P. & C. Laws.) stands in a seasonally semiarid environment in central Oregon. Ecophysiological measurements of processes contributing to fluxes were also made (soil CO_2 effluxes, transpiration). The young stand (YS) is ~17 years old, and has a total LAI of 1.5, with 40% of the leaf area in understory shrubs. The intermediate stand (IS), ~1.5 km from the YS, is ~56 years old, with total LAI ~3.1 (5% in understory shrubs). Our goal was to examine how seasonal weather patterns and age-related site characteristics affect CO_2 and H_2O exchange at these sites. Throughout the measurement period, water vapor exchange for both sites was similar in magnitude and trend. Net ecosystem exchange (NEE) was similar in magnitude (-1 to +1 mmol m^{-2} s^{-1}) for both sites from January 2002 through March. As the rainy season ended, carbon uptake at both sites increased in April, and reached a maximum in early June. Early summer daytime mean NEE was greater at the IS (-6 to -8 mmol m^{-2} s^{-1}) than at the YS (-3 to -4 mmol m^{-2} s^{-1}). While the YS had higher summer soil CO_2 efflux during this period, NEE remained higher at the IS due to higher GEP. Air temperature, vapor pressure deficit (VPD), and incident PAR were similar at both sites, but greater snow cover at the IS resulted in twice the soil moisture of the YS until July, when both sites reached low values (12% and 9%, respectively). A combination of higher leaf area and soil moisture likely accounts for higher early summer carbon uptake at the IS. NEE became strongly correlated with VPD in June as soil moisture levels were rapidly declining. VPD caused lowered NEE at both sites but the IS decreased more substantially than the YS and by mid-July NEE at both sites was -2 to -4 mmol m^{-2} s^{-1}. Even with the diminished carbon uptake at the IS due to the strong coupling between VPD and NEE, we expect the higher soil moisture and LAI at the IS to result in an overall greater net annual carbon uptake than at the YS.

B11C-0756 0830h POSTER

Partitioning Interannual Variability in Net Ecosystem Exchange into Two Causes – Climatic Variability and Functional Change: Method Development with Datasets from Duke Forest

Dafeng Hui[1] (405-325-5003; dafeng@ou.edu)

Yiqi Luo[1] (yluo@ou.edu)

Gabriel Katul[2] (gaby@duke.edu)

[1]Department of Botany and Microbiology, University of Oklahoma, Norman, OK 73019, United States

[2]Nicholas School of the Environment and Earth Sciences, Duke University, Durham, NC 27708, United States

Interannual variability (IAV) in net ecosystem exchange (NEE) is one of the most critical issues in ecosystem ecology. However, our understanding of IAV is extremely limited because of the difficulty in identifying causes of the variability. We proposed here that IAV in NEE is primarily caused by climatic variability via its direct effect and its induced functional change in ecosystem processes. We employed a homogeneity-of-slopes (HOS) model to identify the functional change for IAV in NEE and nighttime ecosystem respiration (R_E). The model is essentially based on multiple regression analysis to relate NEE and R_E with climatic variables and compute slopes of the regression lines using the data in individual years (b_i) as well as the data from all the years (b). If using different slopes for each year significantly improves the model fitting compared

to using one slope for all years, we consider the functional change exists. With the functional change detected, we partition observed variation in NEE or R_E to four components, respectively, due to the functional change, the direct effect of seasonal climate variation, the direct effect of climatic IAV, and random errors. We applied this approach to a dataset collected at the Duke Forest AmeriFlux site from August 1997 to December 2001. Our results indicated that the functional change, seasonal climate variation, climatic IAV, and random error explained 9.9, 59.9, 8.8, and 21.3%, respectively, of the observed variation in NEE and 10.0, 38.8, 5.5, and 43.8%, respectively, of the observed variation in R_E. The considerable contributions by the functional change to IAV in both R_E and NEE necessitate long-term measurements to develop predictive understanding of ecosystem carbon exchange.

B11C-0757 0830h POSTER

Interannual variability in energy and carbon exchange over a midwestern mixed hardwood deciduous forest

Andrew J Oliphant[1] (415-405-2143; andrewo@sfsu.edu); Sue Grimmond[2] (812-855-7971; grimmon@indiana.edu); Heidi Zutter[2] (hzutter@indiana.edu); Hans-Peter Schmid[2] (812-855-6125; hschmid@indiana.); Hong-Bing Su[2] (812-856-5047; hsu@indiana.edu); Steve Scott[2] (812-855-6265; stlscott@indiana.edu); Brian Bovard[2] (812-856-5725; bbovard@indiana.edu)

[1]San Francisco State University, Department of Geography and Human Environmental Studies, 1600 Holloway Avenue, San Francisco, CA 94132, United States

[2]Indiana University, Departmant of Geography, 701 E. Kirkwood Avenue, Bloomington, IN 47401, United States

The goal of this paper is to contribute to the understanding of seasonal and interannual variability of atmosphere-ecosystem exchange for a mixed hardwood deciduous forest. The analysis uses four years of continuous above canopy measurement of carbon and energy exchanges at the Morgan Monroe State Forest (MMSF), as well as energy storage within the forest/air/soil volume. Initially, methodological issues including sampling strategy, quality control, and gap-filling techniques are presented. Particular emphasis is placed on quantifying changes in near-surface volume energy storage, and finding evidence for non-closure and improved methods for forced closure of the complete energy balance. Seasonal and inter-annual variability of exchanges are then investigated. Seasonal variability is found to be significant and strongly linked to biophysical controls, as is commonly found in other deciduous ecosystems. However, year to year variability is remarkably small, both for carbon and energy exchanges, compared with other sites, despite significant interannual variability in climatic drivers. We hypothesize that diversity in species composition and stand age within the flux footprint buffer the effects of climatic variability. Methods for testing this hypothesis using spatial datasets and preliminary results are also presented.

B11C-0758 0830h POSTER

Energy, water and carbon dioxide fluxes measurements over a burned forest site near Yakutsk, Eastern Siberia

Go Iwahana[1] (go@pop.lowtem.hokudai.ac.jp); Larry Lopez[2]; Takashi Hirano[3]; Takashi Machimura[4]; Yoshikazu Kobayashi[5]; Masami Fukuda[1]

[1]Institute of Low Temperature Science, Hokkaido University, N19W8, Sapporo, Hok 060-0819, Japan

[2]Graduate school of Environment Science, Hokkaido University, N13W8, Sapporo, Hok 060-0819, Japan

[3]Graduate school of Agricultural Science, Hokkaido University, N13W9, Sapporo, Hok 060-0819, Japan

[4]Graduate school of engeeniring, Osaka University, Kitasenri, Osaka, Hok 060-0819, Japan

[5]North Eurasian Center, Hokkaido University, N12W8, Sapporo, Hok 060-0819, Japan

Micrometeorological measurements were made over a site which had been burned previous year by wild fire. Study area is located on the right bank of Lena Liver, 25km northwest of Yakutsk, Eastern Siberia. Wild fires burned over this area in places during late summer of 2001. The observation site was formally a mature larch stand with a mean crown height of about 18m. The fire front had passed this site in the middle of September 2001 and surface litter and moss layer with mean depth of approximately 10cm was thoroughly burned. Loosing main roots after the fire, almost all of trees in the area with diameter of 100m were fallen by winds and remained trees were cut down by the first day of the measurements. The observation period was from 25th July till 3rd September. The result of all energy balance components and CO2 flux measurements will be shown as a preliminary report. A quick vegetation recovery caused daytime absorption of CO2 Offsetting night time emission. The trend of CO2 and water vapor fluxes associated well with rain events indicates some vegetation activities. Impacts of the wild fire on radiation environment and active layer thermal regime of the active layer at this observation site are discussed.

B11C-0759 0830h POSTER

Above- and Belowground Net Primary Production of a Black Spruce Fire Chronosequence

Ben Bond-Lamberty[1] (bpbond@wisc.edu)

Chuankuan Wang[1] (ckwang@calshp.cals.wisc.edu)

Stith T Gower[1] (stgower@wisc.edu)

[1]University of Wisconsin-Madison, Department of Forest Ecology and Management 1630 Linden Drive 120, Madison, WI 53706, United States

Net primary production (NPP) was measured in seven different-aged sites comprising a fire chronosequence of black spruce-dominated boreal forest near Thompson, Manitoba. The sites burned in 1998, 1995, 1989, 1981, 1964, 1930, and 1870, and each contained separate well- and poorly-drained stands. Overstory, tree seedling, understory, bryophyte, coarse root, and fine root NPP were measured. Most components were measured for three consecutive years (1999-2001). Tree and seedling mortality was measured and accounted for.

Total NPP (NPP_T) was very low (50-100, all values in g C m^{-2} yr^{-1}) immediately after fire, peaked at 70 years after fire (328 and 297 in dry and wet stand respectively), and declined by 30-50% in the oldest 130-year stands. Aboveground NPP (ANPP) was mostly from deciduous seedlings and understory in the younger stands, but by 60 years black spruce dominated (>85%) production. Moss production was higher in the poorly-drained stands, while understory NPP was higher in the well-drained ones. Belowground NPP (BNPP) comprised between 5 and 40% of NPP_T, was dominated by fine roots, and generally increased in older stands; variability of fine root measurements was extremely high in the poorly-drained stands. Various components of NPP exhibited strong relationships with stand leaf area index. Year-to-year NPP variability was highest for the youngest stands and for understory and detritus production, and lowest for overstory production. These results emphasize the need to account for soil drainage and species succession in NPP modeling of boreal forests.

B11C-0760 0830h POSTER

Effects of Surface Fire on Hydraulic Characteristics of the Larch Trees in Eastern Siberia

Yoshikazu Kobayashi[1,2] (81-11-706-4535; yosikazu@pop.lowtem.hokudai.ac.jp)

Hideyuki Saito[3] (saitoo@for.agr.hokudai.ac.jp)

Masami Fukuda[4] (mfukuda@pop.lowtem.hokudai.ac.jp)

Alexander Nicolai Fedorov[5] (fedorov@mpi.ysn.ru)

[1]Japan Science and Technology Corporation, 2-1-13, Higashi-Ueno, Taito-ku, Tokyo 110-0015, Japan

[2]Research Center for North Eurasia and North Pacific Regions, Hokkaido University, W8 N9, Kita-ku, Sapporo 060-0809, Japan

[3]Laboratory of Silviculture, Graduate School of Agriculture, Hokkaido University, W8 N8, Kita-ku, Sapporo 060-8589, Japan

[4]Institute of Low Temperature Science, Hokkaido University, W8 N19, Kita-ku, Sapporo 060-0819, Japan

[5]Permafrost Institute, Siberian Branch, RAS, Yakutsk, 18, Yakutsk 677018, Russian Federation

Massive and frequent wildfires hit larch forests around Yakutsk region (eastern Siberia) in the spring of 2002. The base of larch tree suffered significant damage by surface fire, and scorched forest floors were observed after the wildfires. In the present study, we discuss the effects of spring surface fires on hydraulic characteristics of larch tree by comparing leaf, stem and soil water potentials, soil water content and sap fluxes observed at damaged larch tree by surface fire, intact or intact and watered larch trees. The field observations were conducted at a larch forest located at about 25 km northwest of Yakutsk, Russia. Seven test stands of larch were selected from three different plots in the larch forest; the first was a burnt plot, the second was an intact plot and the last one was intact and watered plot. The observation period was from 21 July to 2 August 2002. The leaf water potential of burnt larch trees was always 0.2 to 0.5 MPa less than that of intact larch trees, although the soil water content at burnt plot showed relatively higher than that at intact plot. We also observed that the sap flux of burnt larch tree was about 75 percent of that of intact larch tree. There was no obvious difference in the relationships between sap flux, and difference of water potential between stem and leaf for the burnt and intact larch trees. These results showed that the hydraulic conductivity of the burnt larch tree has been reduced due to the significant damage of water flow tissues around the base of burnt tree by surface fire. The thresholds of transpiration and leaf water potential of the intact larch tree in summer season were also discussed by the variation in sap fluxes and leaf water potentials observed at burnt, intact and watered plots.

B11C-0761 0830h POSTER

Short-term Changes in Carbon Cycle After Fire in a Birch Forest of West Siberia

Tomoko Nakano[1] (81-426-77-2595; nakanot@comp.metro-u.ac.jp); Chiho Asahi[2]; Wataru Takeuchi[3] (wataru@iis.u-tokyo.ac.jp); Shiro Ochi[3] (ochi@iis.u-tokyo.ac.jp); Gen Inoue[4] (inouegen@nies.go.jp); Masami Fukuda[5] (mfukuda@pop.lowtem.hokudai.ac.jp)

[1]Department of Geography, Tokyo Metropolitan University, 1-1 Minami-Osawa, Hachioji 192-0397, Japan

[2]Graduate School of Environmental Earth Science, Hokkaido University, Kita 10, Nishi 6, Sapporo 060-0810, Japan

[3]Institute of Industrial Science, University of Tokyo, 4-6-1 Komaba, Meguro, Tokyo 153-8505, Japan

[4]National Insititute for Environmental Studies, 16-2 Onogawa, Tsukuba 305-0053, Japan

[5]Institute of Low Temperature Science, Hokkaido University, Kita 19, Nishi 8, Sapporo 060-0819, Japan

Short-term changes in carbon exchange and carbon storage after the fire were investigated in a birch forest of West Siberia which had been burnt in July of 1998. CO2 and CH4 exchanges through the soil surface were measured with a closed-static chamber technique at both unburned and burnt areas in the summer of 1999 and 2000. A soil survey was also conducted in the summer of 2000 and 2001. Regeneration of vegetation in the burnt area was investigated using NOAA/AVHRR data with sub-pixel land cover characterization. The surface was covered with bare soil and open water in the summer of 1999 (one year after the fire). Then the vegetation gradually recovered and the NDVI had almost returned to the same levels as pre-fire conditions by the summer of 2001. CH4 was released from the surface to the atmosphere at the burnt area when the surface was wet, while CH4 flux became nearly zero as the soil dried and the vegetation was recovered. Soil respiration decreased considerably after the fire. From the results of the soil survey, it was found that the soil of the West Siberian birch forest contains a large amount of organic carbon. After the fire, thickness of the organic layer decreased by about 60 cm. It was suggested that a considerable amount of organic carbon was released into the atmosphere during the fire.

B11C-0762 0830h POSTER

Energy Balance and Modeled Evapotranspiration for a wet Tropical Forest in Costa Rica

H W Loescher[1] (541.737.8020; hank.loescher@oregonstate.edu)

H L Gholz[1]

J M Jacobs[2]

S F Oberbauer[3]

[1]School of Forest Resources and Conservation, University of Florida, Gainesville, FL 32611, United States

[2]Civil and Costal Engineering, University of Florida, Gainesville, FL 32611, United States

[3]Biological Sciences, Florida International University, Miami, FL 33199, United States

The effects of albedo, net radiation (Rn), vapor pressure deficit (VPD), and surface conductances on energy balance and evapotranspiration (ET) were determined for a wet tropical forest in NE Costa Rica from 1997-2000. Sensible (H) and latent heat (lE) fluxes were estimated by the combination of above-canopy turbulent exchange, eddy-covariance, and the change in below-canopy heat profiles. Albedo was ca. 12 percent of incident radiation and did not differ seasonally. Rn was significantly different between years

and explained ca. 79 percent of the variation in H and lE fluxes. The effects of VPD did not explain any addition variation in heat fluxes. lE was always greater than H fluxes when Rn greater than 40 W m-2. Understory heat fluxes were small and contributed little towards daily energy exchange, but may be significant when Rn is small. A dimensionless coefficient (W) was used to determine the relative importance of aerodynamic conductance (ga) and bulk canopy conductance (gb) on lE. During the day, W was greater than 0.6 and peaked at 0.85 suggesting that; the forest was decoupled from physiological controls, lE is more dependent on Rn, and ga exerts more control on lE than gb. Because of these results, both the Priestly-Taylor and the Penman-Monteith models preformed well using only Rn. Because the canopy is wet for ca. 32 percent of the time, there was better precision in estimating lE flux using the Priestly-Taylor model (with an empirically estimated a = 1.24), when the canopy was wet. Annual ET was ranged from 54 to 66 percent of bulk precipitation. Using a Rutter-type model, interception losses where 17-18 precent of bulk precipitation. The overall amount of energy needed for annual ET accounted for ca. 88-97 precent of total Rn.

B11C-0763 0830h POSTER

Re-Assessing the Measurement of Fogwater Inputs to a Tropical Ecosystem

Reto Burkard[1] (+41 31 631 85 42; burkard@giub.unibe.ch); Werner Eugster[1] (+41 31 631 85 51; eugster@giub.unibe.ch); Friso Holwerda[2] (holf@geo.vu.nl); Sampurno Bruijnzeel[2] (sampurno42@hotmail.com); Frederik N. Scatena[3] (fns@sas.upenn.edu); Rolf Siegwolf[4] (rolf.siegwolf@psi.ch)

[1]University of Bern, Institute of Geography, Hallerstrasse 12, Bern CH-3012, Switzerland

[2]Vrije Universiteit, Faculty of Earth and Life Sciences, De Boelelaan 1085, Amsterdam NL-1081, Netherlands

[3]Department of Earth and Environmental Science,University of Pennsylvania, 240 South 33rd Street 156 Hayden Hall, Philadelphia, PA 19104-6316, United States

[4]Paul Scherrer Institute, Laboratory of Atmospheric Chemistry, Laboratory of Atmospheric Chemistry, Villigen PSI CH-5232, Switzerland

For several years the hydrological importance of the fog- and cloudwater deposition to ecosystems in the tropics has been of great interest. In earlier studies carried out in the humid tropics the amount of deposited cloudwater was estimated by indirect methods based on the physical characteristics of the utilized cloudwater collector. In the temperate climatic zone of central Europe most of the studies dealing with cloudwater focus on the additional chemical input due to cloudwater in relation to the amount of deposited rainwater. During our experiment in the Luquillo mountains of Puerto Rico the different aspects of the chemical and hydrological impacts of cloudwater deposition have been investigated. During 43 days, cloudwater fluxes were measured with an eddy covariance setup consisting of a Solent ultrasonic anemometer and a size-resolving cloud droplet spectrometer. Cloudwater samples were taken with a Caltech-type active strand cloudwater collector. Additionally, measurements of rain, throughfall and stemflow were performed. Samples of fog, rain, throughfall and stemflow were analyzed for inorganic ion and stabile isotope concentrations (δ^{18}O and δ^{2}H).

First analysis of the hydrological input show that there exist some significant differences in the deposited amount of cloudwater as measured with our instruments in comparison with previous studies carried out at the same location: Mean liquid water content was 78.6 mg m^{-3} during situations with a visibility below 1000 m (84% of the entire field campaign). The deposition rate of cloudwater was 0.88 mm d^{-1}. A mismatch was found regarding the water balance. We conclude from this that the rainfall amount and therefore also the chemical input by rain is strongly underestimated due to wind-driven rain, which is not measured by standard rain gauges. Depending on the reference value, we have to conclude that the deposition of cloudwater accounts for 6–11% of wet deposition.

B11C-0764 0830h POSTER

Carbon Dioxide Flux in Mixed-grass Prairie: Response to Interannual Variation in Rainfall and Grazing History

Derek Esposito[1] (970-491-1565; dereke@cnr.colostate.edu)

Lisa Walsh (970-491-1565; lisawals@nrel.colostate.edu)

Jace Fahnestock (jace@nrel.colostate.edu)

Jeff Welker (jeff@nrel.colostate.edu)

[1]Natural Resource Ecology Lab, Colorado State University, Fort Collins, CO 80523-1499, United States

Grasslands are an important biome in the exchange of carbon between the biosphere and the atmosphere. However, our understanding of how carbon flux varies due to changes in precipitation, including drought conditions and land use history (grazing intensity) is only rudimentary. In this study we have evaluated the effects of adequate precipitation versus drought on net carbon flux, ecosystem respiration, and gross photosynthesis over three years (1998, 1999, and 2002) using chamber techniques. In addition, during 2002 measurements were taken across three grazing regimes (light, heavy, and ungrazed). Precipitation, or lack thereof, in 2002 made for a drought year compared to 1998 and 1999. The maximum rate of net carbon flux was lowest in 2002 at 3 mmol m-2 s-1 and highest in 1998 at 9 mmol m-2 s-1. Due to the drought conditions of 2002 grazing history had no affect on net flux rates. We propose that precipitation is the overriding factor that controls carbon flux in the mixed-grass prairie ecosystem, while land use has only marginal effects. Further data collected in a non-drought year is needed to corroborate this land use hypothesis.

B11C-0765 0830h POSTER

Comparison of CO2 and O2 concentrations in soil air: A lesson learned about CO2 diffusivity in soils

Alon Angert[1] (alon_a@mail.com)

Eric A Davidson[2] (edavidson@whrc.org)

Kathleen Savage[2] (savage@whrc.org)

Dan Yakir[3] (dan.yakir@weizmann.ac.il)

Boaz Luz[1] (boaz.luz@huji.ac.il)

[1]The Institute of Earth Sciences, The Hebrew University of Jerusalem, Givat-Ram, Jerusalem 91904, Israel

[2]The Woods Hole Research Center, P.O. Box 296,13 Church St., Woods Hole, MA 02543, United States

[3]Department of Environmental Sciences and Energy Research, Weizmann Institute of Science, Rehovot, Rehovot 76100, Israel

Soil respiration is a major component of the global carbon and oxygen cycles and accounts for about one quarter of global respiration. Since respiration consumes O2 and emits CO2, a simple relationship may be expected between the concentration of these gases in soil-air. However, because the [O2] signal in well-drained soils is small, deriving this relationship from field observations is not trivial. In this study, we present high accuracy measurements of O2 concentrations in soil air, that for the first time, enable precise comparison of these concentrations with CO2 concentrations. Soil air was sampled in two sites: an orchard in Israel, and a temperate forest (Harvard forest). The expected ratio of the decrease in [O2] in soil air to the increase in [CO2] can be calculated from the ratio of O2 consumption to CO2 emission in respiration, and the ratio between the diffusivities of these two gases in air as 0.79-0.07. The measured ratio of the decrease in [O2] to the increase in [CO2] in soil air was 0.56-2.48 in the orchard site and 1.06-1.20 in Harvard Forest. These ratios deviate strongly from the expected relationship. In the orchard site, these deviations were probably caused by reactions in the carbonate system due to the calcareous soil of this site. At Harvard Forest, such reactions cannot be quantitatively important because of the low pH of the soil. In this site, we propose that the relationship between CO2 and O2 in the soil air indicates that the ratio of diffusivity of O2 and CO2 in soils is higher than the diffusivity ratio in air. Our results demonstrate that a combination of high accuracy measurements of the O2 and CO2 in soil air is important for better understanding of the soil CO2 dynamics. Such observations will improve estimates of soil respiration that are based only on CO2 concentration and diffusivity.

B11C-0766 0830h POSTER

Partitioning of Soil Respiration Sources Using ^{14}C-Enriched Leaf Litter and Roots in a Temperate Forest, Oak Ridge, TN

Luz Maria Cisneros Dozal[1] (1-949- 824- 3444; cisnerol@uci.edu)

Susan Trumbore[1] (1-949-824-6142; setrumbo@uci.edu)

Paul Hanson[2] (1-865-574-5361; hansonpj@ornl.gov)

Xiaomei Xu[1] (1-949-824-1474)

[1]University of California, Irvine, Department of Earth System Science, Irvine, CA 92697-3100, United States

[2]Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN 37831-6422, United States

Leaf litter enriched in ^{14}C with values ranging from $+952^{o}/_{oo}$ to $+1055\ ^{o}/_{oo}$ and control leaf litter with Δ^{14}C of $+215\ ^{o}/_{oo}$ to $+230\ ^{o}/_{oo}$ were used to establish replicated plots on the Oak Ridge Reservation (ORR), Oak Ridge National Laboratory, Tennessee for tracking of soil carbon cycling. Our goal is to partition the heterotrophic and autotrophic components of total CO_2 emission from the soil. Measurements have been carried out in the summer of 2001 and 2002 at two sites (Walker Branch and TVA) that are on the same soil type, but that have different initial levels of ^{14}C resulting from a localized ecosystem-scale ^{14}C release event in 1999. Measurements include total soil respiration rates using a chamber technique, trapping of CO_2 evolved from chambers and from root respiration to determine ^{14}C and ^{13}C signatures, and incubations of soil and leaf litter in the laboratory to obtain rates of decomposition and ^{14}C and ^{13}C signatures from heterotrophic CO_2 sources. Total C fluxes (mg C/m^2-hr) varied among the sites by up to ~40%, with differences between enriched and control plots similar to site-to-site variation between TVA and Walker Branch. In May of 2002, the ^{14}C signature of the total CO_2 emitted from the enriched plots was always higher than that of the control plots in both sites, with averaged values of Δ^{14}C of $+493\ ^{o}/_{oo}$ and $+357\ ^{o}/_{oo}$ in TVA and of $+300\ ^{o}/_{oo}$ and $+156\ ^{o}/_{oo}$ in Walker Branch, for the enriched and control plots respectively. We use the mass balance equation,

$$\Delta^{14}C_{total} = F \times \Delta^{14}C_{leaf\ litter} + (1 - F) \times (\Delta^{14}C_{root\ and\ soil\ decomposition} + \Delta^{14}C_{roots\ respiration})$$

to estimate the contribution of leaf litter decomposition to the total CO_2 flux (F). Within any one site, the difference in the ^{14}C signature emitted from the soil between the two treatments should be directly proportional to the contribution of leaf litter decomposition only, since the other components (roots and soil decomposition and roots respiration) are assumed to remain the same for enriched and control plots. In both Walker Branch and TVA sites, we calculate leaf litter decomposition to be contributing 18% to the total CO_2 emission from the soil. In contrast, little difference between enriched and control plots was observed in August of 2001, when litter was quite dry, indicating that litter contribution to total soil respiration depends strongly on moisture content.

B11C-0767 0830h POSTER

Effects of Experimental Drought on Soil Respiration and Radiocarbon Efflux from a Temperate Forest Soil

Werner Borken[1] (wborken@whrc.org)

Kathleen Savage[1] (savage@whrc.org)

Eric A. Davidson[1] (508-540-9900; edavidson@whrc.org)

Susan E. Trumbore[2] (setrumbo@uci.edu)

[1]Woods Hole Research Center, PO Box 296, Woods Hole, MA 02543, United States

[2]University of California, Dept. of Earth Systems Science, Irvine, CA 92697-3100, United States

Soil respiration is affected by the water content of both mineral soil and organic horizons. A throughfall exclusion experiment was established at the Harvard Forest in central Massachusetts to quantify the importance of this variation. Weekly measurements of soil respiration began in the spring of 2001, with 4 manual flux chambers installed in each of 6 plots (5 x 5 m). In July 2001, sub-canopy roofs with translucent plastic panels were installed in 3 of the plots, while the other 3 control plots were left open. Temperature probes, TDR probes, and gas tubes were buried at 4 depths in each plot. DC half-bridges for measuring water content of organic material were installed in the O horizons. The roofs were removed in the autumn to allow leaf-fall and snowfall and were reinstalled in the spring of 2002. Hourly automated flux measurements, with one chamber in each of the 6 plots, were also started in the spring of 2002. Radiocarbon contents of CO_2 emissions and concentrations within the soil have been measured periodically. Soil respiration rates were similar in control and treatment plots throughout June 2001, but once throughfall exclusion began in July, the fluxes declined in the exclusion plots. During the 84 days of 2001 that the roofs were in place, 168 mm of throughfall was diverted, and the cumulative soil respiration was 30% lower in exclusion plots compared to control plots (241 and 341 g C m^{-2}, respectively). The automated chamber system revealed an increase in soil respiration

in the control plots within minutes of a precipitation event. Soil respiration declined to pre-wetting values at the same time that the litter layer dried, about 48 hours after wetting. The $\Delta^{14}CO_2$ from soil respiration ranged from 95 to $141^{o}/_{oo}$ in the control plots and from 88 to $263^{o}/_{oo}$ in the exclusion plots. The $\Delta^{14}CO_2$ from root respiration and recently fixed carbon (within 1 year) should be $77^{o}/_{oo}$ (the value of the atmosphere in 2001), so the observed values indicate that the decomposition of older C substrates (>1 year) with higher $\Delta^{14}C$ values contributed to the total CO_2 efflux. Variation between treatments and among dates revealed higher $\Delta^{14}C$ when CO_2 concentrations were lower, which occurred when the soil dried due to natural summer drought in the control plots and more severe drought in the exclusion plots. When the soil was moist, high rates of root respiration and decomposition of young substrates resulted in high soil CO_2 concentrations with relatively low $\Delta^{14}C$. Under dry conditions, root respiration produced less CO_2, while gradual decomposition of old, radiocarbon-rich substrates continues at low rates, resulting in low CO_2 concentrations with high $\Delta^{14}C$. Hence, drought responses differed between heterotrophic decomposition of old C substrates and root and microbial respiration of recently fixed C substrates.

B11C-0768 0830h POSTER

More New Carbon in the Soil of a Poplar Plantation Under Free Air Carbon Enrichment

Marcel R. Hoosbeek (+31 317 484109; marcel.hoosbeek@wur.nl)

Wageningen University, Laboratory of Soil Science and Geology P.O. Box 37, Wageningen, NL 6700AA, Netherlands

Early 1999 three FACE (Free Air Carbon Enrichment) and three control rings were installed on former agricultural fields near Viterbo, Italy. A 9 ha poplar plantation was established using hardwood cuttings. Within the rings two Populus species and one hybrid were planted (P. nigra, P. alba, P.x euramericana) at a density of 10000 per ha. The 314 m2 circular plots were divided in six sectors, with two sectors per species. Carbon enrichment was achieved by injection of pure CO2 through laser drilled holes in tubing mounted on telescopic poles. The average CO2 concentration was 544 +/- 48 micromol mol-1.

During the first year the total C content of the soils decreased on average from 1.05% to 0.95%. During the second and third year the total soil carbon content remained more or less stable, while no treatment effects could be detected due to the large C pool as compared to the annual C influx.

The d13C signature of the CO2 enrichment gas was close to that of ambient CO2, and could therefore not be used as an isotopic signal to follow the incorporation of new carbon into the soil carbon pool. Instead we used root ingrowth cores (40 cm deep, 4 cm in diameter) filled with sieved and well mixed C4 soil. This C4 soil with a d13C value of 18.33 was obtained from a similar soil that had been under corn for many years. For each incubation period, species and rings, two ingrowth cores were placed in the C3 soil. Fractions of new carbon were calculated with a simple mixing model. Multiplying these fractions with the total C content yielded the new C contents (by weight percentage).

During the first year no treatment effect was detected. During the second year, new soil C% under P. alba was respectively 0.12 under ambient and 0.15 under increased CO2 treatment (P= 0.07). The third year showed the same effect on new soil C%, i.e. with P. alba respectively 0.07 under ambient and 0.13 under increased CO2 treatment (P= 0.02), and with P. nigra respectively 0.08 under ambient and 0.15 under increased CO2 treatment (P= 0.01).

B11C-0769 0830h POSTER

Mathematical Modeling and In-Situ Measurements of Soil CO2/O2 Flux Dynamics

Vasile E Turcu[1] ((435) 797-2172; vasile@mendel.usu.edu)

Dani Or[2] (dani@engr.uconn.edu)

[1]Utah State University - Plants, Soils, and Biometeorology Department, 4820 Old Main Hill, Logan, UT 84319, United States

[2]University of Connecticut - Environmental Engineering Program, 261 Glenbrook Road, Unit 2037, Storrs, CT 06269, United States

Gaseous exchange between soil and atmosphere consist primarily of CO2 and O2 fluxes induced by concentration gradients resulting from respiration within the soil profile. Despite their crucial role in the biosphere, dynamics of CO2/O2 concentrations in soil and surface fluxes are rarely measured continuously. A new gradient-based method for continuous monitoring of soil CO2/O2 concentrations was tested in the laboratory and in the field and compared to closed-chamber measurements. In situ measurements were made in different plant communities within a semi-arid ecosystem. A one-dimensional vertical model for soil CO2/O2 fluxes that considers bio-geo-chemical and environmental factors within the basic governing equations for gaseous transport in porous media was developed. Comparisons between model simulations and continuous in-situ measurements of CO2 and O2 concentrations (and fluxes) were in reasonable agreement. Simultaneous measurements of soil CO2 and O2 concentrations provide insights on soil respiration characteristics such as the respiratory quotient (CO2/O2) that ranged from 0.7 to 1.2 and tended to remain remarkably stable under particular experimental conditions. Conversion of measured concentration gradients into surface fluxes was critically dependent on proper estimation of water content profile that affects soil diffusion coefficients. Continuous monitoring in the soil is particularly important following rainfall events where spatial (vertical) and temporal patterns of gaseous fluxes are complex and are unobservable by common surface chamber methods.

B11C-0770 0830h POSTER

Nitrogen Leaching During a Deciduous-to-Coniferous Successional Transition in Alaskas Boreal Forest.

Richard Brenner[1] (907-474-7929; ftreb@uaf.edu)

Jay Jones[1] (907-474-7972; ffjbj@uaf.edu)

Richard Boone[1] (907-474-7682; ffrdb@uaf.edu)

[1]University of Alaska Fairbanks, Institute of Arctic Biology, Fairbanks, AK 99775, United States

We measured lysimeter nitrate (NO3), ammonium (NH4) and dissolved organic nitrogen (DON) concentrations in order to assess the potential for nitrogen leaching over the course of a plant primary successional sequence in the boreal forest. Our study sites were floodplain stands of balsam poplar and white spruce in interior Alaska. These stand types encompass a major successional transition during which there is a decline in soil nitrogen cycling, plant primary productivity and soil temperatures. Soil water was collected weekly during the summers of 2000 and 2001 from lysimeters installed in the organic-mineral interface (~12 cm) and in deeper mineral soil (~40cm) of each stands type. NH4 levels were generally below detection limits (<10 ppb) throughout the course of the study with the NO3 concentrations accounting for the vast majority of inorganic N. Soil water NO3 concentrations in white spruce were significantly higher at 40 cm depth (0.572 mg NO3-N/L) than at 12 cm depth (0.129mg NO3-N/L) and were also significantly higher than the 40 cm depth in balsam poplar (0.198 mg NO3-N/L). DON concentrations decreased with depth in both stand types. Our results suggest that N leaching losses (as NO3) increase over primary succession from a deciduous- to a coniferous-dominated community. We speculate that NO3 losses in white spruce stands may be higher as assimilation by soil micro flora is retarded due to a reduction in soil temperature and available carbon.

B11C-0771 0830h POSTER

Predicting CO2 and Heat Sources-Sinks and Fluxes Within a Forest Canopy Using a Lagrangian Dispersion Model

Cheng-I Hsieh (hsieh@mail.ntust.edu.tw)

National Taiwan University, Department of Bioenvironmental Systems Engineering, Taipei 10673, Taiwan

This study proposes a two-dimensional Lagrangian stochastic dispersion model for estimating spatial and temporal variation of scalar sources, sinks, and fluxes within a forest canopy. Carbon dioxide and heat dispersion experiments were conducted for field testing the model. These experiments also provided data for field testing a newly developed one-dimensional Lagrangian analytical dispersion model by Warland and Thurtell (2000). In general, these two models produce similar scalar source-sink and flux distribution patterns. However, when advective transport is significant, the two-dimensional model marginally better reproduces the flux measurements. To drive these Lagrangian models, velocity statistics through the canopy volume must be a priori specified. The sensitivity of the computed sources, sinks, and fluxes to the description of the flow statistics was further examined. All in all, we found good agreement between model predicted and eddy-correlation measured CO2 and sensible heat fluxes.

B11C-0772 0830h POSTER

Xylem-transported Glucose as an Additional Carbon Source for Leaf Isoprene Formation in *Quercus Robur* L.

Martin Graus[1] (0043-512-507-6249; martin.graus@uibk.ac.at); Armin Wisthaler[1] (0043-512-507-6249; armin.wisthaler@uibk.ac.at); Armin Hansel[1] (0043-512-507-6245; armin.hansel@uibk.ac.at); Jürgen Kreuzwieser[2]; Heinz Rennenberg[2]; Jörg-Peter Schnitzler[3]

[1]Institut für Ionenphysik, Universität Innsbruck, Technikerstr. 25, Innsbruck 6020, Austria

[2]Institut für Forstbotanik und Baumphysiologie, Albert-Ludwigs-Universität, Freiburg, Georges-Köhler-Allee Geb. 053/054, Freiburg i. Br. 79110, Germany

[3]Institut für Meteorologie und Klimaforschung, Bereich Atmosphärische Umweltforschung (IMK-IFU); Forschungszentrum Karlsruhe GmbH, Kreuzeckbahnstr. 19, Garmisch-Partenkirch 82467, Germany

Isoprene is emitted from mature, photosynthesizing leaves of many plant species, particularly of trees. Current interest in understanding the biochemical and physiological mechanisms controlling isoprene formation is caused by the important role isoprene plays in atmospheric chemistry. Isoprene reacts with hydroxyl radicals (OH) thereby generating oxidizing agents such as ozone and organic peroxides. Ozone causes significant deterioration in air quality and can pose threats to human health therefore its control is a major goal in Europe and the United States.

In recent years, much progress has been made in elucidating the pathways of isoprene biosynthesis. Nevertheless the regulatory mechanisms controlling isoprene emission are not completely understood. Light and temperature appear to be the main factors controlling short-term variations in isoprene emission. Exposure of plants to $^{13}CO_2$ showed instantaneous assimilated carbon is the primary carbon source for isoprene formation. However, variations in diurnal and seasonal isoprene fluxes, which cannot be explained by temperature, light, and leaf development led to the suggestion that alternative carbon sources may exist contributing to isoprene emissions.

The aim of the present study was to test whether xylem-transported carbohydrates act as additional sources for isoprene biosynthesis. For this purpose, [U-^{13}C]α-D-glucose was fed to photosynthesizing leaves via the xylem of *Quercus robur* L. seedlings and the incorporation of glucose derived ^{13}C into emitted isoprene was monitored in real time using Proton-Transfer-Reaction Mass Spectrometry (PTR-MS).

A rapid incorporation of ^{13}C from xylem-fed glucose into single (mass 70) and double (mass 71) ^{13}C-labeled isoprene molecules was observed after a lag phase of approximately 5 to 10 minutes. This incorporation was temperature dependent and was highest (up to 13 % ^{13}C of total carbon emitted as isoprene) at the temperature optimum of isoprene emission (40 - 42 ^{o}C) when net assimilation was strongly reduced.

Fast dark-to-light transitions led to a strong single or double ^{13}C-labeling of isoprene from xylem-fed [U-^{13}C] glucose. During a time period of 10 - 15 minutes up to 86 % of all isoprene molecules became single or double ^{13}C-labelled, resulting in a ^{13}C-portion of up to 30 % of total carbon emitted as isoprene.

The results provide potential evidence that xylem-transported glucose or its degradation products can be used as additional precursors for isoprene biosynthesis and this carbon source becomes more important under conditions of limited photosynthesis.

B11D MCC: 132 Monday 0830h

Interactions of Permafrost With Climatic, Hydrologic, and Ecosystems Processes III *(joint with C, H, GC)*

Presiding: **C Ping,** University of Alaska, Fairbanks**; B Hallet,** University of Washington

B11D-01 0830h INVITED

Occurrence and origin of Talik in permafrost near Yakutsk in east Siberia

Masami FUKUDA[1] (81-11-706-5492; mfukuda@pop.lowtem.hokudai.ac.jp)

Tetsuo SUEYOSI[2] (41-1-632-4123; sueyoshi@vaw.baug.ethz.ch)