Next-Generation Ecosystem Experiments – NGEE Arctic

Quarterly Report
June 30, 2012

A progress report submitted to

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Department of Energy, Office of Science, Biological and Environmental Research

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NGEE Arctic Team Uses CT Technology to Analyze Permafrost Cores from Barrow

X-ray computed tomography (CT) is a noninvasive technique for characterizing and monitoring core processes in high spatial and temporal resolution. Researchers at LBNL, ORNL, and UAF recently collected cores of frozen soil or permafrost from the Barrow Environmental Observatory (BEO) near Barrow, Alaska. Cores were bar coded and transported to ORNL and LBNL where they will be analyzed in a variety of ways and data shared among NGEE Arctic science teams. Cores shipped to LBNL were subjected to X-ray computed tomography (CT), a noninvasive technique for characterizing and monitoring core processes in high spatial and temporal resolution. The LBNL-patented X-Ray CT system is being used to quantify freeze state dynamics of permafrost samples and its influence on geomechanical properties; the development of such constitutive relationships is critical for numerical simulation of permafrost deformation. Used in conjunction with freeze-thaw column experiments, the X-ray CT method will be useful for developing an understanding of how freeze-thaw states govern fluxes of water and gases, and organic carbon decomposition.

Permafrost cores arrived at LBNL from Barrow on April 18, 2012 in the morning and were immediately imaged by Tim Kneafsey using X-Ray Computerized Tomography.

Details at a Glance

Activities during the April 1 to June 30, 212 quarter include:

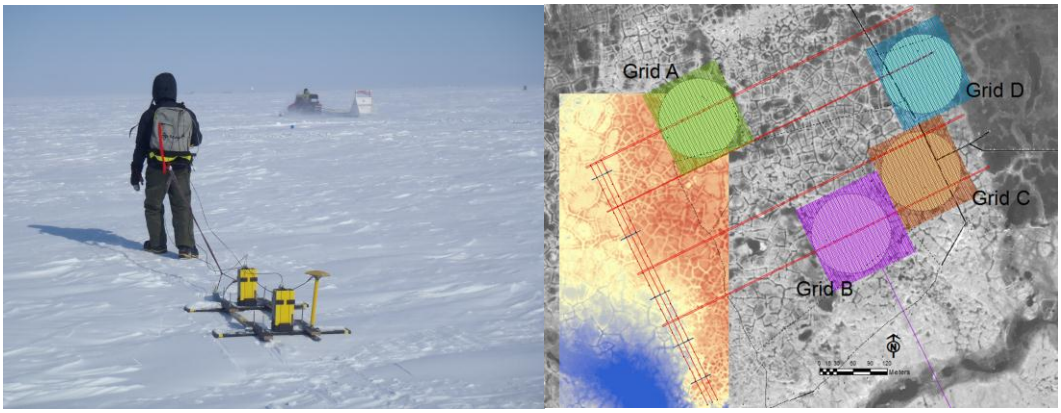
- NGEE Arctic field campaigns focus on geophysics, biogeochemistry, and hydrology
- LANL staff scientist attends hydrology workshop
- NGEE Arctic scientist visits EMSL
- NGEE Arctic develops and deploys permafrost simulator
- Model-experiment (MODEX) workshop attended by several NGEE Arctic investigators
- Footprint analysis completed for potential eddy covariance sites on the BEO

Progress and Accomplishments

NGEE Arctic field campaigns focus on geophysics, biogeochemistry, and hydrology:

Three separate NGEE Arctic teams travelled to Barrow, Alaska this quarter for field sampling and measurements. A biogeochemistry team led by David Graham (ORNL) and Larry Hinzman (UAF) used a hydraulic drill rig and SPIRE coring device during April, 21012 to obtain permafrost samples from the Barrow Environmental Observatory (BEO). The sled-mounted drill rig was operated by Kenneth Lowe (ORNL) who kept the rig operational despite temperatures that fell below -20C. Cores were bar-coded and shipped to ORNL and LBNL for analysis. Cores will be subjected to controlled freeze-thaw experiments and evaluated for CO_2 and CH_4 fluxes under a range of conditions. Samples will also be analyzed for geomechanical properties, geochemistry, and microbial community composition. Such information will be useful for initialization and parameterization of fine-scale models being developed in support of climate prediction.

A second team travelled to Barrow in May, 2012 to continue geophysical characterization of field sites. This activity was started last fall when a similar team, led by Susan Hubbard (LBNL) conducted a series of initial geophysical surveys along a 450 meter transect. This spring Susan and her team returned to undertake additional field measurements and to begin characterization of subsurface features on each of our four field plots that span a range of features from low- to high-centered polygons.



Finally, a third scientific team led by Cathy Wilson (LANL) and Anna Liljedahl (UAF) travelled to Barrow also in May, 2012 for the purpose of installing water depth and water sampling wells at the field site. The wells were constructed of PVC pipe anchored into the permafrost to a depth of 30 to 40 cm to prevent frost-jacking over repeated freeze-thaw cycles. Holes drilled along the sides of each pipe ensured adequate sampling of water. Each well was instrumented with an automated probe that could measure, log, and stored information on water depth. This data will be downloaded during a later field trip and plotted to determine hydrologic flow paths, rates, and magnitudes of water discharge in and among the various ice-wedge polygons.

LANL staff scientist attends hydrology workshop:

Brent Newman participated in a NSF/CUAHSI sponsored workshop entitled "Techniques to Quantify Stream-Groundwater Exchange and Shallow Transport" which was held June 12-15 in State College, Pennsylvania. The focus on the workshop was on innovative techniques to characterize and quantify processes related to the hyporheic zone. The hyporheic zone exists at the interface between surface water and groundwater, and is known to be an important region of enhanced biogeochemical cycling. Because NGEE Arctic wants to address issues related to, for example, connections and biogeochemical transformations that occur between surface water in polygonal ground areas and subsurface saturation in the active layer, it was worth finding out how adaptable the workshop techniques would be for addressing NGEE Arctic science questions related to the surface/subsurface interface. One advantage of the workshop format was that it was very hands on and included actual field implementation of the techniques as well as sessions on postprocessing of field data, modeling, and interpretation. A variety of techniques were covered and the more NGEE relevant approaches are highlighted here. Heat can be a very useful tracer of surface/subsurface flows and other processes, and one of the main techniques covered was high resolution temporal and spatial monitoring of temperature using fiber optic cables as digital temperature sensors (DTS). The DTS systems are a very effective way of monitoring temperatures at a variety of scales. The cables can be laid along the bottom of surface water drainages or the land surface to accurately monitor temperatures at sub-meter scales over kilometer distances. There were also two chemical tracer methods covered, one uses salt (NaCl) as a tracer to measure discharge in difficult to quantify surface flows and a different application to characterize reach-scale hyporheic zone exchanges. These tracer tests can be conducted with simple electrical conductivity loggers. The other tracer approach involved the use of "smart tracers" and appears to have exciting applications for NGEE Arctic. The smart tracer idea is that

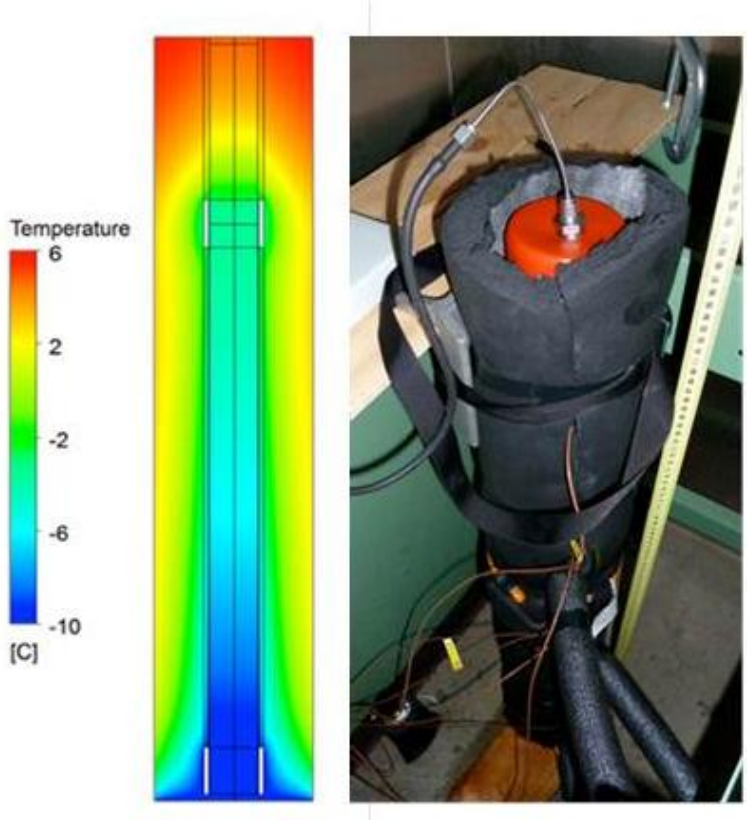
the tracer not only lets you understand pathways and flow rates like a normal tracer, but gives you additional information, and in this case the tracer provides information on the amount of respiration. The smart tracer approach uses an environmentally benign fluorescent tracer called resazurin which is transformed to another fluorescent tracer resorufin when it is subject to microbial respiration in the subsurface. Thus, the degree of conversion to resorufin is a quantitative measure of respiration along a flowpath. Although further evaluation is needed, the smart tracer approach may be quite useful in understanding respiration and carbon cycling in the arctic.

NGEE Arctic scientist visits EMSL:

Baohua Gu (ORNL), a soil and environmental chemist, and member of the NGEE Arctic Biogeochemistry team visited the Environmental Molecular Science Laboratory (EMSL) in late May, 2012. EMSL is funded by DOE's Office of Biological and Environmental Research, which supports world-class research in the biological, chemical, and environmental sciences to provide innovative solutions to the nation's environmental challenges as well as those related to energy production. Baohua visited EMSL to discuss research collaborations on soil carbon chemistry and he was exposed to many aspects of EMSL during his two day visit that included discussions with Nancy Hess and others. One action items that resulted from this visit was the submission of an EMSL user-facility proposal. Baohua and his ORNL colleagues David Graham and Liyuan Liang propose to use combined spectroscopic and nano-scale imaging techniques to: (1) obtain high-resolution measurements and dynamic changes of the chemical composition, molecular structure and size of various soil carbon (C) pools during soil warming experiments under the DOE-BER funded Next-Generation Ecosystem Experiment in the Arctic (NGEE Arctic); (2) determine spatial nano-scale composition of soil organic matter (SOM) and its association and assemblage with minerals and microbes within soil aggregates; and (3) determine temporal changes in SOM structure and its assemblage with minerals during warming experiments both in laboratory and in field. Information obtained in this study is critical to our understanding of the mechanisms of soil C turnover in response to climate warming. EMSL's distinctive focus on integrating computational and experimental capabilities as well as collaborating among disciplines yields a strong, synergistic scientific environment.

NGEE Arctic develops and deploys permafrost simulator at ORNL:

The NGEE Arctic Biogeochemistry team is developing a prototype for a cooling apparatus to gradually thaw frozen permafrost cores recently obtained from the Barrow Environmental Observatory, Barrow, Alaska. This apparatus will thaw ~80-cm soil cores taken from Barrow in April 2012 to a thermal gradient that approximates the summer soil temperature profile. These mesocosms be outfitted with thermocouples, soil water samplers and access ports to enable measurements of soil organic matter mineralization and greenhouse gas (CO_2 and CH_4) production for parameterizing and testing 1-D soil column models.



Simulations of soil column thawing were performed by Charlotte Barbier (ORNL Computational Modeling and Simulation Group), predicting that a two-stage cooling system can produce the equilibrated thermal gradient shown in the above figure. A prototype of this apparatus was constructed with two stages of cooling surrounding the column, inside a walk-in, ventilated 5°C chamber. Test columns containing water-saturated topsoil were frozen at -27°C to approximate saturated tundra cores. Thermocouples were attached to the surface or inserted into a frozen test column. This insulated column has been undergoing controlled warming for two weeks that rapidly thawed the active layer to 13 cm depth, while maintaining frozen soil below. Based on this successful prototype, the team is repeating simulations to refine the thermal gradient, testing sampling methods and making plans to set up mesocosms using cores drilled from the polygonal tundra on the Barrow Environmental Observatory. Modifications of this apparatus will allow simulations of longer thaw seasons and warmer conditions to assess permafrost thawing and soil organic matter transformations.

Dan Hayes receives DOE Early Career Award:

The Biological and Environmental Research (BER) program announced recipients of its 2012 Early Career Awards. NGEE Arctic member Dan Hayes was among those receiving this prestigious award. Dan's application and the central core of his 5-year research plan focuses on modeling carbon cycle processes in Arctic and sub-arctic ecosystems. In his successful application, Dan writes that land areas spanning the northern high latitudes currently store enormous quantities of carbon as frozen organic matter in the region's soils and peatlands. The long-term fate of this carbon will be determined by changing temperatures already observed in these environments. These same environments are projected to warm faster than most other places on Earth over the next century. Rising temperatures will result in more and faster thawing of frozen organic matter. Once thawed, this carbon-rich material is subject to degradation by microbial organisms and/or transport through runoff to aquatic systems. Coupled with these anticipated changes is the role of disturbance from fire, invasive species, and the changing land surface resulting from soil thaw. The combination of global change and disturbance will alter historic patterns of carbon cycling with potentially large additions of greenhouse gasses to the atmosphere, thereby further increasing temperatures. The current scientific understanding of these processes in northern environments is quite limited and the existing knowledge is not consolidated in any one place or system. Data and information exist in different forms and in different places, ranging from satellite-based measurements to individual cores of soils taken for various research purposes. This project intends to survey, integrate, model and evaluate existing information on key processes that control the transfer of carbon from frozen organic material to atmospheric greenhouse gasses (mostly carbon dioxide and methane). The increased understanding that is expected from this project will help to design and implement future state-of-the-art scientific activities by providing priorities to different research areas and also will inform future decisions regarding energy and natural resources of the Arctic.

NGEE Arctic organizes four sessions at upcoming AGU meetings:

Four session proposals were submitted and approved for the 2012 American Geophysical Union (AGU) meetings to be held this coming December in San Francisco, CA. These sessions emphasize (1) system-level feedbacks in climate prediction, (2) accounting for land surface heterogeneity in climate models, (3) geophysical characterization of surface and subsurface interactions, and (4) microbiological processes in in permafrost-dominated ecosystems. The four sessions include:

1. The Arctic System: From Critical Process Studies to Global Perspectives

Co-conveners: W. Maslowski (Naval Postgraduate School), K. Dethloff (Alfred Wegener Institute), L.D. Hinzman (University f Alaska Fairbanks), and A. Roberts (Naval Postgraduate School)

Description: The Arctic is a key player of the Earth System, influencing the global surface energy and moisture budget, atmospheric and oceanic circulation and feedbacks. It has experienced major climate changes such as declining cryosphere, warmer climate and ecosystem shifts. Large variability and sensitivity of Arctic climate to global change make their attribution difficult. Yet, such changes may significantly impact global sea level, future climate change, native communities, natural resource exploration, transportation and international diplomacy. We solicit papers that advance a system level understanding of arctic processes and feedbacks and their global links that are contributing to or resulting from Arctic System change.

2. Representing Plot- to Landscape-scale Heterogeneity for Arctic Terrestrial Modeling

Co-conveners: F.M. Hoffman (ORNL) and J.C. Rowland (LANL)

Description: A critical challenge facing efforts to understand coupled earth system responses to climate change is the representation and incorporation landscape attributes and processes in models at all scales and complexity. Financial and logistical constraints limit the spatial and temporal extents of environmental observations in the Arctic, necessitating systematic sampling strategies and quantitative frameworks for scaling measurements and model parameters from plot to landscape scales. This session focuses on biogeophysical observations, analysis, and modeling of Arctic ecosystems from the bedrock to the canopy across all spatial and temporal scales, including characterization of subsurface properties and geomorphological processes, remote sensing of permafrost, and modeling of plant and soil ecosystems in a changing climate. Of particular interest are methods for representing observed heterogeneity at larger scales.

3. Geophysical Characterization of Permafrost Systems

Co-conveners: S. S. Hubbard (LBNL) and B. J. Minsley (USGS)

Description: The complexity of permafrost dynamics and its critical impact on climate feedbacks warrant continued development of advanced characterization and monitoring approaches. Geophysical methods can provide information about subsurface physical, hydrological, thermal and geochemical variations needed to understand these feedbacks in a non-invasive manner and with a spatial coverage and data density that cannot be achieved using point measurements. This session seeks novel examples that use geophysical data to characterize and monitor permafrost systems through integrated inversion of multiple types of data at various scales, and that investigate physical property relationships between geophysical and permafrost-related properties of interest.

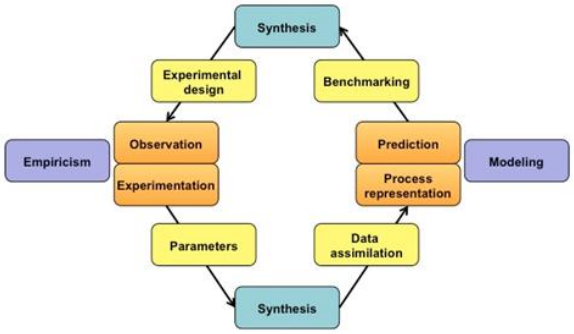
4. Permafrost Microbiology

Co-conveners: J.K. Jansson (LBNL) and M.S. Torn (LBNL)

Description: Permafrost represents one of the largest carbon (C) reservoirs on our planet. Permafrost thaw due to global warming would enhance microbial decomposition of organic matter trapped in permafrost, resulting in release of large quantities of carbon dioxide and methane into the atmosphere. Predicting the future of C emissions from thawing permafrost is

critical to understand for climate models. However, the microbial identities and their functional roles in permafrost and their response to thaw are largely unknown. Therefore, there is an urgent need to apply advanced, state-of-the-art molecular tools to determine the functional roles of microbes in permafrost. This session aims to present current information obtained using molecular approaches about the role of microbes in processing of organic carbon trapped in permafrost as it thaws and impacts of thaw on biogeochemical processes.

Model-experiment (MODEX) workshop attended by several NGEE Arctic investigators:



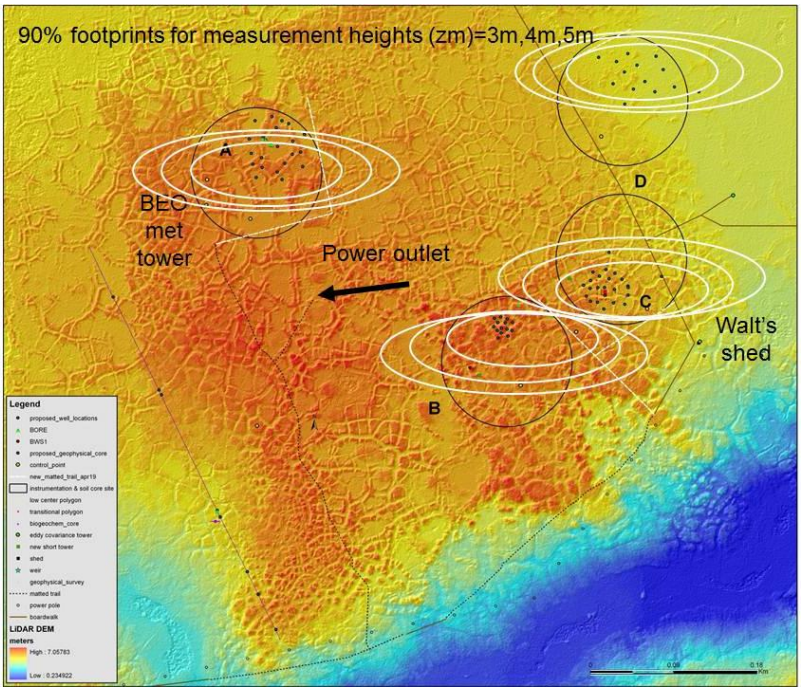
Several participants in the NGEE Arctic project attended the BER-sponsored workshop in late May to discuss "Strategies to Promote Integrated Experiment-Model Approaches in Terrestrial Ecosystem Studies". Participants included Alistair Rogers, Joel Rowland, Margaret Torn, Rich Norby, Charlie Koven, Chonggang Xu, Stan Wullschleger, and others. The general goal of the workshop was to promote a new philosophy of having modeling activities to guide field research activities, which in turn informs modeling activities. This a priori and iterative process of information exchange between the experiment and modeling communities should maximize the intellectual investments and result in high quality predictive models and more scientific discovery. Two workshop reports were generated from this activity, one led by Hanna Lee (NCAR) and another by Heather McCarthy (OSU). A diagram showing the interplay between experiments and models was draw by Peter Thornton and included in the McCarthy et al. workshop report.

NGEE Arctic team members attend Tenth International Conference on Permafrost:

The Tenth International Conference on Permafrost in Salekard Russia was quite well attended by NGEE Arctic researchers and our collaborating partners, including Vladimir Romanovsky, Joel Rowland, Charlie Koven, Haruko Wainwright, Sergei Marchenko, Anna Liljedahl, Bill Cable, Howard Epstein, Drew Slater, and Dave Lawrence. Over 500 participants from more than 25 countries attended the meeting in the Yamal-Nenets region, shared their knowledge about recent outcomes in permafrost research and engineering, discussed future collaborations and projects, and experienced the extraordinary hospitality of the local people. There were 15 scientific sessions and poster sessions with over 100 posters, the conference contributions comprised a large field of permafrost research and reflected the recent importance and interest in polar issues. There may be future opportunities to collaborate with Russian and other international researchers as we advance to circumpolar scales. During the Eighth ICOP, the Troy L. Péwé Award was established to recognize the best presentation by a young researcher. Our own Anna Liljedahl received the award this year for her presentation on the micro-topographic controls on hydrologic processes in the BEO.

Footprint analysis completed for potential eddy covariance sites on the BEO:

Melanie Hahn, a Ph.D. student working on the NGEE Arctic project, aided by Dennis Baldochhi (UC Berkeley) and Margaret Torn (LBNL) completed a footprint analysis for the BEO. The goal of the analysis, pioneered by the eddy covariance community, is to determine the area that contributes to the fluxes seen by the flux tower under various conditions (i.e., what area the flux measurement will represent). In the case of the NGEE Arctic project, this will inform the choice of tower location and measurement height and to help plan sampling campaigns for scaling. Knowing the tower location and influence area prior to major sampling campaigns should lead to better informed sampling plans. The footprint calculations used 5 days of three-dimensional wind and temperature data from the San Diego State University (SDSU) Global Change Research Group (PI: Walt Oechel) sampled at a frequency of 10 Hz. Three of the days were from a temporary tower with a measurement height of 2 m during the growing season in 2011. The other two days were from the permanent tower with a measurement height of 4.1 m during the growing season in 2006. The flux measurements, all relevant variables (u_*, L, σ_v), and the flux footprint were calculated 48 times per 24 hour period. Prior to calculations, the wind speed in three dimensions was rotated for each 30 min block so that the mean wind speed was in the u-direction, and the mean wind speed in the v- and w-directions was equal to zero. The orientation of the footprint is dependent on wind direction. In order to determine the wind direction during the growing season (June - September), instead of merely the five days where 10 Hz wind data was available, minute averages of wind direction at a height of 10m from the NOAA site at Barrow in June through September 2011 were utilized. Statistical analysis of the footprint at z_m=3 m for all days show windward footprint dimensions were not highly variable (a coefficient of variation of <0.02). The 90% flux footprint**,** i.e., the area contributing 90% of the flux measured at the tower over the period, starts at approximately 4.5 m upwind of the tower and extends to approximately 167 m from the tower. Projected footprints were superimposed onto a map of proposed field plots in Barrow (see below). The 75% footprint extends from approximately 5 m upwind to 109 m upwind. There was more variability seen in the crosswind direction. The average lateral extent from the wind centerline was 30.5 m for the 90% flux footprint and 20 m for the 75% flux footprint, both with a coefficient of variation of approximately 0.12.



Interactions with other Agencies, Universities, and National Laboratories

NASA Arctic and Boreal Vulnerability (ABoVE) workshop, June 13-15, 2012. Boulder, CO.

Publications, Presentations, and Posters

Publications:

Xu C., R. Fisher, C.J. Wilson, SD. Wullschleger, M. Cai and N.G. McDowell. 2012. Toward a mechanistic modeling of nitrogen limitation on vegetation dynamics. PLoS ONE e37914.

Lee, H., S.D. Wullschleger and Y. Luo. 2012. Enhancing terrestrial ecosystem sciences by integrating empirical-modeling approaches. EOS 93: 237.

McCarthy. H.R., Y. Luo and S.D.Wullschleger. 2012. Integrating empirical-modeling approaches to improve understanding of terrestrial ecology processes. New Phytologist (in press).

Hayes D.J., A.D. McGuire, D. Kicklighter and S.D. Wullschleger. 2012. Modeling the carbon cycle dynamics of permafrost-dominated ecosystems in the Arctic. Advances in Meteorology (in review).

Hubbard S.S., C. Gangodagamage, B. Dafflon, H. Wainwright, J. Peterson, A. Gusmeroli, C. Ulrich, Y. Wu, C. Wilson, J. Rowland, C. Tweedie and S.D Wullschleger. 2012. Quantifying and relating subsurface and land-surface variability in permafrost environments using surface geophysical and LiDAR datasets. Hydrogeology (in review).

Wu Y., S.S. Hubbard, C. Ulrich and S.D. Wullschleger. 2012. Remote monitoring of freeze-thaw transitions in Arctic soils using the complex resistivity method. Vadose Zone Journal (in review).

Iversen C.M., D. Hayes, R.J. Norby, V. Sloan, P. Sullivan, J. Warren and S.D. Wullschleger. 2012. Root dynamics in the Arctic: A synthesis of observations, manipulations, and modeling. Global Change Biology (in preparation).

Presentations:

Thronton, P.E. A Next-Generation Ecosystem Experiments (NGEE Arctic): Biogeochemical and Geophysical Characterization of Permafrost Ecosystems on the North Slope of Alaska. NASA Arctic-Boreal Zone Modeling Workshop, May 22-24. 2012, Goddard Space Flight Center.

Wullscheger, S.D. Next-Generation Ecosystem Experiments (NGEE Arctic), NASA Arctic and Boreal Vulnerability (ABoVE) workshop, June 13-15, 2012. Boulder, CO.

Rowland, J. Predicting CO2 and CH4 Emissions from the Active Layer in Response to Climate Warming. Tenth International Conference on Permafrost, June 25-29, 2012, Salekhard, Russia.

Koven, C. A combined analysis of permafrost C depth distributions and multi-model permafrost thermal dynamics to estimate C pools vulnerable to warming. Tenth International Conference on Permafrost, June 25-29, 2012, Salekhard, Russia.

Hinzman, L.D. Next-Generation Ecosystem Experiment (NGEE Arctic): A New Project Focused on Improved Climate Prediction. Tenth International Conference on Permafrost, June 25-29, 2012, Salekhard, Russia.

Grosse, G. A Database Synthesizing Published Data on Thermokarst and Thermal Erosion Processes. Tenth International Conference on Permafrost, June 25-29, 2012, Salekhard, Russia.

Liljedahl, A. Ice-Wedge Polygon Type Controls Low-Gradient Watershed-Scale Hydrology. Tenth International Conference on Permafrost, June 25-29, 2012, Salekhard, Russia.

Wainwright, H. Multiscale Bayesian Fusion Approach using Geophysical and Remote Sensing Data for Characterizing Arctic Tundra Hydrogeochemical Properties. Tenth International Conference on Permafrost, June 25-29, 2012, Salekhard, Russia.

Workshops Attended:

European Geophysics Union, General Assembly, April 22-27, 2012, Vienna, Austria.
Web site: http://meetings.copernicus.org/egu2012/

Strategies to Promote Integrated Experiment-Model Approaches to Terrestrial Ecosystem Study. March 19-21, 2012, Bethesda, MD. Web site:
http://ecolab.ou.edu/index.php?research_info&id=21

Techniques to Quantify Stream-Groundwater Exchange and Shallow Transport, June 12-15, 2012, State College, Pennsylvania. Web site: http://www.cuahsi.org/stream-gw-wkshp.html

Arctic-Boreal Zone Modeling Workshop. May 22-24, 2012, Goddard Space Flight Center.

Tenth International Conference on Permafrost, June 25-29, 2012, Salekhard, Russia.
Web site: http://www.ticop2012.org/

NASA Arctic and Boreal Vulnerability (ABoVE) workshop, June 13-15, 2012. Boulder, CO.
Web site: http://www.nacarbon.org/

Posters:

Wullschleger, S.D. Improving climate prediction through process-rich understanding of Arctic terrestrial ecosystems. NASA Arctic and Boreal Vulnerability (ABoVE) workshop, June 13-15, 2012. Boulder, CO. Web site: http://www.nacarbon.org/

Upcoming Meetings: None

Press Releases and News Clips

ORNL Today: NGEE Arctic Updates on Blog…
http://home.ornl.gov/general/ORNL_Today/#link27685

Appendix

IARC Seminar Series 2011-2012
Wednesday, June 13th, 1:30 to 2:30 pm IARC 401

Victoria Sloan

Getting to the root of the problem:
Below-ground plant C stocks and dynamics in Arctic ecosystems

Plant roots are of considerable importance in arctic carbon and nutrient cycling, forming a significant proportion of vegetation biomass and providing the main input to soil organic matter. Despite this, knowledge of root carbon stocks and dynamics in many arctic plant communities is limited, and the relationships between the below and above-ground plant components are unknown. Here, we present the results of three studies undertaken in the Scandinavian Arctic to quantify plant root carbon stocks, root phenology and root turnover rates across a broad range of plant communities. We demonstrate several novel findings, including i) the existence of a strong, cross-community relationship between fine root C stocks and leaf area index, ii) tight coupling between fine root turnover and leaf area index and iii) fundamental differences in the synchrony of root and leaf growth between woody plant and sedge-dominated communities. The cross-community relationships between root parameters and leaf area index (which can be estimated by remote sensing), offer the exciting possibility of generating root datasets for ecosystem models at wider scales than is currently possible, while the differences in timing of root growth between woody plants and sedge has important implications for below-ground processes as shrubs increase in abundance in response to climate warming.

Victoria Sloan just joined the Oak Ridge National Laboratory as a postdoctoral researcher and is a member of the Vegetation Dynamics Team of the NGEE-Arctic project. She received a BSC degree in Ecology and Earth Sciences from the University of Durham (UK), and a MSc degree in Environmental Resource Assessment from the University of Newcastle on peatland restoration. She received her PhD degree in Arctic Plant Ecology from the University of Sheffield in 2011. Her dissertation research on Arctic plant roots conducted at Abisko, Sweden and Kevo, Finland is the topic of her seminar.

Contact: sloanvl@ornl.gov

Seminar Announcement

Thursday, May 17, 2012

9:00 – 10:00 am

Beech River room
(Building 1520, Room 202)

"Fats of the Matter – Identifying Functionally Active Methanotrophs in Pulsing Freshwater Wetlands by ^{13}C-PhosphoLipid Fatty Acids"

Taniya Roy Chowdhury, Ph.D.
School of Environmental & Natural Resources
Ohio State University

Abstract:

Methane (CH_4) is a critical greenhouse gas with ~25% greater global warming potential than carbon dioxide. As the largest natural source of CH_4, wetlands have faced a setback in the global warming scenario. Manipulation of wetland hydrology can be a potential management strategy to enhance CH_4 consumption (by microbial oxidation) from constructed and managed wetlands. Although work in pure cultures have shown the importance of methane oxidizing bacteria (methanotrophs) in regulating net CH_4 flux, few field based studies have been done on the microbial ecology of these CH_4 oxidizing communities and how they respond to differing land management systems. For example, there is considerable interest in enabling current wetlands and creating wetlands that have hydrologic pulsing that is driven by seasonal rainfall and watershed dynamics. However, little is known about the ecology of methanotrophs in the "pulsing fringe" - the oxic sediment-water interface of wetlands. The aim of this study was to characterize the functionally active methanotroph communities and link them to potential methane oxidation rates in response to pulsing wetland hydrology and seasonally induced changes in redox conditions. ^{13}C-CH_4 stable isotope probing of biomarker Phospholipid Fatty Acids was successfully used to track the ^{13}C flow into the methanotroph community. Our results show that, in addition to methanotrophy being controlled by environmental factors such as soil water content, oxygen and methane availability, the physiology of the microorganisms themselves can be uniquely adapted to extant conditions and potentially influence process rates. Results from this study demonstrate that seasonally pulsed wetlands facilitate greater diversity of methanotrophs under elevated methane concentrations, typical of wetlands. This is a contrast to the permanently flooded site where methane oxidation was solely driven by a specialized group of methanotrophs. From the perspective of wetland management, pulsing of wetlands could, therefore, facilitate greater species diversity and concomitant methanotrophy.

Hosted by: David Graham

Seminar Announcement

Tuesday, May 15, 2012

9:00 – 10:00 am

Beech River room
(Building 1520, Room 202)

"Multi-scale controls on the stability of diverse microbial residues in soil"

Heather M. Throckmorton, Ph.D.
Department of Land, Air, and Water Resources
University of California, Davis

Abstract:

Microbial biomass represents an important and highly dynamic C input to soil, yet little is known of factors and mechanisms controlling its subsequent fate and stability. Of particular interest is the question of whether the source and quality of microbial biomass affects its stability due to unique biochemical makeup and differential recalcitrance. This paper presents findings from a study that followed the turnover of diverse nonliving microbial residues (^{13}C labeled) *in situ* in a temperate (California) and tropical (Puerto Rico) forest for 3 and 2 years, respectively. Microbial inputs included temperate and tropical fungi, actinobacteria, Gram (+) bacteria, and Gram (-) bacteria isolated from California and Puerto Rico soils. Presentation of results and findings will emphasize multi-scale controls, and provide a framework for defining relevant factors influencing microbial C turnover. Mean residence times (MRTs) will be discussed, as well as the relative association of microbial inputs with soil physical fractions: i) unassociated with the mineral matrix (light fraction); ii) physically occluded within aggregates (occluded fraction); and iii) associated with mineral surfaces (mineral fraction) in the contrasting ecosystems. Compound-specific recovery and molecular-level dynamics of microbial inputs will be discussed, as determined by analytical pyrolysis-gas chromatography-mass-spectrometry-isotope ratio mass spectrometry (Py-GC-MS-IRMS). A brief methodological discussion of Py-GC-MS-IRMS will also provide a context for results and discussion.

BAOHUA GU

Environmental Sciences Division
Oak Ridge National Laboratory

CONTACT INFORMATION

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THURSDAY, MARCH 29, 2012

TIME	CONTACT	LOCATION
9:00 – 9:15 am	Meet Nancy in EMSL Lobby	
9:15 – 9:45 am	Lili Pasa-Tolic, Mass Spec	EMSL 2579
9:45 – 10:00 am	Presentation Prep	EMSL Boardroom
10:00 – 11:00 am	Presentation-Organo-Mineral Interaction on the Adsorption Hysteresis, Transport and Vulnerability of Soil Organic Carbon	
11:00 – 11:30 am	Mike Wilkins, Microbiology Vanessa Bailey	EMSL 1045
11:30 – 12:00 pm	James Amonette, Geochemistry	EMSL 1045
12:00 – 1:30 pm	Zheming Wang, Fluorescence spectroscopy	Venezia
1:30 – 2:00 pm	Ravi Kukkadapu, Interface Spec/Diffract	EMSL 1393
2:00 – 3:00 pm	Matt Newburn, LA-AMS, LA-ICP Nancy Hess	EMSL 1401
3:00 – 3:30 pm	Paul Majors, imaging NMR	EMSL 2569
3:30 – 3:45 pm	Break	
3:45 – 4:15 pm	Allan Konopka, Microbiology	BSF 2336
4:15 – 5:30 pm	Chongxuan Liu, modeling	EMSL 1371
6:15 pm	Dinner with Nancy and Vanessa	Anthony's

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Environmental Sciences Division
Oak Ridge National Laboratory

CONTACT INFORMATION

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FRIDAY, MARCH 30, 2012

9:00 – 9:45 am	Hongfei Wang, Interfacial Spectrometry	EMSL 2187
9:45 - 10:45 am	Christine Mahoney - NanoSIMS	EMSL 2389
10:45 - 11:00 am	Break	
11:00-11:30 am	Tamas Varga, Tomography	EMSL 2389
11:30 - 12:00 pm	Alex Laskin, nanoDesi	EMSL 1191
12:00 - 1:00 pm	Lunch- Robby Robinson	Bill's Bistro
1:00 - 2:00 pm	Nancy Washton – ^{13}C NMR Karl Mueller	EMSL 2577
2:00 – 3:00 pm	Robby Robinson - LC-FTICR-HRMS Lili Pasa-Tolic	EMSL 2593
3:00-4:00 pm	Nancy Hess – wrap-up	EMSL 1395
4:00 pm	Dinner	