UNITED STATES OF AMERICA

US Permafrost Association

The annual meeting of the US Permafrost Association (USPA) Board of Directors and a general member meeting was held at the 2013 Fall Meeting of the American Geophysical Union. Ed Yarmak replaced Michael Lilly as the president and Gerald “JJ” Frost replaced Tom Douglas as the Treasurer.

Current USPA membership includes 34 student members, 24 regular members, and 12 corporate/non-profits/lifetime members, for a total of 70 members and includes several non US members. An email campaign was initiated at the end of 2013 for the renewal of and recruitment of new memberships.

Meeting and Workshops

American Geophysical Union (AGU): The Fall 2013 meeting of the American Geophysical Union was held December 9-13, 2013 in San Francisco. The permafrost community was well represented, with 200 posters and 112 oral presentation related to permafrost.

Association of American Geographers (AAG): The Annual 2013 meeting of the Association of American Geographers was held March 9-13, 2013 in Los Angeles, California. Nineteen permafrost related sessions were held.

ASCE 10th International Symposium on Cold Regions Development (ISCORD): The Technical Council on Cold Regions Engineering of the American Society of Civil Engineers together with IACORDS sponsored the ASCE 10th International Symposium on Cold Regions Development (ISCORD) in Anchorage, Alaska, June 2-5, 2013.

The symposium theme was "Planning for Sustainable Cold Regions." Several session tracks included presentations relating to seasonally and perennially frozen ground including sustainable development as well as climate change issues. The proceedings can be ordered at: http://ascelibrary.org/doi/book/10.1061/9780784412978.

The next ISCORD symposium will be organized by the Korean Geotechnical Society and will be held in South Korea in 2016. For more information, contact Jong-Sub Lee, Korea University (jongsub@korea.ac.kr).

Photograph the Chairs of the 2016 ISCORD (from the left) Jong-Sub Lee, Eun Chul Shin and the Chairs of the 2013 ISCORD Thomas Krzewinski and Hannele Zubeck. Photograph is from the ISCORD 2013

50th Anniversary of the First International Conference on Permafrost: A one-day permafrost workshop was held on November 15, 2013 at Purdue University to celebrate the 50th Anniversary of the First International Conference on Permafrost that took place at Purdue the week of November 11-15, 1963. The program included a number of speakers representing topics that were discussed at the 1963 Conference and other engineering, climate-related and geotechnical subjects, and a banquet. The program and presentations can be found on the USPA web. The event also was a tribute to recently deceased C.W. (Bill) Lovell a former Purdue faculty member and supporter of many permafrost and IPA activities.

Visiting participants and invited speakers included (from left to right): Fritz Nelson, Ed Clarke, Ed Yarmak, Jess Walker, Tom, Krzewinsjki, Mary Ellen Lovell, Eric Muller, Dick Cameron, Ken Hinkel, Jerry Brown (not in the photo Toni Lewkowicz).

Symposium on Mechanical Properties of Frozen Soils: A Symposium on Mechanical Properties of Frozen Soils took place January 31, 2013 in Jacksonville, FL. The symposium was sponsored by ASTM International Committee D18 on Soil and Rock and Subcommittee Committee D18.19 on Frozen Soils and Rock.

The symposium offered a forum for the exchange of ideas on current research as it relates to testing of mechanical properties of frozen ground; it also provided a rationale for the various details within new standards for testing of frozen soils. The peer-reviewed conference papers are published as *Selected Technical Papers,* 1568,

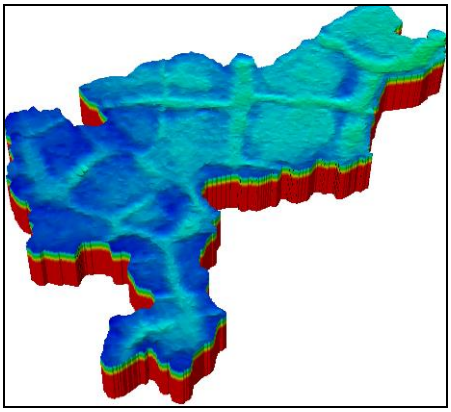
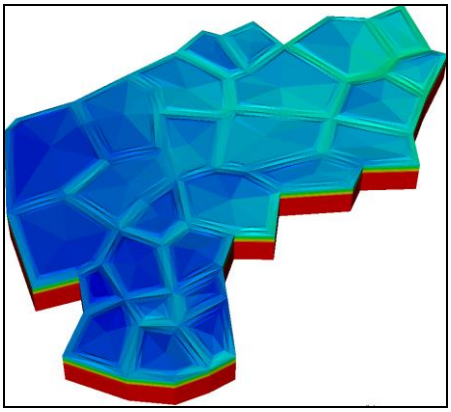
Mechanical Properties of Frozen Soils, available at http://www.astm.org/DIGITAL_LIBRARY/STP/SOURCE_PAGES/STP1568.htm.

These papers portray ideas of authors from Canada, China, Norway, South Korea, Sweden and U.S.A. The papers are divided into four topics: Freeze-thaw Effects on Mechanical Properties, Testing of Mechanical Properties, Mechanical Properties, and Effects of Mechanical Properties on Performance. In addition, the symposium provided a round table meeting where future needs in the area of frozen soil research was proposed and discussed. More information is available from the Symposium Co-Chairpersons and STP Co-Editors Hannele Zubeck (hkzubeck@uaa.alaska.edu) and Zhaohui Yang (zyang2@uaa.alaska.edu), University of Alaska Anchorage, Anchorage, AK, USA.

Institution Member Activities:

The Next-Generation Ecosystem Experiments (NGEE Arctic): *NGEE Arctic team seeks to represent field-scale processes in global climate models.* Earth System Models require process knowledge that while often obtained from data collected at the plot-scale, must be represented at a much larger scale of 10 to 100s of kilometers for use in climate projections. Scaling process knowledge and observations across several orders of magnitude is a significant component of this challenge. The problem is especially complex for highly heterogeneous Arctic landscapes where hydrologic, biogeochemical, and vegetation dynamics at sub-meter scales have large feedback effects on the regional to global climate system. A series of measurement, modeling and computational issues involved in developing a robust scaling framework must be addressed if we are to capture critical spatial and temporal feedbacks between terrestrial ecosystems and climate.

The Next-Generation Ecosystem Experiments (NGEE Arctic) team, led by Oak Ridge National Laboratory is entering their third year of integrated field, laboratory, and modeling studies on the Arctic Coastal Plain near Barrow, Alaska. This large, multidisciplinary team is conducting multi-scale observations for use in the design, parameterization, and evaluation of models operating at fine, intermediate, and global scales. The team is developing a multi-scale modeling framework to improve the representation Arctic ecosystem processes in global scale climate models through a series of nested mechanistic models. Project scientists have successfully developed high-resolution models for thermal, hydrologic and biogeochemical processes in Arctic ecosystems. A massively parallel model (PFLOTRAN) operating at sub-meter resolution solves a system of nonlinear partial differential equations describing multiphase, multicomponent and multiscale flow and reactive transport in the surface and subsurface. This model has been successfully applied to simulate seasonal changes in active layer depth, temperature, moisture content, and hydrologic flow paths in and among individual polygons and cohorts of polygons where LiDAR-derived micro-topography drives complex patterns of lateral water flow.

a.  b. 

Simulation of permafrost thermal hydrology using PFLOTRAN for a watershed near Barrow, AK (frozen soils are in red vs thawed soil in blue). (a) Fine scale simulation resolving micro-topography at 0.25m spatial resolution (b) Intermediate scale simulation using a coarse mesh that captures the geomorphological features like polygon centers/ridges/troughs.

The NGEE Arctic team plans to include carbon cycle biogeochemistry, plant and microbial processes, and CO_2 and CH_4 dynamics to the model in the near future; scientists at Los Alamos National Laboratory are incorporating geomechanical properties into the model for the purpose of representing aspects of permafrost degradation and deformational characteristics (i.e., thermokarst). Eventually, these coupled multi-scale models will be integrated within a scaling framework where field observations will be used to parameterize and constrain the high-resolution model which captures processes and features like micro-topography and surface and subsurface hydrology. The modeling framework has been designed to capture complex local ecosystem processes and inform the global climate models via not just statistical or empirical approaches, but rather mechanistic process-based parameterization. Lessons learned from these models will be used to simulate feedbacks between surface-subsurface hydrology and biogeochemistry and the terrestrial biosphere, a task that will be greatly facilitated by the direct coupling of PFLOTRAN with the Community Land Model (CLM) which in turn is a component of a global scale Community Earth System Model (CESM).

The NGEE Arctic project (http://ngee-arctic.ornl.gov/) is supported by the Office of Biological and Environmental Research in the DOE Office of Science. Partner institutions include Brookhaven, Los Alamos, and Lawrence Berkeley National Laboratory, and the University of Alaska Fairbanks.

***Geophysical Institute Permafrost Laboratory, University of Alaska Fairbanks*:** The Geophysical Institute Permafrost Laboratory (GIPL) research team (Vladimir Romanovsky, Sergey Marchenko, Alexander Kholodov, and William Cable) in collaboration with Russian colleagues continued the development of the observational borehole network for the thermal state of permafrost (TSP) monitoring in Alaska, Russia, and Central Asia as part of the Arctic Observing Network project. The work

included data collection and maintenance of existing boreholes, instrumentation of new or recovered boreholes, and gathering of historical data. In 2013, data from 20 new shallow boreholes in northwest Alaska and 3 permafrost observatories in the western part of the Canadian Archipelago were collected. Detailed description of boreholes, link to the data, and further information on this project can be found at http://permafrost.gi.alaska.edu/, data from some of these sites are available in near-real time. The Russian-US TSP project web portal, part of GIPL web site, was further improved.

In April 2013, Guido Grosse (GIPL) participated in a snowmachine expedition for the NSF Arctic Observatory Network-sponsored CALON project (Circum-Arctic Lakes Observation Network) with Benjamin Jones (USGS), Christopher Arp (UAF) and Ben Gaglioti (UAF) on the Alaska North Slope (eastern transect between Toolik Field Station and Teshekpuk Lake Observatory; A team lead by Ken Hinkel, U Cincinnati, conducted a similar survey along a western transect starting in Barrow. The CALON team visited more than 25 lakes and permafrost sites and collected sub-ice lake water samples for biogeochemical analysis, measured talik temperatures, surveyed snow and lake ice properties, performed GPR surveys of lake ice, ground truth contemporary TerraSAR-X data, and drilled permafrost cores. In August 2013, the CALON team (including Louise Farquharson, UAF) revisited the lake sites, conducting water sampling, bathymetric surveys, DGPS surveys of lake water levels and shore profiles, maintenance of lake temperature and water level loggers, and measurements of permafrost temperature. Also, old permafrost deposits were sampled along the northern shore of Teshekpuk Lake for paleo-environmental analysis.

In June 2013, Grosse with researchers from NGEE Arctic (Stan Wullschlaeger, Rich Norby, Victoria Sloan, and Jennifer Liebig) and Oak Ridge National Lab (Dan Hayes, Santonu Goswami) conducted a week-long fieldtrip on the Seward Peninsula along the Taylor highway from Nome northwards. They collected temperature data from four permafrost boreholes located along a gradient from discontinuous to continuous permafrost. Also, they conducted surveys of thermokarst landforms using DGPS, a field spectrometer, and vegetation descriptions.

In November 2013, Grosse took a new research position at Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research in Potsdam, Germany, to lead the European Research Council funded 5-year PETA-CARB project (Rapid permafrost thaw in a warming Arctic and impacts on the soil organic carbon pool) that focuses on remote sensing of thermokarst processes and quantification of associated carbon pools and fluxes in Alaska and Siberia. Grosse maintains an affiliation with the GI, UAF.

Reginald Muskett continued his research on energy and mass changes associated with changes in permafrost across the Northern Hemisphere. His latest research findings are published in Atmospheric and Climate Sciences (*Muskett 2013a*; *2013b*) and Open Journal of Modern Hydrology (*Muskett 2014*). Reginald also co-convened and co-chaired Permafrost sessions (Oral and Poster) at the EGU 2013 and gave two permafrost related presentations at EGU 2013 and one at AGU 2013.

Santosh Panda, Sergey Marchenko and Vladimir Romanovsky worked on a National Park Service (NPS) funded permafrost modeling project focused on developing high-resolution (28-m) maps of near-surface permafrost temperature and active-layer thickness for national parks in Alaska. Permafrost modeling of *Denali National Park and Preserve* and *Wrangell-St. Elias National Park and Preserve* are completed. The reports will be published as NPS' Natural Resource Technical Reports.

PhD student Prajna Regmi continued remote sensing analysis of thermokarst lake methane ebullition from Fairbanks lakes within a NASA-funded project on North American lake methane emissions and object-based lake classification using high resolution satellite imagery for the Western Alaska LCC region. PhD student Louise Farquharson worked on remote sensing-based mapping and classification of thermokarst landforms on the Alaska North Slope and Brooks Range Foothills, around the CALON lake sites. She also worked on permafrost affected coastal processes along the northern Seward Peninsula coastline. The coastal work is funded by National Park Service and the Climate Change Youth Initiative Fellowship.

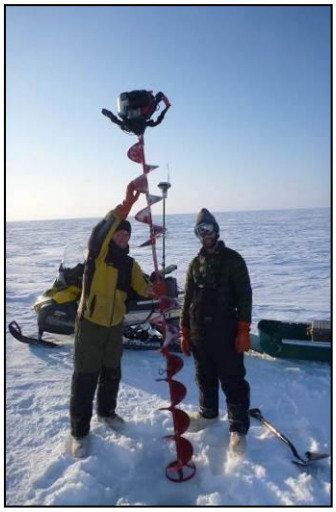
References

Muskett, R.R., GOSAT CH4 and CO2, MODIS Evapotranspiration On the Northern Hemisphere June and July 2009, 2010 and 2011, *Atmosphere and Climate Sciences*, 3 (2), pp. 177-185, 2013a. doi:10.4236/acs.2013.32019.

Muskett, R.R., MODIS-Derived Arctic Land-Surface Temperature Trends, *Atmosphere and Climate Sciences*, 3 (1), pp. 55-60, 2013b. doi:10.4236/acs.2013.31008.

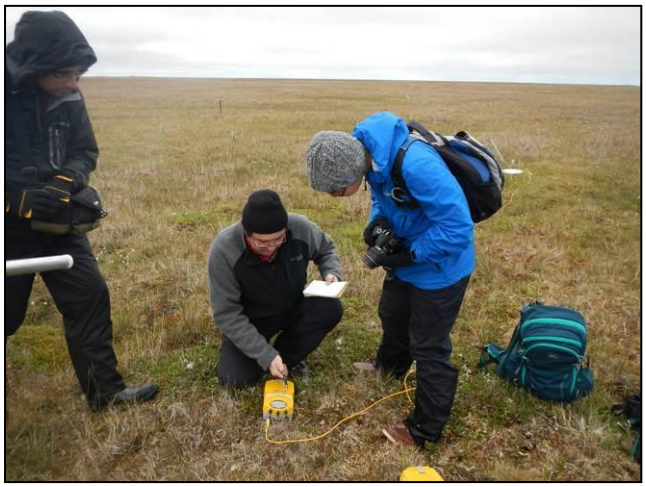
Muskett, R.R., ICESat-Derived Elevation Changes on the Lena Delta and Laptev Sea, Siberia, *Open Journal of Modern Hydrology*, 4, pp. 1-9, 2014. doi:10.4236/ojmh.2014.41001.

Vladimir Romanovsky (GIPL Group Leader) drilling a hole in the ground to install temperature sensors and Bill Cable preparing the sensors for installation at a permafrost observation station on North Slope of Alaska (Photo: Santosh Panda).



NSF CALON field team members Chris Arp and Ben Gaglioti after successful drilling through lake ice of a thermokarst lake, Alaska Northslope, in April 2013 (Photo: G. Grosse).

The George Washington University: There were major developments in interdisciplinary permafrost-related research at George Washington University during 2013. In August 2013 Dr. Dmitry Streletskiy assumed a tenure-track faculty position in the Department of Geography of GWU and Dr. Qin Yu who specializes on Arctic vegetation and landscape dynamics joined the department as a university-funded post-doctoral fellow. GWU permafrost research is focusing on three thematic areas: long-term monitoring of active-layer and near-surface permafrost (CALM), interactions between permafrost and hydrologic regimes in the Russian Arctic, and socio-economic development in Russian permafrost regions.



The 2013 Circumpolar Active Layer Monitoring (CALM) project field activities were conducted in Alaska and Russia. The Alaska field team consisted of Nikolay Shiklomanov, Dmitry Streletskiy (GWU), Anna Klene (University of Montana), Fritz Nelson (University of Delaware), three GWU students (K. Nyland, K.Pyne, S. Ross) and a University of Montana graduate student (J. Watts). Annual active-layer and ground-temperature observations were conducted at a series of CALM sites representative of the diverse climatic and landscape conditions on the North Slope of Alaska and Seward Peninsula. Ground-subsidence monitoring by means of differential GPS was conducted at several sites. Another University of Montana graduate student (J. Smith) successfully completed her degree and results are being prepared for publication. The GWU CALM project facilitated annual observations at 86 Russian sites. All data are available at CALM webpage at www.udel.edu/Geography/calm.

Dmitry Streletskiy, in collaboration with colleagues at the University of New Hampshire, received a three-year NSF grant titled “Interactions between air temperature, permafrost and hydrology in the high latitudes of Eurasia.” In July 2013, field-work was conducted in the vicinity of Igarka, Russia, and involved collection of climate, hydrologic, and permafrost data from several representative small watersheds in cooperation with Igarka field station operated by the Yakutsk Permafrost Institute (Russia) and Krasnoyarsk Forest Institute (Russia).

We have continued to develop methodology for quantitative evaluation of socio-economic impacts of permafrost degradation. Over the last year we have broadened this research by including political, economic, and demographic issues related to development of Russian permafrost regions. This research effort is collaborative between the GWU Geography Department, the GWU Institute for European, Russian and Eurasian Studies (IERES), and the University of Tromso, Norway. In May 2013 we organized a conference on Arctic Urbanization where several issues related to socio-economic impacts of permafrost degradation were actively discussed. An edited volume on Arctic urbanization is currently in preparation. In July 2013 Valeriy Grebenets (Moscow State University, Russia), Dmitry Streletskiy (GWU), Nikolay Shiklomanov (GWU), Marlene Laruele (GWU), Alexander Shiklomanov (UNH), Fritz Nelson (UDEL) and 12 Russian and American students participated in educational and research field activities in Central Siberia along the Yenisei River. Students were introduced to methods of permafrost investigations in natural and technogenically modified landscapes, including site evaluations, temperature and active-layer monitoring, and soil coring. Emphasis was made on relations between permafrost and other components of Arctic natural system and socio-economic problems of urbanization in permafrost regions, including migration and the effects of permafrost on urban infrastructure. We have continued our research on indigenous permafrost ice cellars in Barrow, AK, with monitoring continuing of the thermal regime in six cellars. Based upon community input, aerial photographs, and visual surveys GWU graduate student K. Nyland with assistance from Dr. Anna Klene (University of Montana) completed a senior thesis and presented results at several conferences.

Fritz Nelson has retired from teaching at the University of Delaware and now holds research appointments at the University of Wisconsin-Milwaukee and Northern Michigan University. In Milwaukee Nelson is affiliated with the American Geographical Society Library, where he is working on aspects of the history of Arctic exploration and science. His climatological and permafrost

research projects, including CALM, will henceforth be administered through NMU.

US Army Cold Regions Research and Engineering Laboratory (CRREL)*:* Tom Douglas and Kevin Bjella report on a busy 2013 for permafrost research by U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) personnel in Fairbanks, AK and Hanover, NH. Projects on permafrost hydrology and biogeochemistry continued at sites from Fairbanks to the Alaska Range. A large project was initiated to apply geophysical measurements, borehole drilling, suborbital and satellite-based imagery, and soil and vegetation mapping to identify ground state conditions on permafrost terrain around Fairbanks. Sites include the CRREL Farmers Loop Road and Permafrost Tunnel sites. A group of new projects were initiated focused on supporting infrastructure development on permafrost. Ongoing work at Thule, Greenland and Barrow, Alaska in support of Department of Defense facilities continues. Upgrades at the CRREL Permafrost Tunnel included an additional 100 feet of new excavation and the construction of a new log cabin visitor center. Planning is underway for Phase III of the tunnel expansion project with a tentative execution during the winter of 2014-5.

United State Geological Survey (USGS): "USGS Permafrost Research in the Fate of Carbon in Soil Systems (FOCSSY) Project." USGS researchers plan to quantitatively define the controls and vulnerabilities of terrestrial soil carbon (including permafrost and wetlands) using replicated studies with both long- and near-term perspectives. Northern latitudes are especially important for investigations of carbon because of the very large stocks and the impending vulnerability of soil carbon stocks to the rapid warming and

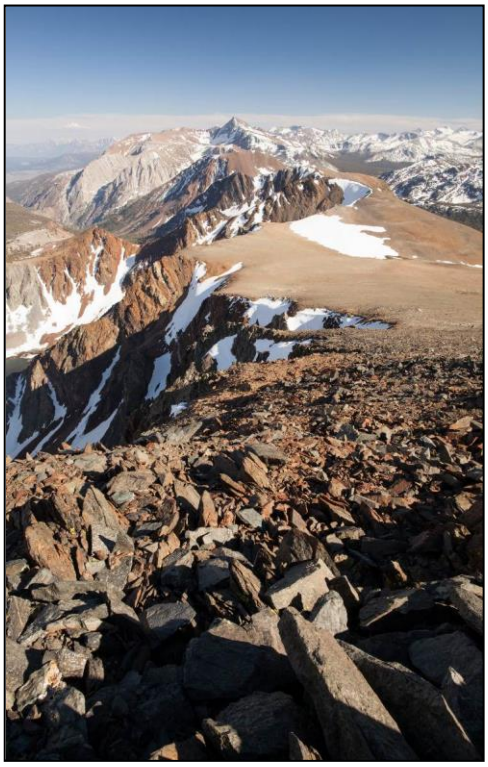
increase disturbance in these regions. The past 10 years have benefited from a targeted effort by this team to address soil carbon in northern latitudes, specifically permafrost and peatland soils residing in the boreal forest biome of North America. Alaska has since become a hotspot for studies of permafrost carbon, permafrost hydrology, permafrost biota, changing fire regimes, and ecosystem vulnerability. Members of this project include Mark Waldrop, Jennifer Harden, Miriam Jones, Kristen Manies, Jack McFarland, Steve Blazewicz, Monica Haw, and Dave McGuire, with outside investigators University of Alaska, Fairbanks, University of Guelph, UC Irvine, and Lawrence Berkeley National Labs.

In the past we have demonstrated that the impacts of warming on soil carbon stocks have been particularly severe in discontinuous permafrost landscapes in the Boreal Forest Biome over the past decade due to the shift toward late season wildfires (Turetsky et al, 2010b). Permafrost degradation has increased (Grosse et al, 2011), and very large stocks of soil C are anticipated to shift from frozen to unfrozen states over coming decades, with increasing vulnerabilities to combustion, hydrologic shifts, and microbial decomposition (Harden et al, 2012; Graham et al., 2012). The impact of thawing permafrost and other global changes on the atmospheric CO_2 and CH_4 emissions involve complex plant-microbe-soil feedbacks (Chapin et al., 2009). Meanwhile the sheer amounts of N associated with thawing permafrost (Harden et al, 2012) caused us to focus new attention on a better understanding of C and N cycling in deep soils that are undergoing thaw. Our intensive gas measurements and our documentation of historic changes in permafrost, ecosystem processes, and carbon budgets (for example Jones et al, 2012) demonstrate that such shifts can affect soil microbial communities that impact both net C budgets (O'Donnell et al, 2010) and the balance of CO_2 and CH_4 (Waldrop et al., 2012; Fan et al., 2012; Turetsky et al., 2008).

Experimental tasks for this project in 2014 consist of using isotopic and molecular tools in combination with chronosequence and manipulation approaches to examine plant-microbial interactions, organic matter quality, and nutrient processing in response to permafrost thaw. Specifically, we identify sources and pathways of C fluxes to the atmosphere, rates of aerobic and anaerobic respiration and methane cycling, rates of nitrogen fixation, mineralization, denitrification and N_20 production, and relate these processes to microbial community dynamics along a permafrost thaw chronosequence. These approaches will help us answer the following questions, *How does permafrost that alter the sources of respired C? What are the decomposition dynamics in different soil horizons and how do microbial populations fuel anaerobic decomposition or affect the temperature sensitivity of processes? How do we link molecular microbial data to biogeochemical processes?.*

Project bibliography can be found here: http://carbon.wr.usgs.gov/biblio.html

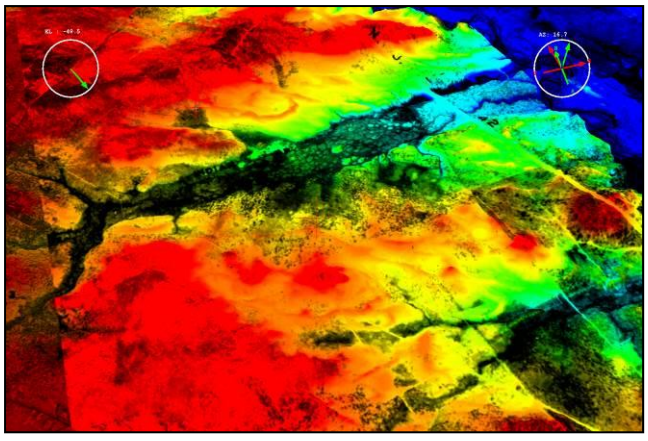
United State Geological Survey (USGS): "Alpine Permafrost Research" Our research on alpine permafrost in the Sierra Nevada, CA and at two sites in Alaska (adjacent to Gulkana Glacier and



Wolverine Glacier) had both successes and some failures this year. We successfully measured snow depth, ground surface temperature, and meteorological variables over most of the annual cycle at all three sites. A misbehaving data logger, a vanishing solar panel, and a grizzly bear, however, did cause some setbacks. Our preliminary analysis indicates the following: 1. permafrost is extensive in the eastern Alaska Range (big surprise), and 2. permafrost may exist in patches on wind-scoured plateaus of the High Sierra but is rare to absent in the heavily snow-covered valleys where a thick, warm snowpack buffers the underlying ground. We plan to perform energy balance modeling in the coming year.

Individual Member Activities:

Mark Demitroff, the University of Delaware, is planning transition to the University of Alaska Fairbanks to study the problem of Pleistocene past permafrost, wind action, and attendant fluvial system modification. High resolution geodetically corrected LiDAR data is being processed to provide a measured view of the true bare-earth ground that is otherwise hidden by thick vegetation. His goal is to add to the range of Earth analogs for Mars studies, and to conserve and preserve certain



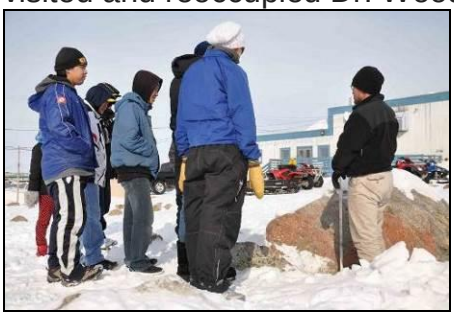
"periglacial" landscapes as critical habitat of the 700,000-hectare New Jersey Pinelands Biosphere Reserve.

Caitlin Rushlow *(*Ph.D. Candidate, Dept. of Geosciences, Idaho State University)*:* I spent my summer doing fieldwork out of Toolik Field Station in Arctic Alaska. There, I work on an NSF-funded project investigating the physical controls on water and nutrient flux from hillslopes as mediated by water tracks. This was an exciting summer because of the copious amounts of snow (see photo) that lasted later into the summer than usual, perhaps representative of future conditions if the Arctic climate becomes warmer and wetter. It was also a year with copious amounts of mosquitos, more than seen in recent memory. Enough to elicit a viral video captured by another team at the station that made it as far as the Huffington Post: http://www.huffingtonpost.com/2013/07/31/alaskan-mosquito-swarm-video_n_3682619.html

This year I was also happy to receive a grant from the USPA for travel to the AGU Fall 2013 Meeting.

Kenji Yoshikawa (UAF) and ***Ulli Neumann*** traveled along the Northwest Passage by snow mobile in spring of 2013, to cover the permafrost monitoring network of the northern communities in Canada. Yoshikawa published the community based permafrost monitoring book using their sites of nearly 300 communities mainly

in North America. An electric version is available at http://issuu.com/permafrostbook/docs/piots. The hard copy book was delivered to all communities. Yoshikawa (UAF) plans to establish a permafrost outreach network in Siberia during spring, 2014, traveling 12000 km by Land Cruiser along the Russian winter road of the Arctic Siberia. Yoshikawa and Mauna Kea Management Office team visited and reoccupied Dr. Woodcock's boreholes at the top of Mauna Kea, Hawaii.



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