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 2014 Fall Meeting of the American Geophysical Union. Tom Krzewinski as elected as the new President; other election results were: Mark Waldrop as President-Elect, Molly McGraw as Secretary, and Margaret Darrow as Member-at-large.

Current USPA membership includes 34 student members, 48 regular members, and 13 corporate/non-profits/lifetime members, for a total of 95 members and includes several non US members. The Board of Directors initiated a survey to determine the best means to enhance membership.

Meeting and Workshops:

American Geophysical Union (AGU): The Fall 2015 meeting of the American Geophysical Union will be held December 14-18, 2015 in San Francisco. The meeting is scheduled to have 36 permafrost related regular sessions and 33 permafrost related poster sessions.

Association of American Geographers (AAG): The Annual 2015 meeting of the Association of American Geographers was held April 21-15, 2015 in Chicago. Twenty-four permafrost related sessions were held at this meeting.

Institution Member Activities:

***Geophysical Institute Permafrost Laboratory, University of Alaska Fairbanks*:**
The Geophysical Institute Permafrost Laboratory (GIPL) research team led by Prof. Vladimir Romanovsky continued the development of the observation borehole network for the thermal state of permafrost (TSP) monitoring in Alaska, Russia, and Central Asia as part of the Arctic Observing Network project "*Development of sustainable observations of thermal state of permafrost in North America and Russia: The U.S. contribution to the GTNP*". The work included data collection and maintenance of existing boreholes, instrumentation of new or recovered boreholes, and gathering of historical data.

As part of a project involving approximately 120 shallow boreholes that were donated to GIPL by ExxonMobil, in 2015, nine additional shallow (10 m) boreholes were instrumented which brings the total number of shallow boreholes instrument so far to 24. The transect of boreholes follows the Alaska Highway from the US/Canada border to Delta Junction and then follows the Trans-Alaska Pipeline System (TAPS) corridor north to Prudhoe Bay. GIPL will continue to instrument and collect data from the selected boreholes for the next 3 years.

Use of AIEM permafrost module output to assess the permafrost changes in the 21st century: During the first year of this project, the GIPL team modeled the permafrost dynamics of North Slope of Alaska through 2100. The second year of the project will be focused on modeling the effects of surface disturbances, both natural and anthropogenic, on permafrost thermal dynamics over the entire North Slope of Alaska. It is a two year project funded by the USGS Alaska Climate Science Center.

Community based permafrost and climate monitoring in rural Alaska: The GIPL team secured 3 years of funding (2015-2018) from the National Science Foundation for this project. The overarching goal of this project is to help build the tribal capacity to monitor changes in local climate and permafrost. The GIPL team will establish new permafrost observatory system in the Upper Kuskokwim region as part of this project.

Dr. Reginald Muskett continues satellite-based investigations of changes within the permafrost and periglacial regions of Earth. This year Dr. Muskett had two publications: one an investigation of soil moisture retrieval algorithms with soil moisture measurements (Muskett et al., 2015a, Int. J. Geosciences) and the other an investigation of Alaska's North Slope using the NASA Ice, Cloud and land Elevation Satellite (ICESat) Geoscience Laser Altimeter System (GLAS) and the JAXA Advanced Land Observation Satellite (ALOS) Phased Array type L-band Synthetic Aperture Radar (PALSAR) to further our understanding of radar scattering (surface and volume) by the active-layer, snow cover and tundra vegetation (Muskett et al., 2015b, Int. J. Geosciences). Dr. Muskett is working with other members of the Lab and other institutes on new funding proposals to for the coming year. Dr. Muskett continues to convene and chair permafrost science sessions at the European Geoscience Union General Assembly in Vienna, Austria and the American Geophysical Union Fall Meeting in San Francisco. This year JPL and NASA convened the second annual workshop for developing the dual-band satellite radar mission NASA - Indian Space Research Organization (NISAR). The workshop was held at the NASA Ames Research Center, Moffet Field, California. At the workshop Dr. Muskett gave a poster presentation of his newest paper about interferometric synthetic aperture radar (InSAR) scattering properties on the tundra of the North Slope, Alaska. There he also shared information and insights with the mission working groups and science teams.

Dr. Alexander Kholodov continued to conduct his long-term observations of permafrost temperature in Yakutia. In collaboration with colleagues from Melnikov Permafrost Institute 3 more boreholes were instrumented for continuous temperature monitoring around Yakutsk. As part of a NSF funded project "*Vegetation and ecosystem impacts on permafrost vulnerability*" he took part in an ecological survey at the GIPL permafrost observation sites in collaboration with Woods Hole Research Center and Colgate University. Also Dr. Kholodov conducted permafrost coring near Healy, Alaska; 3 short (2.5 meters) and one long (5.3 meters) cores were described and subsampled for cryolithological, biogeochemical and paleoenvironmental analyses. A previously existing deeper borehole (5 m deep) was instrumented for continuous measurement in order to extend and improve monitoring system at the Healy research site. He served as a lead mentor in 2015 International Arctic Research Center summer school "*Arctic in a warming climate: connection to vegetation, permafrost and hydrology*".

Dr. Santosh Panda continued his work on a National Park Service (NPS) funded permafrost modeling project focused on developing high-resolution (30 m) maps of near-surface permafrost temperature and active-layer thickness for national parks in Alaska. High-resolution permafrost modeling for the five Arctic national parks has been completed recently. The modeling products and the report will be available by spring 2016 on GIPL website. As part of a permafrost outreach project entitled "*Hot Times in Cold Places: The Hidden World of Permafrost*" funded by NSF, Dr. Panda travelled to seven communities in interior Alaska and help conduct community science night on permafrost. One of the goals of this project is to improve the delivery and effectiveness of STEM learning related to climate change. He participated in New Generation of Polar Researchers Leadership Symposium held at University of Southern California Wrigley/Boone Center for Environmental Leadership during May 2-9, 2015. He served as a mentor in 2015 International Arctic Research Center summer school "*Arctic in a warming climate: connection to vegetation, permafrost and hydrology*". He is editor of Changing Ice, a newsletter of cryosphere research in Alaska.

William Cable continues to pursue his master's degree (finishing summer 2016), studying the spatial variation in permafrost thermal regime at both regional and local scales, while working part-time as a Research Professional in the GIPL. In April, he attended the EGU General Assembly in Vienna and presented a poster, "Evaluating Ecotypes as a means of Scaling-up Permafrost Thermal Measurements in Western Alaska" (http://goo.gl/ME694z). William spent most of the summer traveling around Alaska, visiting permafrost observatories to collect data and make repairs. He continues to serve as a GTN-P National Correspondent and on the Secretariat as the Technical Assistant for GTN-P.

PhD student Prajna Regmi Lindgren, together with other project members of the NASA funded project on North American lake methane emissions, published a research paper on "Detecting and Spatio-Temporal Analysis of Methane Ebullition on Thermokarst Lake Ice Using High Resolution Optical Aerial Imagery" (Lindgren et al., 2015, Biogeosciences Disc.). Lindgren continues research on remote sensing-based detection and classification of methane ebullition bubbles in thermokarst lake ice and as well as mapping of lake distribution and changes in Western Alaska. The Western Alaska Landscape Conservation Cooperative (WALCC) funded the research on lake mapping and change analysis with a focus to assess the dynamics of lake habitat change in major lake districts of the WALCC region in relation to permafrost change. Lindgren presented the preliminary outcome of this research in two village communities (Selawik and Kotzebue) in November 2014, and in a webinar in May 2015 organized by the WALCC. Lindgren and Guido Grosse are involved in a new NASA ABoVE project on scaling local thermokarst lake methane emissions to larger regions using remote sensing data.

Visit Geophysical Institute Permafrost Laboratory website for further details on the current and past projects, data, reports, publications of all GIPL members, and latest permafrost news, *www.permafrostwatch.org*. GIPL Team: Vladimir Romanovsky, Sergey Marchenko, Alexander Kholodov, Reginald Muskett, Dmitry Nicolsky, William Cable, Santosh Panda, Prajna Regmi Lindgren, Louise Farquharson and Viacheslav Garayshin, Lily Cohen.

The George Washington University: Permafrost research at GWU is focused on three thematic areas: long-term monitoring and dynamics of the 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. Field activities for the Circumpolar Active Layer Monitoring (CALM) project were conducted in Alaska and Russia during the summer of 2015 under the CALM IV program. CALM IV is funded by the U.S. National Science Foundation's Arctic Observing Network program for the 2014-2019 period, and provides support for field operations at permafrost observatories in northern and western Alaska and at numerous Russian sites. The project is headquartered at GWU, with subcontracts to the University of Montana and Northern Michigan

University. The 2015 Alaska field team consisted of Nikolay Shiklomanov (GWU), Anna Klene (University of Montana), Fritz Nelson (Northern Michigan University and Michigan State University), and four students (K. Nyland (MSU), S. Ross (GWU), Z. Li (GWU) and C. Queen (NMU). 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. All data generated under CALM's programs are available through the CALM webpage.

Dima Streletskiy (GWU) was appointed the Chair of the GTN-P Steering Committee during the Second GTN-P National Correspondents Workshop in Quebec, Canada, September 19-20, 2015. The 2nd GTN-P National Correspondents Workshop, funded by IASC and supported by the IPA and the AWI, was visited by 28 participants involved in the GTN-P Steering Committee, the Secretariat, Advisory Board, as National Correspondent or as invited external collaborator (e.g. IASC, IPA, NSIDC and NORDICANA-D) representing 16 countries. The involvement of Early Career Scientists in GTN-P was discussed in order to sustain and excel GTN-P in the future. The decision was made for a wide call for “Young National Correspondents” of GTN-P (YNC) through PYRN. YNC will work closely with their national correspondents and be exposed to all aspects of the GTN-P from data collection and management to participation in scientific reports, meetings and publications. GTN-P will present the results of the new state of permafrost report at the ICOP2016 in Potsdam and will give a data management course for Young National Correspondents in association with the PYRN workshop at ICOP.

Our research on socio-economic impacts on permafrost degradation has continued. Over the past three years we have collaborated with the GWU Institute for European, Russian and Eurasian Studies (IERES) on NSF-funded Research Coordination Network (RCN) project on Arctic Urban Sustainability. It is a multi-disciplinary, international effort examining the interconnections among resource development, climate change, and evolving demographic patterns with the goal of providing advice to U.S., Russian, and other policy-makers on how to develop Arctic and related infrastructure in a way that produces minimal impact on the environment. The permafrost component of the project involves participants from the US and Russia representing geography, permafrost engineering, architecture, and climatology. In 2015 GWU housed an RCN meeting with 40 participants from the US, Russia, Canada, and Europe. Building on the NSF RCN in 2015 we have developed a successful NSF Partnership in International Research and Education (PIRE) project on Promoting Urban Sustainability in the Arctic. The project will start in April 2016 and has a substantial permafrost-related research and educational components. The 2015 funded ARCTIC-ERA (ARCTIC climate change and its impact on Environment, infrastructures and Resource Availability) Belmont project is collaborative effort between Laboratoire de Glaciologie et Géophysique de l'Environnement (France), The GWU (USA), Shirshov Institute of Oceanology (Russia), the Institute of Economic Forecasting (Russia), and HS&S Corp. (USA) are working to forecast and provide estimates of the magnitude of environmental changes in the Arctic and their impact on the communities’ well being and infrastructure. Within the framework of the ARCTIC-ERA project the GWU team is responsible for geographic assessment of the effect of permafrost changes on human infrastructure.

The project “Collaborative Research: Interactions Between Air Temperature, Permafrost, and Hydrology in the High Latitudes of Eurasia” has completed its fieldwork component. Stable isotope composition of rain, snow, and various types of ground ice was used to determine various inputs and pathways to river flow in several watersheds. More than 500 samples were collected over the three year period at Igarka, Russia in collaboration with the Igarka Geocyology Lab of the Melnikov Permafrost Institute SB RAS, and University of New Hampshire.

Kelsey Nyland has completed a master's degree in geography at GWU with a thesis entitled Climate- and Human-Induced Land Cover Change and its Effects on the Permafrost System in the Lower Yenisei River of the Russian Arctic. Kelsey has moved to Michigan State University to pursue a Ph.D. in Geography. She will continue to be actively involved in the CALM IV and Arctic Urban sustainability projects. Fritz Nelson has been named Professor Emeritus at the University of Delaware, and now holds academic appointments as Adjunct Professor at Northern Michigan University (NMU) and Michigan State University (MSU). He maintains involvement in CALM IV through NMU and is developing a program of research and graduate education in periglacial geomorphology at MSU. After 1 January 2016 Nelson's email address will be fnelson@msu.edu.

Institute of Northern Engineering (INE), University of Alaska Fairbanks (UAF):

A research group led by Prof. Yuri Shur continued working on the NSF-funded project "Dynamics and consequences of increasing ice-wedge degradation". During these studies, which started in 2010, the team has performed field work to assess ice-wedge degradation and stabilization at six intensive study sites, including the Jago River, Prudhoe Bay, Barrow, and Itkillik sites in northern Alaska and the Creamers Field and Horseshoe Lake sites in central Alaska. Five stages of ice-wedge degradation and stabilization, including undegraded wedges (UD), degradation-initial (DI), degradation-advanced (DA), stabilization-initial (SI), and stabilization-advanced (SA), and processes of ice-wedge thermokarst and thermoerosion have been characterized have been characterized. The field efforts included measurements of surface microtopography with ground-based LIDAR, descriptions of soil stratigraphy and ground ice, estimations of ground-ice content, monitoring water levels with pressure transducers and time-lapse cameras, logging soil temperatures, and vegetation sampling. In 2015, two peer-reviewed papers were published (Jorgenson et al., 2015; Kanevskiy et al., 2015).

Team: Yuri Shur (INE), Torre Jorgenson (Alaska Ecoscience), Mikhail Kanevskiy (INE), Nataliya Moskalenko (Earth Cryosphere Institute, Russia), Dana Nossov Brown (UAF), Kim Wickland (USGS), Josh Koch (USGS).

Jorgenson, T., Kanevskiy, M.Z., Shur, Y., Moskalenko, N.G., Brown, D.R.N., Wickland, K., Striegl, R., and Koch, J. (2015) Ground ice dynamics and ecological feedbacks control ice-wedge degradation and stabilization. JGR Earth Surface 120, doi:10.1002/2015JF003602.

Kanevskiy, M., Shur, Y., Strauss, J., Jorgenson, M.T., Fortier, D., Stephani, E., and Vasiliev, A. (2015, in press) Patterns and rates of riverbank erosion involving ice-rich permafrost (yedoma) in northern Alaska. Geomorphology, doi:10.1016/j.geomorph.2015.10.023.

A research group led by Dr. Margaret Darrow continues to monitor the movement and analyze the morphology of frozen debris lobes (FDLs) in the southern Brooks Range, Alaska. This project uses remotely sensed data from multiple acquisition methods (e.g., LiDAR, InSAR, historic aerial imagery, data gathered by unmanned aircraft system (UAS), and DGPS measurements in the field) to study FDLs, which are slow-moving landslides on permafrost-affected slopes. Large advances have been made in understanding the rates and episodes of movement of these geohazards by analyzing these features at different temporal scales using the various methods. The effectiveness of each method will be discussed in an upcoming paper in summation of the research project. Additional slope stability and GIS analysis of FDL-A, the closest FDL to the Dalton Highway, will be presented in

a forth-coming paper “Investigating Movement and Characteristics of a Frozen Debris Lobe, South-Central Brooks Range, Alaska” (Simpson et al., in press).
Team: Margaret Darrow (INE), Franz Meyer (UAF), Wenyu Gong (UAF), Keith Cunningham (UAF), Ronald Daanen (DGGS), Nora Gyswyt (INE)

Simpson, J. M., Darrow, M. M., Huang, S. L., Daanen, R. P., Hubbard, T. D. “Investigating movement and characteristics of a frozen debris lobe, south-central Brooks Range, Alaska.” *Environmental & Engineering Geoscience*, (in press).

The Next-Generation Ecosystem Experiments (NGEE Arctic): Investigating linkages between surface and subsurface properties is critical for understanding the fate of terrestrial ecosystems in a changing climate. Near-surface soil hydrological and biogeochemical processes are widely known to be influenced by strong surface and subsurface interactions in ice-rich landscapes, but seldom are studies designed to examine co-variation in active layer and permafrost properties at scales appropriate for inclusion into Earth System Models. In this study, researchers in the NGEE Arctic project investigated linkages between soil and landscape property dynamics in the Arctic tundra in Barrow, AK. This was done along transects that traverse a range of geomorphological conditions, including ice-wedge polygons, interstitial tundra, and drained-haw lake basins. Landscape characteristics were inferred from topographic, multi-spectral and thermal-infrared imaging measurements using either a kite-, pole- and tram-based platform at various temporal and spatial scales from continuous monitoring along a 35 m long transect to occasional campaigns along 500x40 m corridors (see Figure). Soil properties are inferred using electrical resistivity tomography, time-domain reflectometry, temperature measurements, and soil sample analysis. Overall, scientists were able to identify the spatiotemporal linkages between various soil and landscape properties, including water inundation, vegetation, topography, thaw layer thickness, soil water content, temperature,

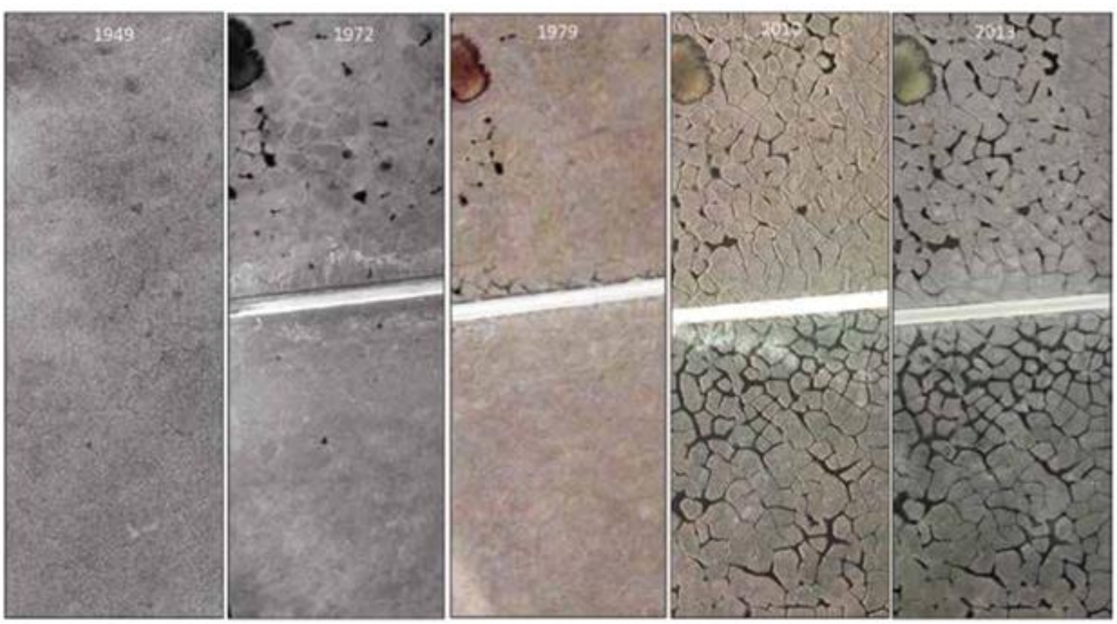
The picture on the left shows the co-acquisition of electrical resistivity tomography (ERT) along transects on the Barrow Environmental Observatory. Geophysical data acquired using the ERT arrays are collocated with point-scale measurements of various soil properties and landscape images using a kite-based platform equipped with a multi-spectral camera. Landscape images (such as the ones shown on the right) are involved in the reconstruction of geo-referenced mosaic and digital surface model, which are further used to investigate co-interactions between subsurface and surface properties.

electrical conductivity, and snow thickness. This research confirms the complementary nature of various ground- and aerial-based approaches and proxies to estimate soil properties within a framework that considers uncertainty, resolution, and spatial coverage. Among other results, a relatively strong relationship was observed between changes in soil electrical conductivity, water content, active layer thickness, and vegetation state. These associations reinforce the importance of water distribution on various processes including vegetation dynamics, thermal conductivity, surface-subsurface energy exchange, redox reactions, and biogeochemical mechanisms. Identifying such linkages is crucial if we are to extrapolate knowledge from point-scale and core-based biogeochemical measurements at specific sites over larger scales to ultimately improve parameterization of models simulating ecosystem feedbacks to climate. Results from this study will be presented at the Fall AGU meeting in San Francisco (Dafflon et al., B41D-0469).

University of Alaska Fairbanks

D.A. (Skip) Walker, Yuri Shur, Gary Kofinas, Mikhail Kanevskiy, Marcel Buchhorn, Martha Raynolds, Lisa Wirth, Jana Peirce, Tracie Curry, Michael Willis

Following the discovery of oil at Prudhoe Bay, Alaska, a series of environmental studies documented the landscape changes resulting from the rapidly expanding network of roads and oilfield facilities (Walker et al., 1987; National Research Council (NRC), 2003; Raynolds et al., 2014). The latest studies noted a steep increase in the abundance of thermokarst features within the oilfield since 1990 (Fig. 1). A full description of the landscape and permafrost changes in the Prudhoe Bay Oilfield, derived mainly from regional- and landscape-scale mapping studies, is in Walker et al. (2014). In-depth field studies of thermokarst within the Prudhoe Bay Oilfield have been recently conducted (Jorgenson et al. 2015, Walker et al. 2015).



Colleen Site A study area time series 1949-2013, showing progression of change. Imagery and original scales: Jul 1, 1949, U.S. Navy, BAR, black & white, 1:20,000; July 15, 1972, U.S Army Cold Regions Research and Engi- neering Laboratory (CRREL), black & white, 1:6,000; July 13, 1979, Prudhoe Bay Unit, color,1:18,000; 2010 BP Alaska, digital, color, 1-foot resolutions; 2013 BP Alaska, digital, color, 0.75-foot resolution. Notes: The Spine Road was constructed in 1969 so it does not appear on the 1949 image. The 1949 image is degraded, but most of the thermokarst pits that are present in 1972 are still visible.

During August 2014 and 2015, we examined road-related thermokarst features that were accessible near the Deadhorse airport. The main objective of the field program was to document the extent and effects of road dust and road-related flooding to the topography, landforms, permafrost, soils, and vegetation. We were particularly interested in changes to the permafrost and ice-wedges. We chose two main study sites: (1) Colleen Site A, which is located along the Spine Road, the oldest most heavily traveled road in the region, and (2) the Airport Study Site. The Colleen Site has extensive thermokarst that formed deep troughs over degrading ice wedges on the surface with low-centered ice-wedge polygons. Historical changes to thermokarst at this site are documented in annual aerial photographs taken by the U.S. Navy (1949) and oil industry every year since discovery of the field in 1968. The Airport Site is located adjacent to the Sagavanirktok River on better-drained terrain, where thermal erosion has deeply eroded the polygonal ice-wedge troughs forming high-centered polygons with over a meter of center-trough micro-relief. Field studies at both sites include measurements of topography, active layer, vegetation, dust, flooding, snow, soil temperatures, and spectral reflectance along transects on both sides of the road. Shallow permafrost boreholes with depths from 50 to 257 cm were drilled in ice-wedge troughs and centers of polygons (57 boreholes at Colleen Site A and 28 boreholes at the Airport Site). A full data report is available for the 2014 field studies (Walker et al. 2015), and another is in preparation for the 2015 studies. Interviews of oil-industry personnel and local residents are being conducted to examine the various perspectives of the effects of roads to help in developing adaptive management methods. The U.S. National Science Foundation's Arctic Science Engineering and Education for Sustainability (ArcSEES) initiative is funding the study. Early results will be presented at the 2015 AGU meeting.

Jorgenson, T., Kanevskiy, M.Z., Shur, Y., Moskalenko, N.G., Brown, D.R.N., Wickland, K., Striegl, R., and Koch, J. (2015) Ground ice dynamics and ecological feedbacks control ice-wedge Degradation and Stabilization. JGR Earth Surface. (In press)

National Research Council (NRC). (2003). Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope (pp. 1–305). Washington, D.C.: National Academy Press.

Raynolds, M. K., Walker, D. A., Ambrosius, K. J., Brown, J., Everett, K. R., Kanevskiy, M., et al. (2014). Cumulative geoecological effects of 62 years of infrastructure and climate change in ice-rich permafrost landscapes, Prudhoe Bay Oilfield, Alaska. Global Change Biology, (20), 1211–1224. http://doi.org/10.1111/gcb.12500

Walker, D. A., Webber, P. J., Binnian, E. F., Everett, K. R., Lederer, N. D., Nordstrand, E. A., & Walker, M. D. (1987). Cumulative impacts of oil fields on northern Alaskan landscapes. Science, 238(4828), 757–761.

Walker, D A, Raynolds, M. K., Buchhorn, M., & Peirce, J. L. (Eds.). (2014). Landscape and permafrost change in the Prudhoe Bay Oilfield, Alaska (pp. 1–84). Fairbanks, AK: Alaska Geobotany Center, University of Alaska, AGC Publication 14-01.

Walker, D. A., Buchhorn, M., Kanevskiy, M., Matyshak, G. V., Raynolds, M. K., Shur, Y. L., & Peirce, J. L. (2015). Infrastructure-Thermokarst-Soil-Vegetation Interactions at Lake Colleen Site A, Prudhoe Bay, Alaska (No. AGC 15-01). (D. A. Walker, M. K. Raynolds, M. Buchhorn, & J. L. Peirce, Eds.)AGC Data Report (pp. 1–100). Fairbanks.

Walter Anthony, K. M., S. A. Zimov, G. Grosse, M. C. Jones, P. Anthony, F. S. Chapin III, J. C. Finlay, M. C. Mack, S. Davydov, P. Frenzel, S. Frolking

Shift of thermokarst lakes from methane source to climate-cooling carbon sink

Our recent efforts have focused on understanding the dual role thermokarst lakes play in the climate system by emitting greenhouse gases and sequestering atmospheric carbon. Walter Anthony et al. 2014 compiled basal dates of thermokarst lake initiation in the Arctic; quantified carbon stocks in undisturbed permafrost soil profiles and in thermokarst lake basins; and estimated past and present methane and carbon dioxide emissions from thermokarst lakes using both flux measurements and carbon mass balance approaches.

Thermokarst lakes formed across vast regions of Siberia and Alaska during the last deglaciation and are thought to be a net source of atmospheric methane and carbon dioxide during the Holocene. However, the same thermokarst lakes can also sequester carbon, and until recently it was uncertain whether carbon uptake by thermokarst lakes can offset their greenhouse gas emissions. Walter Anthony et al. (2014) used field observations of Siberian permafrost exposures, radiocarbon dating and spatial analyses to quantify Holocene carbon stocks and fluxes in lake sediments overlying thawed Pleistocene-aged permafrost. We find that carbon accumulation in deep thermokarst-lake sediments since the last deglaciation is about 1.6 times larger than the mass of Pleistocene-aged permafrost carbon released as greenhouse gases when the lakes first formed. While methane and carbon dioxide emissions following thaw lead to immediate radiative warming, carbon uptake in peat-rich sediments occurs over millennial time scales. With the help of an atmospheric perturbation model we assess thermokarst-lake carbon feedbacks to climate and find that thermokarst basins switched from a net radiative warming to a net cooling climate effect about 5000 years ago. High rates of Holocene carbon accumulation in lake sediments (47 ± 10 g C m^{-2} a^{-1}, mean ± SE, n=20 lakes) were driven by thermokarst erosion and deposition of terrestrial organic matter, by nutrient release from thawing permafrost that stimulated lake productivity and by slow decomposition in cold, anoxic lake bottoms. When lakes eventually drained, permafrost formation rapidly sequestered sediment carbon. Our estimate of about 160 Pg of Holocene organic carbon in deep lake basins of Siberia and Alaska increases the circumpolar peat carbon pool estimate for permafrost regions by over 50 percent. The carbon in perennially-frozen drained lake sediments may become vulnerable to mineralization as permafrost disappears, potentially negating the climate stabilization provided by thermokarst lakes during the late Holocene.

Walter Anthony, K. M., S. A. Zimov, G. Grosse, M. C. Jones, P. Anthony, F. S. Chapin III, J. C. Finlay, M. C. Mack, S. Davydov, P. Frenzel, S. Frolking. 2014. A shift of thermokarst lakes from carbon sources to sinks during the Holocene epoch. *Nature*, 511, 452-456, DOI 10.1038/nature13560

***United States Army Cold Regions Research and Engineering Laboratory (CRREL)**:* The U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) continues to expand detailed permafrost characterization studies at their Permafrost Tunnel and Farmer's Loop Research sites near Fairbanks, Alaska. This includes intensive drilling and sampling along transects, repeat geophysical surveys, and repeat active layer probing, vegetation analysis, soil thermal measurements, and snow characterization. We are also maintaining a growing network of sites around Fairbanks where hyperspectral imagery, airborne LiDAR, snow depth, seasonal thaw, and vegetation spectral measurements are being made. New projects include work on the hydrogeology of Tanana Flats, soil microbiologic and bacterial measurements of permafrost of varying ages, and hydrochemistry of permafrost terrains across Alaska. Large scale permafrost characterization studies are ongoing for the North Slope Borough, the State of Alaska Department of Transportation, and the U.S. Navy. A suite of research projects in Greenland includes refining methods for delineating, sampling and characterizing ground ice conditions of glacio-fluvial/weathered bedrock for infrastructure and developing rehabilitation methodologies for active infrastructure suffering from thaw-degradation in Greenland.

U.S. Geological Survey: Permafrost-related research at the USGS spans multiple disciplines and regional science centers. Broad research themes include permafrost thermal regime measurements, soil microbiology and biogeochemistry, hydrologic modeling and aquatic biogeochemistry, geophysical investigations, and remote sensing and landscape change. A selection of the USGS personnel involved, specific project goals, and outcomes during 2015 are provided below.

Permafrost Thermal Regime Measurements: Gary Clow and Frank Urban with the USGS Geosciences and Environmental Change Science Center (GECSC) oversee the DOI/GTN-P USGS Permafrost and Climate Monitoring Network located on federal lands in northern Alaska. In 2015, the annual data series update from the team was released and a subsequent release with data through July 2014 will be published before the end of the calendar year. In addition, network station maintenance, snow surveys and instrument retrievals/deployments were conducted during the spring and summer of 2015. Gary Clow is constructing mathematical models to extract the climate signal from the borehole temperature measurements collected during the past 40 years. Frank Urban represented the United States as a correspondent at the annual GTN-P workshop in Quebec City.

Soil Microbiology and Biogeochemistry: Mark Waldrop is the Principal Investigator of the USGS Soil Biogeochemistry Group which seeks to understand the forms, causes, and consequences of soil carbon gains and losses in response to permafrost thaw in northern latitude ecosystems. His team includes Jack McFarland, Jennifer Harden, Kristen Manies, Miriam Jones, and Monica Haw. The team works in close collaboration with the Bonanza Creek LTER and university colleagues Rachel Machelprang at CSU Northridge on microbial metagenomics and Rebecca Neumann at U. Washington on measurement and modeling of methane cycling. In Alaska, this team focuses primarily on permafrost thaw and its effects on soil C storage and greenhouse gas fluxes in lowland thermokarst environments. During 2015, the team published findings related to the phylogenetic composition of microbial communities in permafrost, the active layer, and a thermokarst bog located in Interior Alaska and demonstrated the potential linkage between molecular data and ecosystem level process rates. These microbial community relationships may help explain the processes involved with findings by the group showing that permafrost carbon is rapidly lost following permafrost thaw in boreal permafrost peatlands. A new NASA astrobiology project will focus on microbial strategies for survival and activity in permafrost. Miriam Jones is also co-Principal Investigator on an NSF-funded project to examine the role of peatlands and thermokarst lakes on the atmospheric methane concentrations over the Deglacial and the Holocene. Synthesis work included identifying peatland properties specific to permafrost peatlands, and using plant macrofossils and peat properties to identify the timing of permafrost aggradation in existing permafrost peatlands.

Hydrologic Modeling and Aquatic Biogeochemistry: Michelle Walvoord, with the USGS National Research Program (NRP), led a USGS team that completed a four year integrated field and model based study to investigate permafrost influence on hydrologic processes and fluxes in interior Alaska.

The research was done in collaboration with scientists from the US Army CRREL office and resulted in methodological advances in geophysical measurements as well as concerted efforts focused on widespread Interior Alaska lake surface area changes and feedbacks. In addition, Cliff Voss is finalizing the public release of a computer simulation code (USGS-SUTRA code) that represents the flow of groundwater, subsurface energy transport (temperature change), and subsurface freeze/thaw. Kim Wickland and Rob Striegl of the USGS NRP also recently published a paper that describes the rapid conversion of ancient permafrost soil-derived dissolved organic carbon (DOC) to carbon dioxide (CO_2), and implications for detection of aged DOC in aquatic systems from permafrost thaw. Kim Wickland and Dave Krabbenhoft (USGS Wisconsin Water Science Center) launched a field study in 2015 focused on the effects of permafrost thaw on mercury and carbon cycling in cooperation with Denali National Park. The project will continue in 2016. In addition, Rob Striegl will lead a recently funded NASA ABoVE Project to assess the vulnerability of inland waters and the aquatic carbon cycle to changing permafrost and climate across boreal northwestern North America.

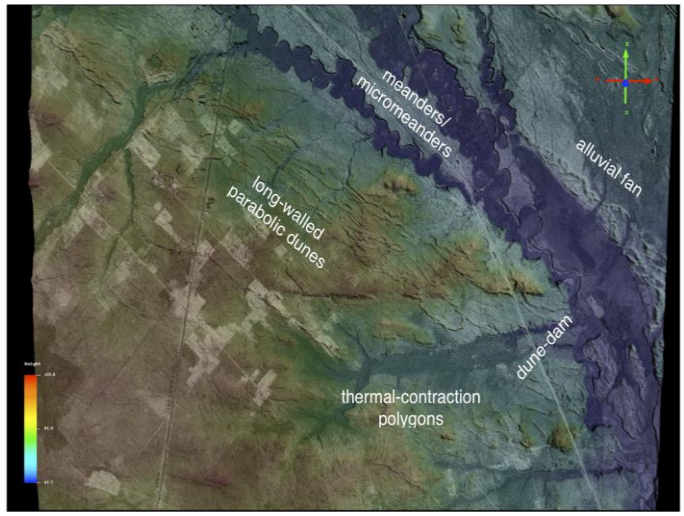
Geophysical Investigations: Burke Minsley and other research scientists from the USGS Crustal Geophysics and Geochemistry Science Center (CGGSC) as well as the USGS Office of Groundwater Branch of Geophysics (OWG BG) used geophysical methods to map permafrost characteristics. Permafrost geophysical measurement efforts focused on collecting electrical resistivity tomography (ERT) data in Interior Alaska to characterize the impact of fire on permafrost. In addition, a nuclear magnetic resonance (NMR) probe was tested for applications of quantifying *in situ* unfrozen water content in shallow soils and permafrost. The team published a recent numerical hydrogeophysical modeling study showing the utility of airborne electromagnetic data for better understanding the state of sublacustrine permafrost thaw. In August 2015, Bruce Richmond, Peter Swarzenski, Tom Lorenson and Cordell Johnson from the USGS Pacific Coastal and Marine Science Center in Santa Cruz, CA, surveyed rapidly eroding permafrost bluffs on Barter Island, a barrier island on Alaska's Arctic coast. The researchers aim to document seasonal to decadal coastal-bluff change and associated hydrogeologic processes along a 3-kilometer stretch of permafrost coastline on Barter Island.

Remote Sensing and Landscape Change: Bruce Wylie and Jennifer Rover of the USGS Earth Resources and Observation and Science (EROS) center and Neal Pastick (SGT contractor to USGS EROS) are involved in a collaborative partnership with other scientists to map permafrost, water dynamics in lakes, and soil organic layer thickness in mainland Alaska. Machine learning, data fusion, remotely-sensed Landsat data, and other digital map products are used to extend field observations of permafrost related attributes. The EROS team recently published a study that focused on developing binary and probabilistic maps of near-surface permafrost distributions at a 30 m resolution by employing decision tree models, field measurements, and remotely sensed (Landsat) and mapped biophysical data. The team also has an *in press* publication related to soil carbon and permafrost estimates and susceptibility in Alaska. Ann Gibbs and Bruce Richmond from the USGS Pacific Coastal and Marine Science Center in Santa Cruz, CA, recently released a comprehensive report covering more than 1000 miles of the Alaskan coast between the U.S. Canadian border and Icy Cape. Benjamin Jones, with the USGS Alaska Science Center (ASC), is involved in a number of studies related to northern high latitude landscape and ecosystem dynamics and change. The ASC team, that also includes Carson Baughman and Benjamin Gaglioti, focuses on the use of remote sensing, GIS, field surveys, laboratory analyses, and model development in Arctic and Boreal regions to better understand short-term and long-term changes occurring in permafrost-influenced landscapes. In 2015, the team published findings related to post-fire thermokarst development in arctic tundra, the role of beaded streams in arctic permafrost landscapes, observing a catastrophic thermokarst lake drainage, and the role of lake ice regimes on the hydrologic response of arctic lakes. The team is currently working on developing a remote sensing based Permafrost Essential Climate

Variable (ECV) program and they are contributing to the recently funded NSF-Arctic Lake Ice Systems Science project, which focuses on winter lake dynamics and interactions with permafrost, hydrology, and climate to predict future Arctic system responses.

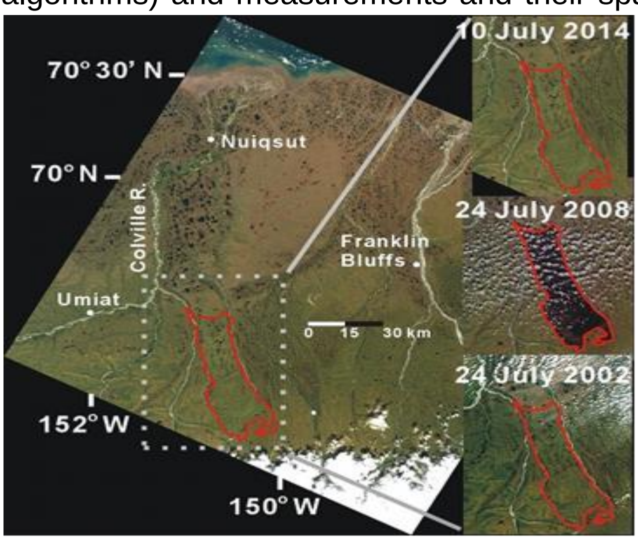
Individual Member Activities:

Mark Demitroff: USPA-board member Mark Demitroff (Stockton University) has been working on evidence of strong Pleistocene wind-action, and its effects to land-surface processes and palaeohydrology in the ice marginal Pinelands National Reserve, New Jersey. He now collaborates with Franklin & Marshall College on the cold climate landscapes and sediments of unglaciated Pennsylvania and Maryland (thermal-contraction polygons, gelifluction features, pingo-like structures, thermokarst).



LiDAR-image of the true bare-earth ground showing relict periglacial features in the Great Egg Harbor National Wild and Scenic River watershed, Newtonville, NJ (M. Cicali & M. Demitroff). Stockton University).

Reginald Muskett (Ph.D., Research Associate, Geophysical Institute Permafrost Lab University of Alaska Fairbanks) continues research investigations into the changes of the permafrost regions of the Northern Hemisphere with measurements from the joint mission NASA-DLR Gravity Recovery and Climate Experiment (GRACE), the JAXA Advanced Land Observing Satellite (ALOS) Phased Array L-band Synthetic Aperture Radar (PALSAR) and other satellite remote measurement and sensing systems. This year he published papers on Arctic active-layer soil moisture retrievals (satellite-based algorithms) and measurements and their spatial-temporal variations (Muskett, 2015a) and the North Slope, Alaska, with emphasis on the Anaktovuk wildfire and Barrow regions using measurements from the NASA Ice, Cloud and land Elevation Satellite (ICESat) Geoscience Laser Altimeter System (GLAS) and the JAXA ALOS PALSAR for comparison of the backscatter properties of the tundra at two far-separated electromagnetic wavelengths (Muskett, 2015b).



A region of interest on the North Slope, Alaska: The Anaktovuk Wildfire scar, as observed in LANDSAT7 and 8 images from 24 July 2002 (before the wildfire), 24 July 2008 (one year after the wildfire) and 10 July 2014 (showing vegetation recovery seven years after the wildfire) (Muskett, 2015b). For more on tundra vegetation recovery see Bret-Harte et al. (2013).

In 2015 Reginald continued his activity of convening and chairing permafrost science sessions at the European Geoscience Union (EGU) General Assembly, Vienna, Austria, and at the American Geophysical Union Fall Meeting in San Francisco, Califronia. At the EGU Reginald co-convened and co-shared again the session "Permafrost Open Session." At the AGU he was co-convener and co-chair of the session "Applications of Near Surface Geophysics in Periglacial Regions Posters."

This year JPL and NASA convened the second annual workshop for dual-band satellite radar mission NASA - Indian Space Research Organization (NISAR). The workshop was held at the NASA Ames Research Center, Moffet Field, California. At the workshop Reginald gave a poster presentation of his newest paper about interferometric synthetic aperture radar (InSAR) scattering properties on the tundra of the North Slope, Alaska. There he also shared information and insights with the mission working groups and science teams.

Muskett, R.R., Romanovsky, V.E., Cable, W.L. and Kholodov, A.L. (2015a) Active-Layer Soil Moisture Content Regional Variations in Alaska and Russia by Ground-Based and Satellite-Based Methods, 2002 through 2014. International Journal of Geosciences, 6, 12-41. http://dx.doi.org/10.4236/ijg.2015.61002

Muskett, R.R. (2015b) ICESat GLAS Elevation Changes and ALOS PALSAR InSAR Line-of-Sight Changes on the Continuous Permafrost Zone of the North Slope, Alaska. International Journal of Geosciences, 6, 1101-1115. http://dx.doi.org/10.4236/ijg.2015.610086

Bret-Harte, M.S., Mack, M.C., Shaver, G.R., Huebner, D.C., Johnston, M., Mojica, C.A., Pizano, C., Reiskind, J.A. (2013) The response of Arctic vegetation and soils following an unusually severe tundra fire. Phil Trans R Soc B 368: 20120490. http://dx.doi.org/10.1098/rstb.2012.0490

Deaths

A.V. Pavlov (1930-2015)

Aleksandr V. Pavlov, one of the most accomplished permafrost scientists in permafrost history, passed away on November 4, 2015. Born in January 1930, he lost his parents while he was a boy and he and his sister had spent several years in an orphanage. He was in Leningrad during the Leningrad Siege. Before attending open university, he spent 4 years in a technical school. He graduated from Leningrad Polytech University and soon became a PhD student of the Academy of Sciences with residence at the Obruchev Permafrost Institute. He always remembered that period with great pleasure. He had a room in a dormitory of the Academy of Sciences and could attend the Moscow Chess Club. He was a very talented chess player and had high ranking in the chess hierarchy. His Ph.D. study was under M.M. Krylov on winter irrigation and he received his PhD in agricultural science. At that time, the Soviet Union started a program of Development of Virgin Lands and every institution, business, and industrial enterprise were to send their employees there even against their will. The Obruchev Permafrost Institute had only one candidate to send and this was Pavlov. Only health problems inherited during the WWII saved him from this adventure. He did not have a place to live in Moscow and for about 6 years he lived 100 km from Moscow at the small Zagorsk scientific station of the Permafrost Institute. Fortunately, it was the best time for the station. It was chosen as one of the experimental sites of the International Geophysical Year 1957-1958 (IGY) and Pavlov lead, unique for that time, the thermal balance studies under several typical landscapes. His first book "Thermal exchange of freezing and thawing soils with the atmosphere" was based on his work during the IGY. He was an extremely hard worker and colleagues joked that he would never find time to have a family, but he did find his future wife Nina and they have two wonderful children Lena and Sergey.

In the beginning of 1960s Academician P.F. Shvetsov started the permafrost program at VSEGINGEO (USSR Institute of Hydrogeology and Engineering Geology) and Pavlov was invited to join it. After working at the VSEGINGEO for a few years he went to the Yakutsk Permafrost Institute. Many international scientists met him and visited his experimental sites during 2nd International Permafrost Conference. In 1974 he became a Doctor of Science in Geography. After 15 years work in Yakutsk, he returned to VSEGINGEO and led investigations on the monitoring of the thermal regime of permafrost at numerous sites. He continued his non-stopped work and only during lunches did he take time off to play fast chess games with two other well-known permafrost scientists, Grechishchev and Chistotinov, and not leaving them many chances for victory. I began my work at the Obruchev Permafrost Institute as his assistant. We spent three winter months together in the field in a very remote area where he tried to teach me heat transfer and without success to play cards and chess.

He wrote more than 15 books during his lifetime in permafrost science. He has left a long lasting memory in his numerous publications and with the people who worked with him. Maybe he can rest now for first time in his life.

Prepared by his friend Yuri Shur, University of Alaska Fairbanks.

H. Jesse Walker (1921-2015)

H. Jesse Walker died peacefully on May 10, 2015 at his home in Baton Rouge Louisiana at the age of 92. He was born in Michigan in 1921. He lived briefly in Colorado as a child, before the family finally settled at Morro Bay, California. He attended the University of California, Berkeley until World War II interrupted his studies. He enlisted after the bombing of Pearl Harbor and became a pilot in the Marine Corps, flying countless supply missions in the Pacific Theater. He returned to his studies at the end of the war, completing both a BS and a MS degree in geography. Carl Sauer was his Master's thesis advisor.

Dr. Walker began working in the North American Arctic in the 1950s during his PhD research (1960 Louisiana State University). He flew over the Colville River delta, Alaska toward the end of his dissertation fieldwork. Looking down from the airplane, he became intrigued by this large Arctic river making it the focus of much of his research for the rest of his long life. During the 1950s through the 1980s, he spent many of his summers in the delta conducting fieldwork and mentoring graduate students. The result is a massive body of work that has laid the foundation for Alaskan Arctic research. His other research interests led him to coastlines throughout the world, most notably, Taiwan, Japan, Mauritius and Louisiana.

He was a humble and unassuming man, who had a passion for science and learning. Meeting him, one would never guess that he was a highly regarded scientist. Counted among his numerous awards and honors are the Patron's Medal from the Royal Geographical Society (2008), the Mathes Award from the American Association of Geographers (2009), the First Richard J. Russell Award in Coastal Geography - Association of American Geographers, Fellow of the American Academy of Science (1990), the First Honorary Fellow of the International Association of Geomorphologists (1989), a Doctor of Philosophy Honoris Causa degree from the University of Uppsala, Sweden (1986), Fellow of the Arctic Institute of North America (1979) and a Boyd Professorship at LSU (1977).

Jesse worked at Louisiana State University for over 50 years and was actively writing and publishing until his death. Fittingly, his last journal article was about the Arctic and was published several months after his passing.

Written by his friend and colleague *Molly McGraw,*
Southeastern Louisiana University.

Compiled by: Molly McGraw, Secretary US Permafrost Association (4 December 2015)
(molly.mcgraw@selu.edu)