Witness The ARCTIC

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In this Issue

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ARCUS Member Highlight: The Arctic Centre

Note: "Witness the Arctic" regularly features the research and related programs of ARCUS member institutions. This article spotlights the Arctic Centre at University of Lapland, located in Rovaniemi, Finland.

The Arctic Centre at the University of Lapland is built exclusively for Arctic research and outreach. Founded in 1989, it is located in the Arktikum House situated in Rovaniemi, Finland. The Arctic Centre hosts an international staff of about 80 whose work includes social sciences, anthropology, natural sciences and law studies, which in combination support a holistic understanding of developments and life in the Arctic.

Arktikum House hosts a number of exhibitions. The Arctic Centre is located in the same building. Photo courtesy of Veli Kouri.

The Arctic Centre has three multidisciplinary research groups: global change, sustainable development, and the Northern Institute for environmental and minority law. The research concentrates on the interaction between people and environment. The Centre has expertise in a multitude of areas, including stakeholder participation, sustainability and social impacts, traditional knowledge, land use and natural resources, local and indigenous peoples, economy and ecology, mitigation, and resilience. Additionally, science communication programs at the Arktikum Science Centre improve general understanding of the Arctic by giving visitors a "tour" through the Arctic regions. The Centre also hosts a number of Arctic events annually, ranging from local discussions and Arctic handicraft markets to major international Arctic conferences.

The cold room is one of the attractions at the Arktikum Science Centre. Photo courtesy of Jani Kärppä.

The Arctic Centre enjoys a strong international reputation and is Finland's leading center of excellence for the Arctic. The expertise at the Arctic Centre is also utilized in the Arctic Council and the Barents Euro-Arctic Council activities. The Arktikum House where the institute is located was built following an international architecture competition. It hosts two major exhibitions: the Arctic Centre's Arktikum Science Centre and the city of Rovaniemi's Regional Museum of Lapland. It has become one of the most popular tourist attractions in the region.

The University of Lapland

The Arctic Centre is the research unit of the University of Lapland. The University has faculties of social sciences, law, education, and art and design. The University concentrates on service design, northern well-being, and the changing nature of work as well as sustainable development, law, and justice.

Upcoming Event - In the Spirit of the Rovaniemi Process Conference, 24-26 November 2015

This conference is the second in a series of biennial international Arctic conferences under the headline "In the

Spirit of the Rovaniemi Process" organized by the Arctic Centre together with the City of Rovaniemi and the Arctic Society of Finland. The conferences highlight the importance and contemporary legacies of the so-called Rovaniemi Process from the early 1990´s that started the international Arctic cooperation, resulted in the Arctic Environmental Protection Strategy, and contributed to the establishment of the Arctic Council. With the theme "Local and Global Arctic," this year's conference will address the interaction of the global, regional, and local levels in the Arctic. Updated information is available here (http://www.rovaniemiprocess.fi/en).

In the Spirit of the Rovaniemi Process is a series of three biannual Arctic conferences organized by the Arctic Centre and the City of Rovaniemi. Photo courtesy of Jani Kärppä.

Examples of Current Research Activities

Resilience in Social-Ecological Systems of Northwest Eurasia (RISES)

A research project entitled Resilience in Social-Ecological Systems of Northern Eurasia RISES (http://www.arcticcentre.org/EN/RESEARCH/Projects/Pages/RISES), led by research professor Bruce Forbes and funded by the Academy of Finland, will reconstruct the environmental histories of integrated social-ecological systems in Fennoscandia and Yamal, West Siberia that have been characterized by both climate change and the constant adaptation of people and their reindeer herds through the late Holocene.

During many years the Arctic Centre has conducted field research at the Yamal Peninsula on the Siberian tundra. Reindeer herders there need to adapt to new conditions. Photo courtesy of Bruce Forbes.

The project will link indigenous Sámi and Nenets oral histories with archaeology, paleoecology, and modern ecological and climate studies for a holistic explanation of stable states. The aim is to produce a state-of-the-art assessment on the relative roles of, and feedbacks between, humans, animals, and climate in the structure, function, and resilience of past and contemporary systems.

Human Security as a Promotional Tool for Societal Security in the Arctic (HuSArctic)

The main objective of the Human Security as a Promotional Tool for Societal Security in the Arctic (HuSArctic) (http://www.arcticcentre.org/EN/RESEARCH/NIEM/Projects/HuSArctic) research project led by senior researcher Dr. Kamrul Hossain from the Northern Institute of Minority and Environmental Law is to address human challenges of the Arctic population from a different angle, namely from the human security perspective as it is conceptualized today.

The project will focus on the Barents region as that area is facing numerous human activities such as mining and mineral activities in Finnish and Swedish Lapland, offshore oil and gas activities in Northern Norway, and both onshore and offshore oil and gas activities in Russia's Barents region. In the Arctic perspective this will bring added value to the ongoing discussions and dialogues concerning the vulnerability of, as well as adaptation to, the challenges facing Arctic inhabitants, more particularly its indigenous and local communities. Knowledge developed from this project would bring benefit both to the policy level decision-makers as well as local people, communities, and stakeholders.

Oral History of Empires by Elders in the Arctic (Orhelia)

This anthropology research project, Oral History of Empires by Elders in the Arctic (Orhelia) (http://www.arcticcentre.org/EN/RESEARCH/Sustainable-Development-Research-Group/Anthropology-research-team/Oral-History-of-Empires-by-Elders-in-the-Arctic----ORHELIA), is subtitled "A comparative history of the relations between states / Empires and their subjects in their northernmost peripheries." Reports from the field trips are available at the Arctic Anthropology Blog (http://arcticanthropology.org/).

The Orhelia project develops a comparative history of relations between remote people and states in the eyes of Arctic indigenous elders, by using the method of life history analysis and oral history fieldwork combined with anthropological participant observation. Doing so, the project will also contribute to preserve incorporeal cultural heritage among Uralic speaking northern minorities of Europe and study the transmission of historical heritage between different generations. The project is funded by the Research Council for Society and Culture at the Academy of Finland and it is led by research professor Florian Stammler.

Science Popularization and Social Impact

Barents Media Guide

The Barents Mediasphere project has published a Barents Media Guide (http://www.barentsinfo.org/guide), which serves journalists from inside and outside the Barents region as well as the general public with interest in the theme.

The map-based web guide includes basic information about the media in the Barents Region. It also gives practical information about the region and how to act there, which is essential for the work of journalists. On the website there are also video stories addressing journalistic work on the Barents region and cooperative networks of the regional media.

The Kolarctic ENPI-funded Barents Mediasphere project ran from 2012-2014. It aimed at enhancing cross-border information. Led by the Arctic Centre at the University of Lapland, other partners included BarentsObserver and TV Murman from Murmansk. The Media Guide now compiles the information and experiences produced by the project.

Arktikum Science Centre: Standing Short

The story of the trees in the Arctic is told in Standing Short, a new temporary exhibition at the Arctic Centre at the University of Lapland. The public is welcome to enjoy the exhibit, learn wooden facts, see delightful illustrations, hug a tree, and enjoy some fun learning silly facts such as what a 'spruce's ass' is and why the mountain ash has been considered a sacred tree. The public is also invited to visit the permanent Changing Arctic exhibition.

Northern lights are a common sight around Rovaniemi, pictured here with the Arktikum House. Photo by Pekka Koski.

Interested?

For more information about the Arctic Centre, visit the website (http://www.arcticcentre.org/EN). You are also warmly welcome to come to Rovaniemi and visit the Arktikum House, as about 80,000 other people are already doing every year. Note: Santa Claus lives nearby, only about 10 minutes by car.

For questions, contact Markku Heikkilä, Head of Science Communications, (markku.heikkila@ulapland.fi) or phone: + 358 40 4844300. A new Director (unknown as of this publication) of the Arctic Centre will start in early 2016.

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Study of Environmental Arctic Change (SEARCH) Update

Program Leadership News

In September 2015, Brendan P. Kelly joined SEARCH (https://www.arcus.org/search-program/structure/new-ed) as the program's first Executive Director. In this capacity Kelly is leading the day-to-day efforts of the SEARCH Science Office to implement SEARCH's vision and achieve the program's long-term science goals.

A membership rotation of the SEARCH Science Steering Committee (SSC) (https://www.arcus.org/search-program/structure/ssc-committee) also occurred in September. As part of the rotation, SEARCH welcomed four new members: Betsy Baker (University of Vermont), Courtney Carothers (University of Alaska Fairbanks), Marika Holland (National Center for Atmospheric Research), and Dee Williams (Bureau of Ocean Energy Management). Additionally, the SSC elected Caspar Ammann (National Center for Atmospheric Research) to serve as the next SSC Chair. Ammann will take over this leadership role from Hajo Eicken in November. As the new Chair, Ammann will lead the Science Steering Committee's efforts to guide the SEARCH program. Eicken will continue to work with SEARCH as Past-Chair until the end of the Arctic Observing Summit in March of 2016.

Arctic Observing

The Arctic Observing Open Science Meeting (AOOSM) (https://www.arcus.org/search-program/meetings/2015/aoosm) will be held in Seattle, Washington on 17-19 November 2015. Over 200 people will gather to:

- Present and discuss scientific findings and advances resulting from Arctic observing projects;
- Discuss operational and technological achievements of observing science projects and efforts funded through U.S. local, state, and federal agencies, and private and non-profit organizations;
- Explore how well new observational achievements meet major science goals;
- Identify opportunities for collaboration to develop high impact scientific synthesis products and papers; and
- Strengthen the goals, identity, and activities of an integrated Arctic Observing System.

SEARCH is also developing an updated vision and framework for effective and sustained observations in the Arctic, which will be released in November.

SEARCH Planning Meeting

In November 2015 the SEARCH Science Steering Committee, Action Team leads, and invited participants will meet in Seattle, WA following the Arctic Observing Open Science Meeting to discuss goals for the coming year. Meeting discussions will focus on defining activities, outcomes, and implementation plans for the SEARCH science themes, Arctic observing, and cross-cutting initiatives.

SEARCH Action Team Highlights

"Sea Ice" Action Team: Improve Understanding, Advance Prediction, and Explore Consequences of Changing Arctic Sea Ice

The SEARCH Sea Ice Action Team (SIAT), led by Jennifer Francis (Rutgers University) and Henry Huntington (Huntington Consulting), hosted its first workshop on 9-10 September 2015 in Bristol, Rhode Island to develop a strategy to support the Action Team's primary focus on science communication. The strategy document produced as part of the workshop is now available on the SEARCH website (https://www.arcus.org/search-program/sea-ice).

Two projects now in development by the SIAT include: 1) a science communication workshop (https://www.arcus.org/search-program/sea-ice/activities), featuring Andy Revkin of *The New York Times*, which will be held December 2015 in San Francisco, CA as part of the American Geophysical Union's 2015 Fall Meeting and 2) the development of a "Sea Ice Matters" website that will include collaboratively developed, peer-reviewed, and concisely edited scientific content on a variety of topics.

More information is available through the SIAT webpages (https://www.arcus.org/search-program/sea-ice).

The "Permafrost" Action Team: Document and Understand How Degradation of Near-Surface Permafrost Will Affect Arctic and Global Systems

The SEARCH Permafrost Action Team (PAT), led by Ted Schuur (Northern Arizona University), will host an annual meeting of the Permafrost Carbon Network (PCN) on 13 December 2005 in San Francisco, CA. With co-sponsorship from the International Arctic Science Committee (IASC), the science synthesis activities of the

Permafrost Carbon Network will help contribute to the Permafrost Action Team's ongoing efforts to link existing research about permafrost carbon and climate to global biospheric and climate models.

More information is available through the PAT webpages (https://www.arcus.org/search-program/permafrost).

The "Land Ice" Action Team: Improve Predictions of Future Land Ice Loss and Impacts on Sea Level

The SEARCH Land Ice Action Team (LIAT), led by Fiamma Straneo (Woods Hole Oceanographic Institution) and Ted Scambos (National Snow and Ice Data Center), will convene an international gathering of over 40 scientists, students, agency officials and Greenlandic stakeholders to discuss the design and implementation of a Greenland Ice Sheet Ocean Observing System (GrIOOS) in San Francisco, CA 12-13 December 2015.

The meeting, which is co-sponsored by the Climate & Cryosphere (CliC) project of the World Climate Research Program (WCRP) and the Greenland Ice Ocean Observing Network (GRISO), will be used to identify GrIOOS priorities, establish an implementation plan, and promote action within the existing network of international agencies that would contribute to GrIOOS development.

More information is available through the LIAT webpages (https://www.arcus.org/search-program/land-ice).

SEARCH at the American Geophysical Union Fall Meeting 2015

SEARCH will host a variety of activities at this year's AGU Fall Meeting, including an open Town Hall, several SEARCH sessions and presentations, and workshops organized by the SEARCH Action Teams. The Town Hall, scheduled for Wednesday, 16 December from 12:30-1:30 p.m. PST, will provide a forum to discuss SEARCH plans and activities. Please visit the SEARCH at AGU webpage (https://www.arcus.org/search-program/meetings/2015/agu) to learn more about the many SEARCH activities planned.

Sea Ice Prediction Network: A Contribution to SEARCH

The Sea Ice Prediction Network (SIPN) (https://www.arcus.org/sipn) team (https://www.arcus.org/sipn/leadership) led a successful 2015 Sea Ice Outlook season. The Sea Ice Outlook (https://www.arcus.org/sipn/sea-ice-outlook) process produced reports in June, July, and August containing a variety of predictions and perspectives on Arctic sea ice—from observations of current conditions, to advanced numerical models, to qualitative perspectives from citizen scientists. The 2015 season had a record number of contributions. The Leadership Team also continued a series of webinars (https://www.arcus.org/sipn/meetings/webinars), including a discussion of industry needs for

seasonal and sub-seasonal ice information, and a discussion of the 2015 Sea Ice Outlook and summer sea-ice season. Two Action Teams were convened, one to evaluate the state of sea ice models and another to develop post-season products for the 2015 Sea Ice Outlook. A workshop focused on Arctic sea ice data will be held Monday, 14 December 12:00-1:00 p.m. PST. More information about the workshop will be distributed through the SIPN Mailing List (https://www.arcus.org/sipn/mailing-list).

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SEARCH Brings Essential Coordination to Interdisciplinary Arctic Science: Observations from the SEARCH Executive Director

By: Brendan P. Kelly, SEARCH Executive Director

Arctic residents, industries, government agencies, and other decision-makers seek to understand the Arctic as a complex, interacting system. SEARCH facilitates such understanding through crosscutting transdisciplinary research aimed at answering stakeholder questions. At the heart of many stakeholder questions are rapid changes in the environment related to diminishing sea ice, land ice, and permafrost. Those changes in the cryosphere need to be tracked, forecasted, and understood in terms of physics and in terms of their societal and environmental consequences. We are rich in scientific talent making significant progress. Too often, however, we lack sufficient resources to support the significant additional time required to engage in vital cross-disciplinary and cross-cultural discussions. SEARCH is dedicated to facilitating just such discussions.

While science can advance in the absence of facilitators, I believe that certain problems—by their nature—call for coordination among and within disciplines. The unprecedented rapid change in Arctic environments demands that we organize and speed up the pace of acquiring new system-level understanding. The process of facilitating such an understanding is inherently messy. Agencies and interagency bodies struggle with it, and the broader scientific community struggles with it. In the United States, we are making progress both within and outside of the government. The interagency process is getting increasingly well organized, and in the broader science community SEARCH has promoted many projects and discussions that have advanced our systems-level understanding of the Arctic. At both levels, there remains plenty of room for improved coordination, but if one considers our understanding of the Arctic today versus that of 20 years ago when SEARCH was being formed, it is clear that we have made considerable progress.

SEARCH has developed a plan that details a better approach to stakeholder participation in the conception and conduct of research. At the same time, SEARCH is participating in the collaboration teams established by the Interagency Arctic Research Policy Committee (IARPC), thus bringing together the considerable Arctic talent in and outside of the government. As SEARCH's first Executive Director, I am excited to help implement these new directions.

I intend to help clean up some of the messes, but I dare not promise a total cleanup. I think we are best off recognizing that science communities are messy and, while we strive to maximize efficiency, we need to appreciate the benefits of tolerating a certain amount of mess. For one thing, some messes reflect the rich diversity of ideas and approaches in our research community. Indeed, we are very fortunate to have such talent, and I am honored to work with them, mops-in-hand.

Also complex, but essential, are the efforts of the people in institutions supporting Arctic research. The National Science Foundation (NSF) provides the largest share of support for the SEARCH program, including the important supporting services provided through the Arctic Research Consortium of the United States (ARCUS). Critical reviews by NSF program officers and reviewers continually help to refine the SEARCH effort. The National Center for Atmospheric Research has committed salary support for the Chair of SEARCH's Scientific Steering Committee. The U.S. Geological Survey will provide postdoctoral support for the SEARCH Permafrost Action Team. The University of Alaska Fairbanks is supporting part of the Executive Director's salary, and the Center for the Blue Economy (Middlebury Institute of International Studies at Monterey) provides the Executive Director's office. Other agencies have provided support in the past and continue their intellectual engagement. Included in the latter group is the U. S. Arctic Research Commission, which provides important input to the research community and has repeatedly provided funding and ideas that have helped the community advance collectively.

There can be no doubt that the understanding of the Arctic system that we—researchers, program managers, resource managers, policy makers, and stakeholders—achieve in the next 20 years will be of long-lasting and global significance. I am confident that SEARCH will play an important role in that effort and that—with its partners—SEARCH will help optimize the mess-to-productivity ratio.

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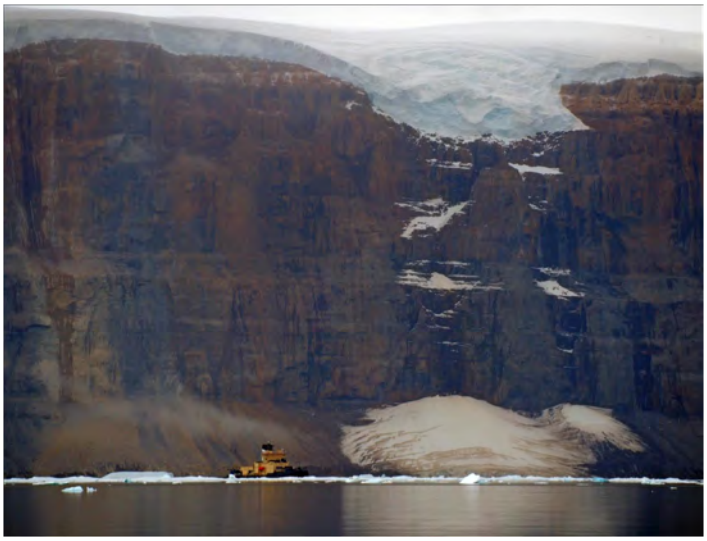
Petermann-2015 Expedition Launches International Collaboration in Arctic Science

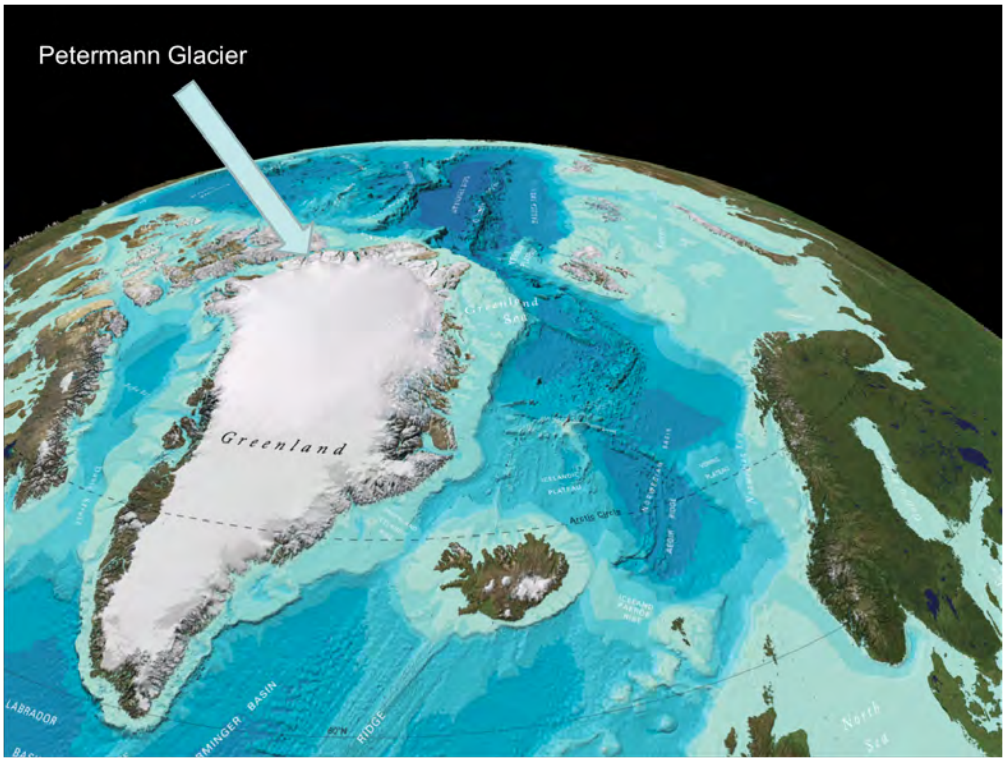
By: Alan C. Mix, Oregon State University, Martin Jakobsson, Stockholm University, and the Petermann-2015 Scientific Party

In summer of 2015, 58 scientists from six countries took Swedish Icebreaker (I/B) *Oden* to explore and sample the Petermann Fjord and Ice Shelf system and its outer reaches in Hall Basin and Nares Strait northwest of Greenland. This region plays an outsized role in the changing global climate; a deep canyon extending 750 km inland serves as a drain for the Greenland Ice Sheet and Nares Strait serves as a flow pathway of low-salinity waters from the Arctic Ocean to deep-ocean convection sites in the Labrador Sea, potentially influencing global ocean circulation.

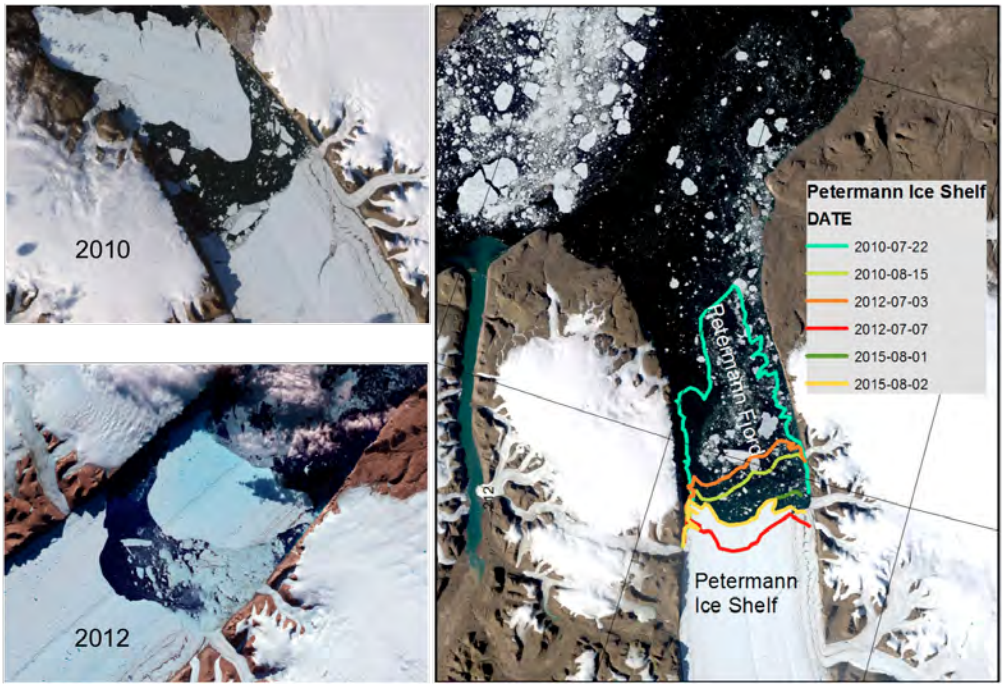


The Swedish Icebreaker Oden cruises the Petermann Fjord in northeast Greenland. Photo courtesy of the Petermann Expedition.

The Petermann Ice Shelf offers insights into ice shelf-ocean interactions, essential to projecting future climate impacts on Greenland and global sea level changes. Until recently, the ice front has been relatively stable near the fjord's outer sill. In 2010 and 2012, however, Manhattan-sized bergs calved and 30-40% of the shelf disappeared. A smaller, approximately 3 km berg, calved during the expedition in 2015. The ice shelf is thinning near the zone where it is grounded in the Petermann Fjord, and deep surface cracks in the floating shelf suggest that it may be poised for further ice losses in the future. When this will happen, and how significant this will be to the grounded portions of Petermann Glacier and the interior of Greenland, remain unknown.



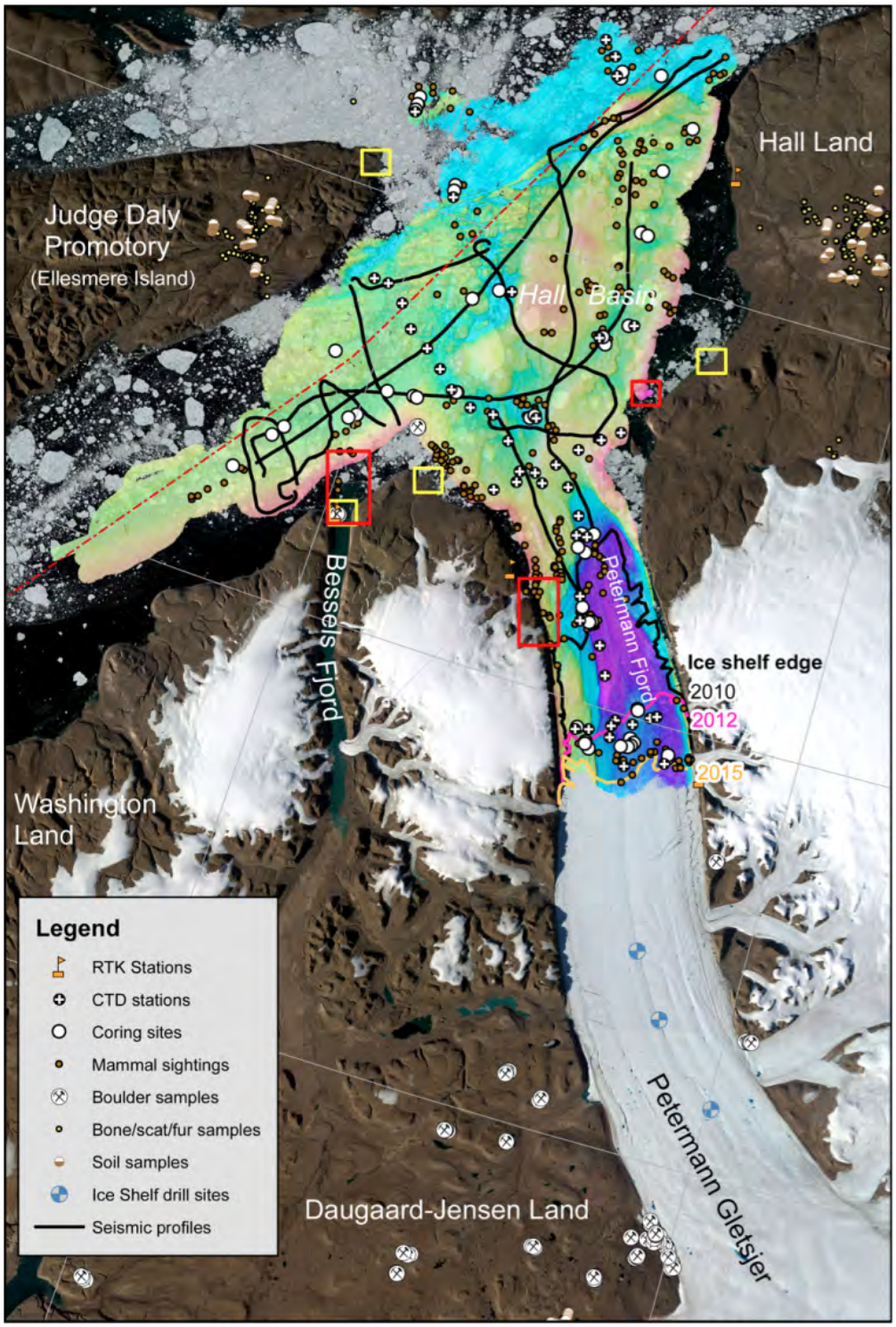
The Petermann Fjord is on the northwest coast of Greenland. Image courtesy of Martin Jakobsson. Base map from GEBCO.



Major calving events in 2010 and 2012, which resulted in loss of about 30-40% of the Petermann Ice Shelf, provided the Petermann-2015 expedition access to study a system that had been covered by ice for centuries. Images courtesy of NASA.

The Petermann-2015 expedition (29 July to 2 September) focused on past variations of the ocean-ice-climate-sea level system to assess how the coupled system has responded to changing climate. Interagency and international collaborations included NSF, NASA, the British Antarctic Survey, UNAVCO, the Polar Geospatial Center (PGC), the Swedish Polar Research Secretarial, and the Geological Survey of Denmark and Greenland. Specific objectives

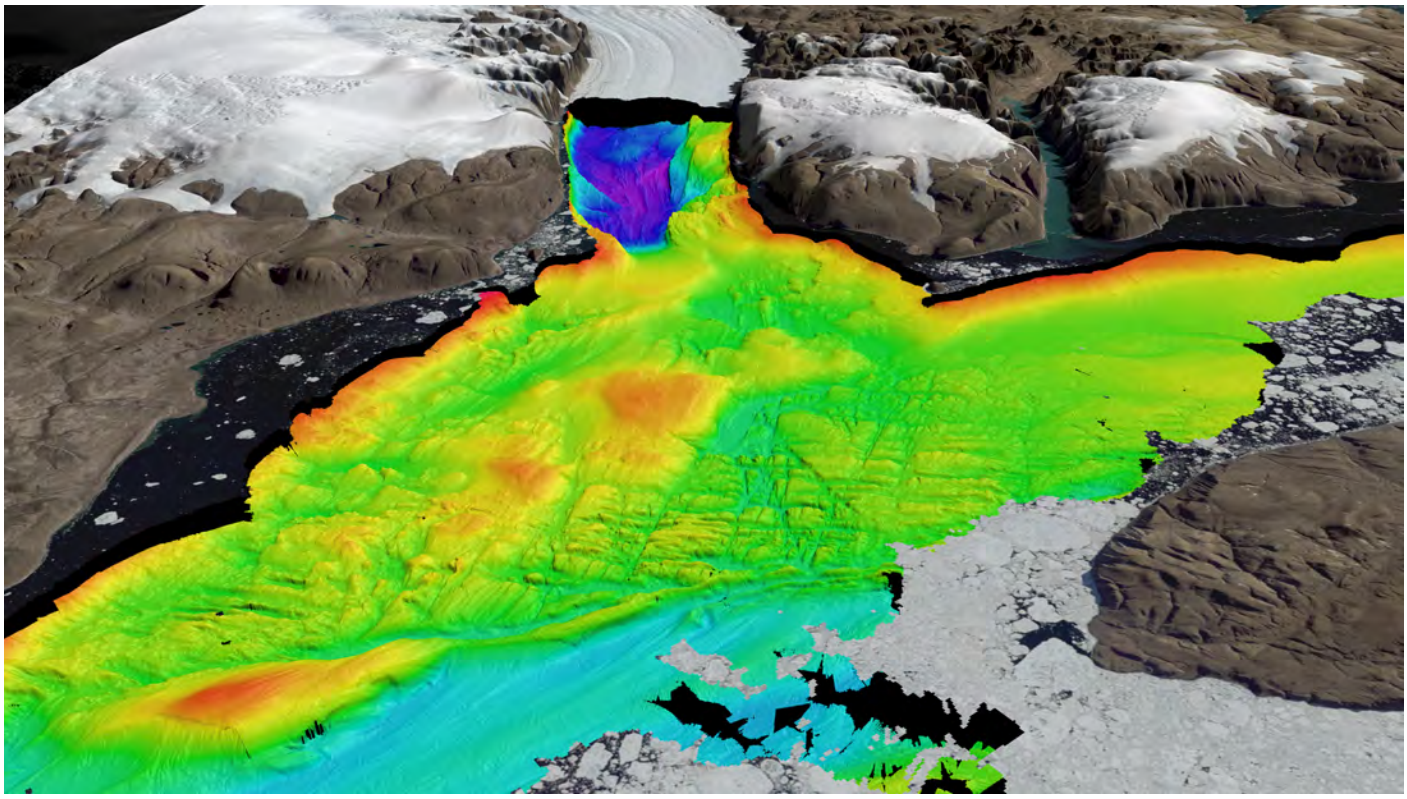
included 1) multi-beam bathymetric surveys to map this poorly known area, 2) sub-bottom reflection profiles to optimally site sediment coring transects and to constrain sedimentary and crustal geometries, 3) water column profiles to track sources and variability of relatively warm deep waters entering the fjord, 4) coring transects to assess past climate/ocean changes and their relationship to ice shelf and ice sheet responses, 5) boreholes through the ice-shelf to recover sub-ice cores and to emplace instruments to monitor the water column beneath the shelf and weather at the surface, 6) date relative sea-level (RSL) histories in uplifted coastal deposits to model isostatic adjustments to former ice loading and retreat , 7) cosmogenic exposure dating of moraines and erratic boulders to reconstruct paleo-ice distributions, 8) paleomagnetic assessment of Earth's magnetic field variation near the North Pole, 9) baseline observations of marine mammals and terrestrial ecosystems, and 10) public education regarding changing climate in the Arctic and the potential impacts of future sea-level change including blogs, videos, a CBS/60 Minutes news feature, visits with a delegation from Nunavut, a teacher-at-sea, and a teleconference with three U. S. Senators and Swedish dignitaries.



Summary map of the Petermann/Nares system, bathymetry, track lines, and sample locations. Image courtesy of Petermann Expedition.

Not only did every scientific element of the expedition succeed, each contributed synergistically such that all goals were exceeded. Icebreaker *Oden* proved to be nimble in heavy ice and an exceptional mapping platform; the region was transformed in one month from Mare Incognita to one of the best-mapped regions in the high-latitude oceans. Sub-bottom surveys and coring transects documented multiple generations of glacial advance and retreat in at least

three different ice streams; we mapped several “fossil” bathymetric rises where a larger glacier previously established stable grounding lines. Preliminary analysis of the new sediment cores suggests that past ice shelves may have jumped between these grounding zones during retreat phases, perhaps very rapidly, implying that future changes in the grounded Petermann Glacier and inland ice may also occur quickly.



Oblique graphic perspective of fossil grounding line at the Petermann Sill. Striations show past ice flow path from the Petermann Fjord toward Nares Strait. Bathymetric data from Petermann Expedition mapping, Terrestrial Data courtesy from George Roth, Polar Geospatial Center, University of Minnesota. Image courtesy of Martin Jakobsson.

Water column studies verified projected warming of waters spilling over the Petermann Fjord sill, and tracked the watermass flow paths from the Arctic Ocean along the Canadian margin and through a series of newly mapped silled basins and channels, all the way to the ice-shelf grounding line. This complex pathway suggests that warming of the deep fjord near the ice shelf grounding line may occur in discrete steps, depending on how the intermediate basins control mixing of the water flows. Instruments left behind to monitor the sub-ice temperatures and salinities will detect these changes.

Following up on the field sampling, post-expedition dating, and modeling will constrain rates of change in regional ice cover and relative sea level. With this rate information we will know better how fast and how much the system can change. And analysis of the sediment cores will reveal the ocean’s role in large scale ice retreats of the past.

The biology teams documented several unique ecosystems in Hall Land, Washington Land, and Ellesmere Island, still taking shape in response to past ice retreats and highly dependent on their geological substrate such as whether

the land surface was recently below sea level. Differences in regional populations suggest relative isolation from migration. Post-expedition studies will help to assess the degree of genetic mixing between these populations. Marine mammal observations provided a comprehensive catalogue of regional populations and behaviors. Both studies form a strong baseline against which future studies may document changes in biological structure in a warming climate.

Although much work remains for the laboratory, the field study provides a strong base upon which future expeditions may build. Southward transport of thick multiyear ice in 2015 prevented access to much of the Canadian coast and Robeson Channel toward the Lincoln Sea; these regions provide logical targets for future studies. The well-surveyed portion of the Petermann Fjord and Hall Basin is now ready to serve as a natural laboratory for multi-disciplinary monitoring of fragile Arctic systems under a changing climate.

Acknowledgements: We thank U. S.-NSF Polar Programs, NASA, UNAVCO, CH2M Polar Field Services (Jessy Jenkins), Polar Geospatial Center (George Roth), British Antarctic Survey, GEUS, the Swedish Polar Research Secretariat (Ulf Hedman), and the Swedish Maritime Administration (Captain Mattias Petersson and crew).

Further information including related maps, videos, and a list of participants is available on the Petermann's Glacial History website (http://petermannsglacialhistory.wordpress.com/).

The PolarHub: Service-Oriented Cyberinfrastructure for the Polar Sciences

By Wenwen Li, PhD, Assistant Professor, GeoDa Center for Geospatial Analysis and Computation, School of Geographical Sciences and Urban Planning, Arizona State University

Substantial research attention has been directed to the polar regions in recent years because they are key drivers of the Earth's climate, a source of rich mineral resources, and home to a variety of marine life. Due to climate change, the polar systems are being pushed towards a tipping point: the polar environment is at high-risk from melting snow and sea ice, permafrost thawing, and acidification of the Arctic oceans. To advance our understanding of the polar climate system and its impacts on the environment, economy, and people at local, regional, and global scales, there is a pressing need for a new cyberinfrastructure to improve the accessibility, usability, and visibility of polar scientific data.

A two-year research project funded by the National Science Foundation in 2014-2015 aims at developing a cutting-edge cyberinfrastructure portal to help polar scientists effectively and efficiently collect polar data, integrate knowledge, and analyze scientific phenomena to support effective decision making. This project is a collaborative effort between Principal Investigator (PI) Wenwen Li from Arizona State University, and Co-PI Chaowei Yang from George Mason University.

During the course of the project, Li is leading the effort to create building blocks of a polar cyberinfrastructure to support efficient data discovery and access. The main goal of this project is to transform the old science paradigm (80% of time searching for data and 20% time used for analysis) by providing tools that will enable better access to polar data and information. A cybersearch engine, the PolarHub (http://polar.geodacenter.org/polarhub2), has been established to continuously mine the Internet to discover dispersed polar data resources to support various polar applications.

The PolarHub system introduces an innovative large-scale web mining technique to enable a scalable, sustainable, and interactive platform for polar data and service discovery. At present, PolarHub 2.0 has been launched at Arizona State University. A prominent feature of PolarHub 2.0 is the emphasis on collaborative data discovery and community involvement. Its graphic user interface allows end users to interact with the PolarHub service repository to search for PolarHub-discovered services, to create a new Web crawling task that searches for more service instances on the Internet, and to dynamically visualize the changing distribution pattern of identified services. So

far, PolarHub has identified more than 49,000 geospatial data services that provide web map data, web coverage data, web feature data, and sensor observation data. These datasets contain almost 2 million unique data layers depicting the environmental, atmospheric, and social conditions of the poles and the rest of the world. This number continues to increase as PolarHub finds additional datasets. To interact with the system and find polar data, go here (http://polar.geodacenter.org/polarhub2).

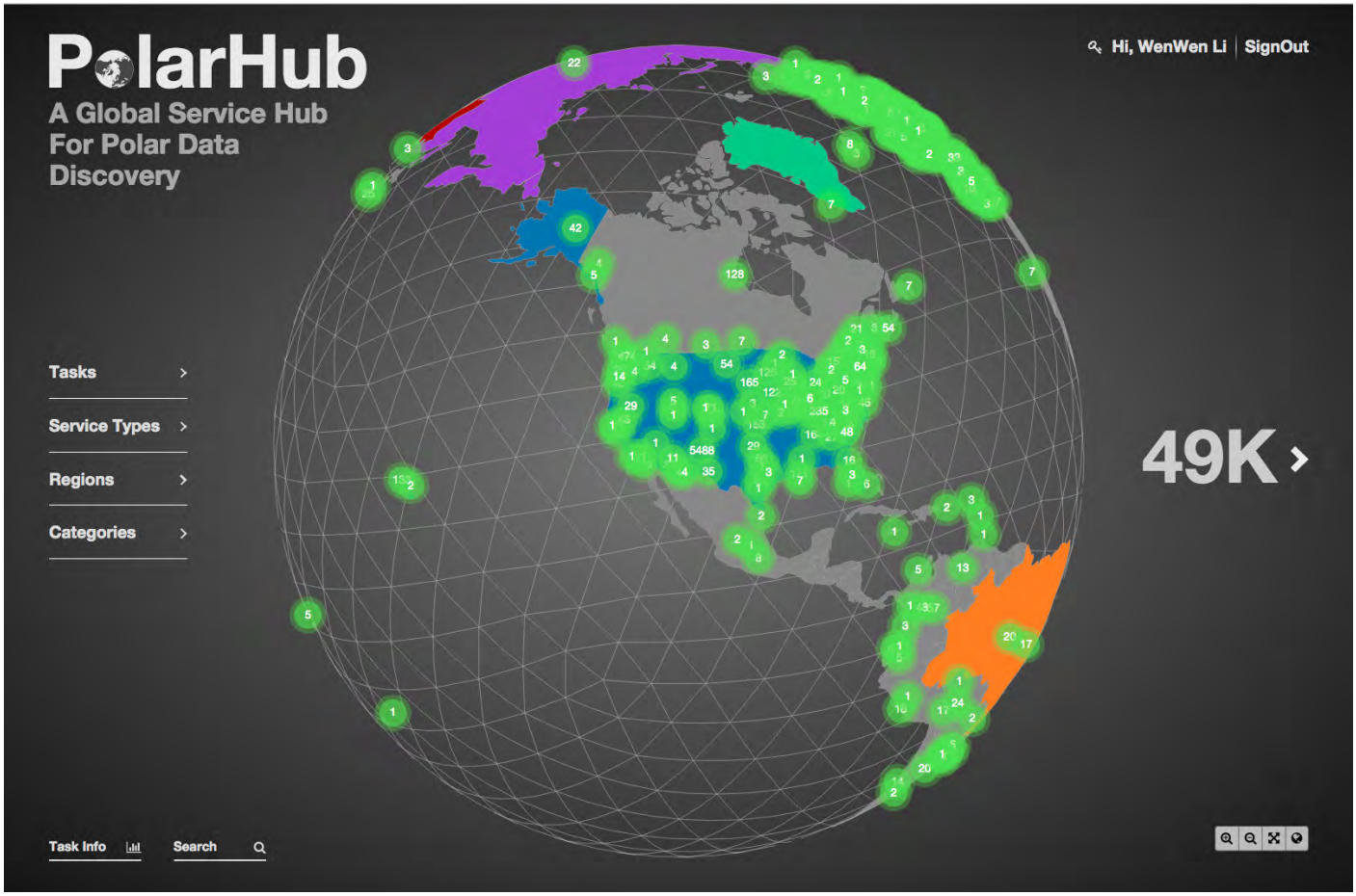


Figure 1: On the graphic user interface of PolarHub 2.0 above, numbers positioned on the globe show the amount of geospatial data services found and hosted at each location. Statistical information of PolarHub-identified data services, according to type, is displayed at the lower-left corner. The Task bar allows an authored user to create a new crawling task. PolarHub also allows data filtering using criteria such as Service Type, Coverage Region, and Categories (Themes). Image courtesy of Wenwen Li.

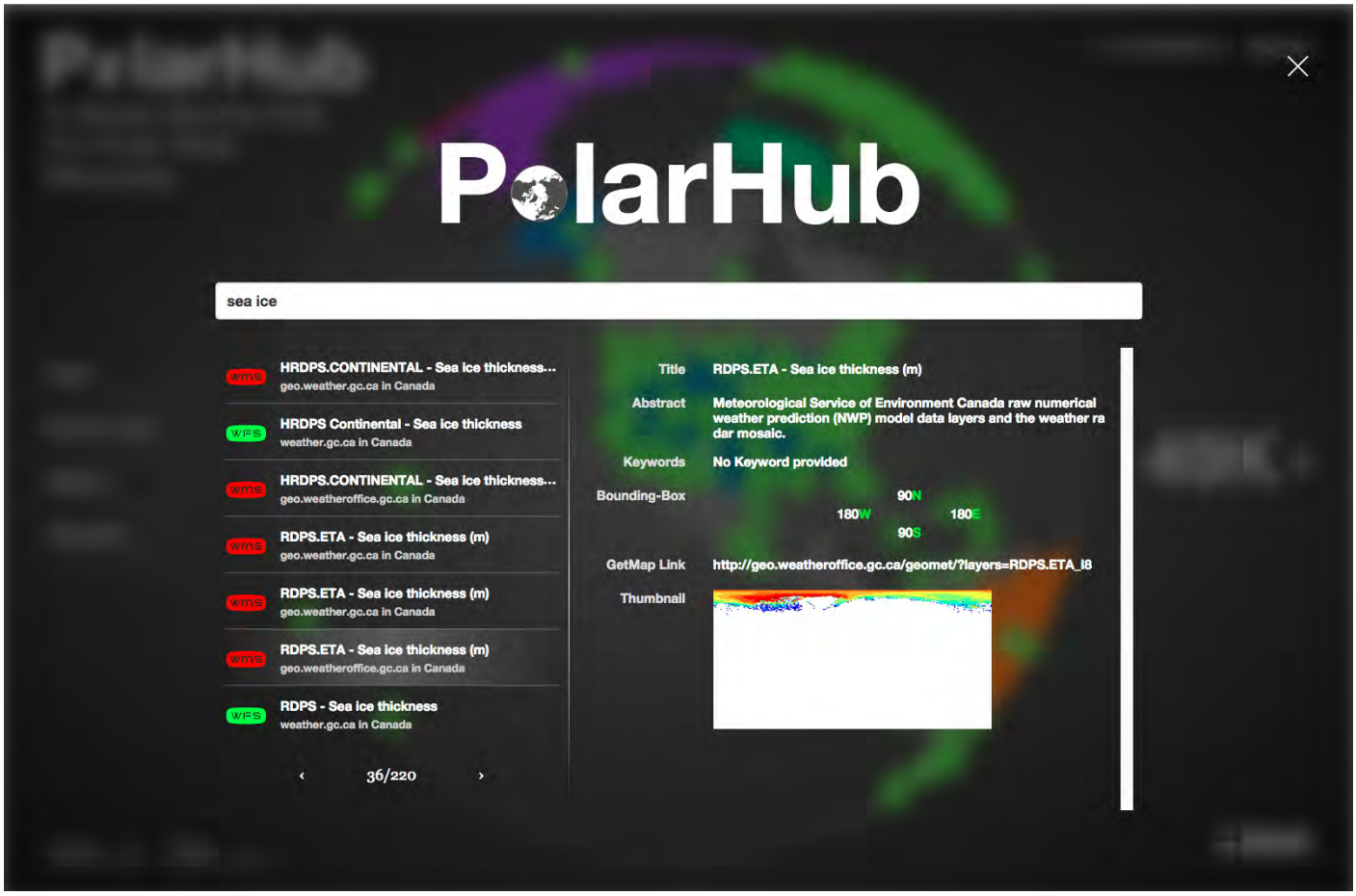


Figure 2: PolarHub 2.0 also also allows a free-text search of the data in its repository. The results in the screenshot are services found using search keywords Sea Ice. The title, web host, and type of each record is displayed on the left. The table on the right shows the metadata information and a thumbnail of the sea ice thickness data named GDPS.ETA—Sea Ice Thickness (m) from a Meteorological Service of Environment Canada. Image courtesy of Wenwen Li.

The long-term goal of Li's research is to establish a central data repository, or a global hub, for widely dispersed polar data to increase accessibility and re-usability; bridge the gap between polar data providers and consumers; and eventually provide timely support for spatial decision-making and discovery of new knowledge. As we enter the era of big (geo) data, PolarHub provides a new platform for users to "surf" the data deluge—supporting insightful polar data acquisition and analytics.

This project will contribute to the growth of a "cyberpolar" community through collaboration among Geographic Information System (GIS) scientists, polar scientists, and computer scientists focusing on specific polar issues. Results will be incorporated into lessons and hands-on experience for undergraduate and graduate students through classroom activities.

To interact with the PolarHub 2.0 and find polar data, go to the live system here (http://polar.geodacenter.org/polarhub2). For more information about the project and its outcomes, please contact Wenwen Li (Wenwen@asu.edu).

ACADIS Data Management Service to the Community

By: James Moore, Manager, Science and Technology Projects, National Center for Atmospheric Research Earth Observing Laboratory

The Advanced Cooperative Arctic Data and Information Service (ACADIS) (http://www.aoncadis.org/) team continues to support data management needs of projects funded by NSF's Division of Polar Programs (PLR) Arctic Sciences Section (ARC) with data submission, preservation, search, and sharing services. NSF has extended the ACADIS team's support to the community through current ACADIS grants until 15 January 2016 in anticipation of a new support agreement for ACADIS being in place in late 2015. The team's intention is to provide uninterrupted ACADIS support to the NSF/PLR/ARC community if possible.

The team's highest priority is to keep the ACADIS archive open and fully operational for the input, access, and archival of all datasets produced by NSF/PLR/ARC funded investigators. Researchers will also have ongoing access to ACADIS support staff to address data management support questions.

When researchers submit data to ACADIS, they will notice a new and improved data submission interface. For a quick review of changes, please see the documentation here (http://bit.ly/acadissubmission) or full documentation here (https://www.aoncadis.org/media/ProvidersGuide.pdf).

ACADIS team members are ready to help researchers prepare documentation to meet NSF proposal requirements. Feel free to request a Data Management Plan (DMP) review. The DMP template is also freely available for download and use here (http://bit.ly/datamgmtplan).

The Arctic Data Explorer (ADE) search portal for interdisciplinary Arctic data across agencies, repositories, and nations now includes over 28,000 datasets across 14 repositories. It is available here (http://bit.ly/arcticdatasearch).

ACADIS, funded by NSF, is a joint effort by the National Center for Atmospheric Research (NCAR) (http://ncar.ucar.edu/), the University Corporation for Atmospheric Research

(UCAR) (https://www2.ucar.edu/), and the National Snow and Ice Data Center (NSIDC) (http://nsidc.org/).

For more information about ACADIS or to submit, retrieve, and search data, please visit the ACADIS website (http://www.aoncadis.org/). To send feedback or questions, contact support@aoncadis.org or call 720-443-1409.

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Sensitivity of Tundra Carbon Balance to Warming and Permafrost Thaw

By: Marguerite Mauritz, Postdoctoral Researcher at the Center for Ecosystem Science and Society, Northern Arizona University; and Ted Schuur, Professor of Ecosystem Ecology at the Center for Ecosystem Science and Society, Department of Biological Sciences, Northern Arizona University

Overview

Climate change will be felt most strongly in high latitude regions of Earth, with Arctic temperature increases expected to be about two times higher than the global average. As the climate warms, thawing of perennially frozen ground (permafrost) is likely to be an important mechanism for moving significant quantities of stored carbon into the atmosphere. Permafrost stores a third of the carbon found in soils of ecosystems globally. Permafrost carbon has accumulated over thousands of years, protected from microbial decomposition by frozen or waterlogged conditions. Release of just a fraction of this frozen carbon pool into the atmosphere, as greenhouse gases carbon dioxide and methane, could make climate change happen faster than expected.

With climate change, warmer air temperatures causes frozen ground to thaw, which in turn influences the surface water that sits in the soil on the permafrost surface. Environmental changes in both temperature and moisture have the potential to alter plant communities, soil microbial communities, and soil decomposition rates, which together control the storage of ecosystem carbon. How much, how quickly, and in what form carbon (carbon dioxide or methane) is released from permafrost ecosystems controls the feedback from permafrost carbon to climate change. Two central questions address this issue and motivate our research: 1) How does permafrost thaw affect ecosystem carbon storage? and 2) How much of the old carbon that has been frozen for hundreds to thousands of years is being lost in response to warming? Answers to these questions will help inform how Arctic ecosystems will impact the rate of future climate change.

Figure 1: Purple shades outline areas of permafrost distribution and extent. Image courtesy of the International Permafrost Association.

Experimental Site

The Eight Mile Lake (EML) research watershed combines observations and experimental manipulation to understand how warming and permafrost thaw impact ecosystem carbon exchange in an Arctic ecosystem undergoing rapid change. EML is located in Interior Alaska near Denali National Park in the zone of discontinuous

permafrost where permafrost temperature already hovers near freezing. The vegetation at the site is moist acidic tundra comprising graminoid sedges (grasslike plants), evergreen and deciduous shrubs, and a moss understory, and is typical across large swaths of the Arctic. At this site, we have established two experimental systems to address the effect of permafrost thaw on ecosystem carbon balance (see Figure 2).

The Permafrost Thaw Gradient represents a gradient in space spanning areas from minimal permafrost thaw to extensive permafrost thaw that has been degrading for decades. Here, we have been monitoring ecosystem carbon exchange since 2003 adjacent to a permafrost borehole that has documented long-term permafrost degradation since 1985. A second manipulative experiment was established in 2008 to complement observations at the Thaw Gradient. We have manipulated air and soil temperatures, and water table at the Carbon in Permafrost Experimental Heating (CiPEHR, 2008) and Drying (DryPEHR, 2011) project in order to isolate the independent effects of changes in temperature and moisture on tundra carbon balance.

Figure 2. Clockwise from top left: A) Eddy covariance tower measuring landscape carbon dioxide and methane fluxes at the Permafrost Thaw Gradient; B) CiPEHR and DryPEHR with carbon dioxide flux chambers and air warming chambers during the growing season; C) CiPEHR in winter with snow fence and drifted snow passively warming soils and thawing permafrost; D) snow removal occurs in spring to maintain constant water inputs and constant spring melt date between warming and control plots. Images courtesy of Maurtiz and Schuur.

How does permafrost thaw affect tundra carbon storage?

Across the Permafrost Thaw Gradient, increased permafrost degradation measured by a thicker active layer (seasonally thawed layer at the soil surface) enhanced carbon loss via microbial and plant metabolism together measured as ecosystem respiration (Reco). At the same time, thaw also increased plant carbon uptake as measured by gross primary productivity (GPP) Similarly, experimentally-induced permafrost thaw at CiPEHR demonstrated that warming rapidly stimulated photosynthesis (GPP) and respiration (Reco) even in the relatively short duration of the manipulation experiment. At both the Permafrost Thaw Gradient and CiPEHR, photosynthesis was stimulated more than respiration in the summer months, with the result that permafrost thaw actually caused more atmospheric carbon to enter the ecosystem than was lost, as measured by positive net ecosystem carbon exchange (NEE) (see Figure 3). Carbon gain during the summer was offset by carbon losses in the winter, when plants are largely dormant but soils are still above-freezing and microbes are active through much of the fall. Non summer season carbon loss offset all the summer gains in the warming manipulation, and even exceeded summer gains at the Permafrost Thaw Gradient making it a net source of carbon to the atmosphere on an annual basis.

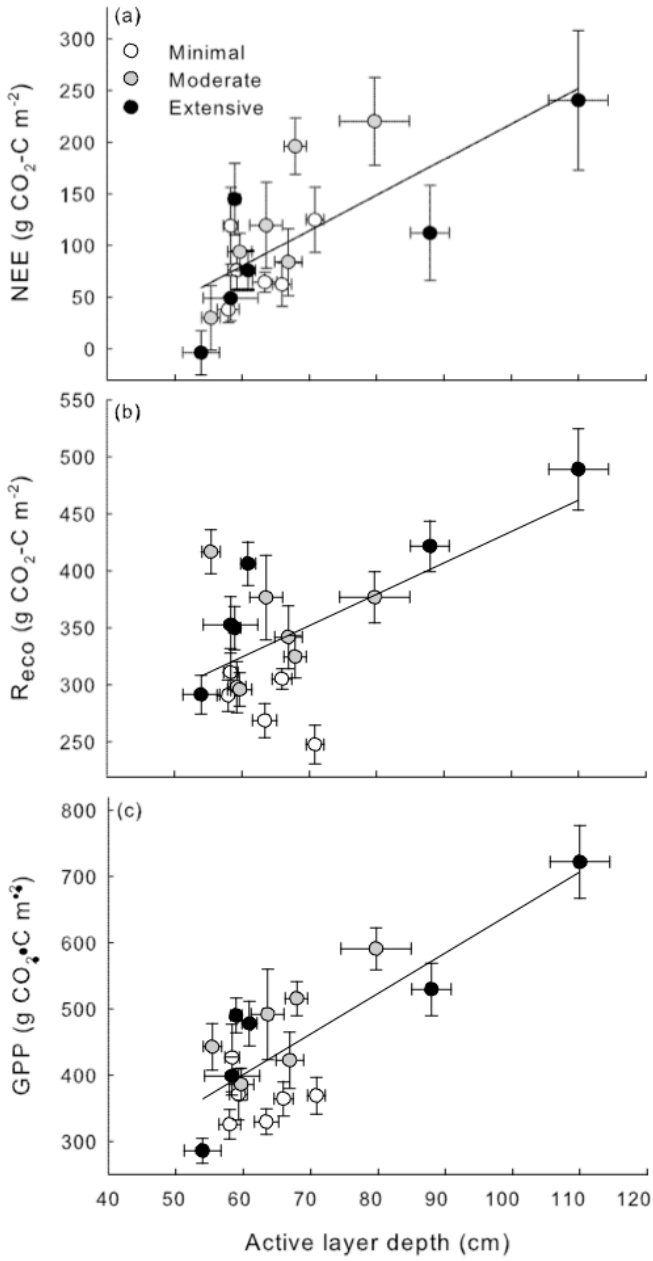

Figure 3. Effects of thaw (increased active layer thickness) on growing season net ecosystem carbon exchange (NEE) at the Permafrost Thaw Gradient. Positive NEE shows that plant carbon uptake responds to permafrost thaw more strongly than respiration carbon losses and the ecosystem is storing atmospheric carbon in the summer. However, in winter when plants are dormant but soil microbial processes continue, carbon losses offset summer gains such that the ecosystem appears to lose carbon when accounting for the full annual balance (winter data not shown here). Image courtesy of Trucco et al.

Using carbon isotopes (13C and 14C) we can investigate the age of carbon being lost as well as the sources (plants, soil), and begin to understand the mechanisms of ecosystem carbon storage. Carbon isotope data has revealed that increased permafrost thaw stimulates the contribution of old carbon to ecosystem respiration (see Figure 4). This means that carbon trapped in permafrost for long periods of time can become available for microbial decomposition

once thawed. This old carbon release to the atmosphere is what depletes the permafrost carbon pool and accelerates climate change.

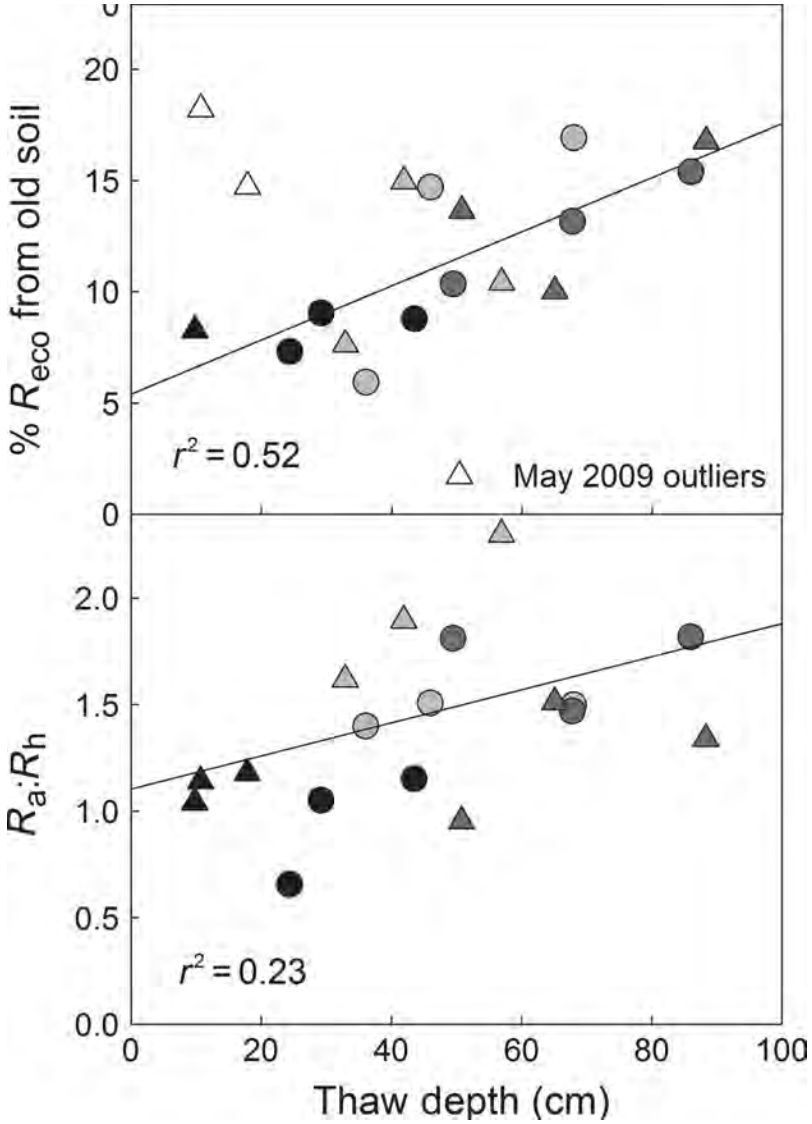

Figure 4. Relationship between increasing thaw depth and old carbon in ecosystem respiration at the Permafrost Thaw Gradient. Image courtesy of Hicks-Pries et al.

Future directions

Continued measurements of ecosystem carbon exchange at both the Permafrost Thaw Gradient and the CiPEHR/DryPEHR warming experiment will be important for quantifying the long-term impact of permafrost thaw on carbon emissions to the atmosphere. Our expectation for the warming manipulation is that the plant productivity response will level off sooner than the microbial response, meaning that the summertime carbon sink may decrease over time. Additionally, new observations of methane at the Permafrost Thaw Gradient will reveal the importance of this greenhouse gas in response to hydrologic changes that accompany permafrost thaw. Because methane has a

much higher warming potential than carbon dioxide, shifts in the release of these two gases will influence the net effect of permafrost carbon emission on climate change.

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Early Stage Biome Shift for Alaskan White Spruce Related to Warmer Climate

By: Debbie Carter, Public Information Officer, UAF Cooperative Extension Service/School of Natural Resources and Extension, University of Alaska Fairbanks and Glenn Juday, Professor of Forest Ecology, School of Natural Resources and Extension, University of Alaska, Fairbanks

Sam Demientieff takes a core sample from a mature white spruce along the lower Yukon River in 2007. Photo courtesy of Claire Alix.

University of Alaska Fairbanks (UAF) scientist Glenn Juday noticed something curious while studying the growth of white spruce in Alaska. Spruce in the Interior grew least in warm summers and most in cool summers. Why did warmer summer temperatures affect tree growth? Was this happening everywhere spruce occurred? What was the best way to test the role of temperature in controlling growth?

Juday and French archaeologist Claire Alix originally collaborated to sample trees that grew along the interior Alaska floodplains of the Yukon, Tanana, and Kuskokwim Rivers as part of a study cross-dating driftwood, but Juday realized their research could also help analyze how climate controls the growth of trees.

Juday, a forest ecologist, reasoned that floodplains have approximately the same elevation, soil type, and origin. If they studied the same species, white spruce, on floodplains from eastern Alaska downstream to treeline, then the differences in growth patterns would be due mainly to temperature differences. "We just got more and more excited the more we thought about it," says Juday. "This was an opportunity to do a clear climate transect."

A typical stand of white spruce along the Tanana River downriver from Fairbanks, Alaska shows eroding banks due to shifting currents. Photo courtesy of Glenn Juday.

Juday and Alix, along with Tom Grant, a research professor at UAF, harvested tree cores and disks from 540 white spruce in 36 stands along the rivers. They conducted fieldwork for several years between 2002 and 2012, sampling from near Fort Yukon downriver to the western edge of the boreal forest near the Bering Sea. At each location, they chose the largest mature and old-growth trees.

A field sampling crew poses along the Yukon River near Galena in 2007. Photo courtesy of Claire Alex.

Altogether, they analyzed 167,000 tree ring width measurements. They then compared historical temperature and precipitation data from the Alaska communities of Fairbanks, McGrath, and Bethel to determine how temperatures matched growth rates at the different sites.

The results from their research were published this summer in the journal *Forest Ecology and Management* (http://www.sciencedirect.com/science/article/pii/S0378112715002212). The study found that Interior sub-Arctic climate has become too hot and dry to be the ideal environment for white spruce. Western Alaska has become the optimum climate region for the species. And even more importantly, the research confirmed what Juday had long suspected: a biome shift is already underway.

They identified trees that were "positive responders," or grew better in warmer conditions, and those that were "negative responders," or grew less under warmer conditions. The largest concentration of negative responders was in interior Alaska, and nearly all the positive responders were downriver in western Alaska. For the first time in the two centuries of recorded tree growth, the positive responders grew more than the negative responders. Pointing to

a chart that shows positive and negative responders, Juday says, "That was the smoking gun evidence that climate change has arrived here."

Since the 1970s, Interior white spruce trees have experienced markedly lower growth than during the 19th and early 20th centuries. With modest additional warming, the study noted, "widespread tree death will be unavoidable on warmer lowland Interior sites, where persistence of white spruce is unlikely." The study concludes, "We find that July mean monthly temperature (MMT) and annual precipitation in Fairbanks are now outside the limits that previously characterized the North American distribution of white spruce and are near the reported physiological limits of the species. Our results of the spatial and temporal change of white spruce temperature sensitivity provide strong empirical evidence of a previously proposed early stage biome shift in boreal Alaska due to clear climatic causes."

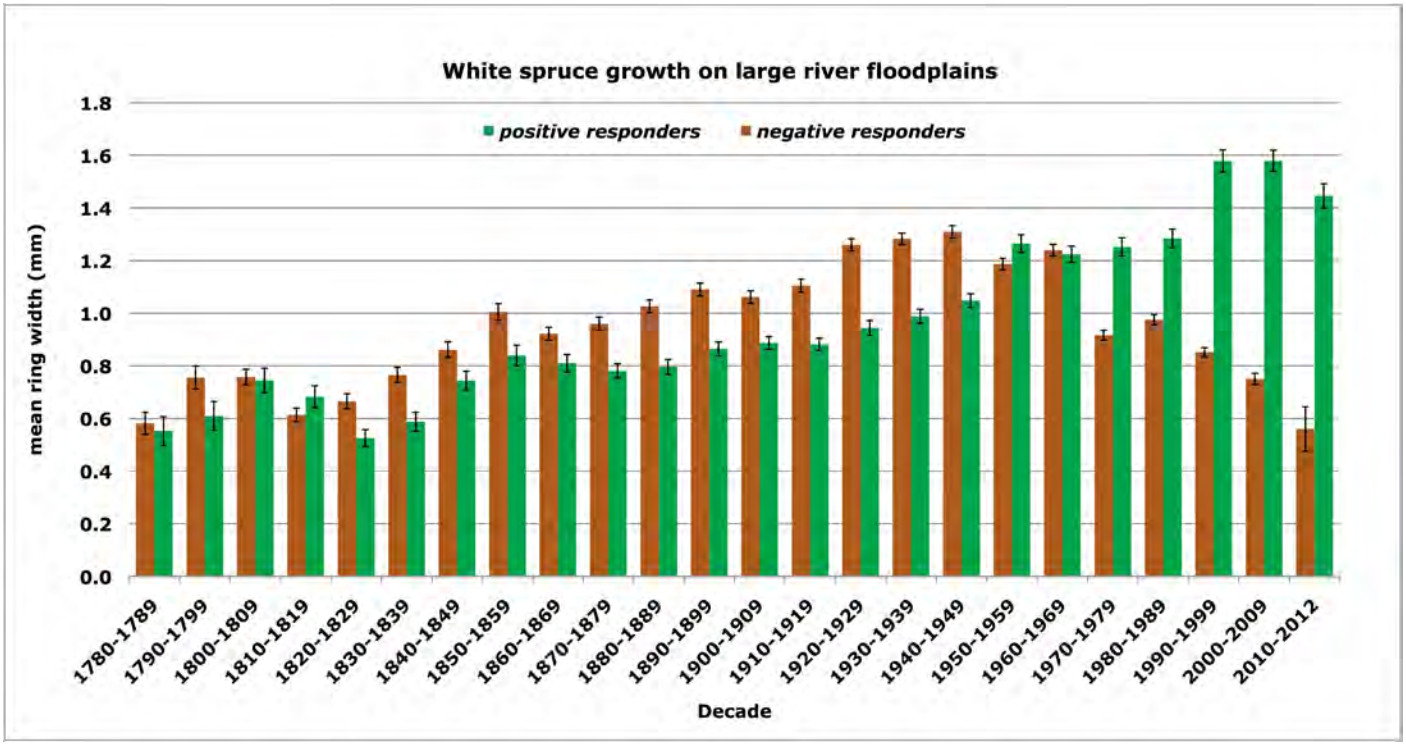


Figure 4 shows mean ring width growth of floodplain white spruce across Alaska by decade since the late 18th century. The mean ring width of negative responders has declined markedly since the 1970s when temperatures warmed. Positive responders (trees growing more as temperatures increase), mainly in downriver western Alaska, have grown larger average rings than Interior trees since the 1970s. Image courtesy of Glenn Juday.

Juday points to a U.S. Geological Survey publication, "Atlas of Relations Between Climatic Parameters and Distributions of Important Trees and Shrubs in North America," (http://pubs.er.usgs.gov/publication/pp1650C) which shows that white spruce does not occur naturally at July MMT above 15.7° C without substantially more than 270 mm precipitation. According to the study, the July MMT temperature increased from 15.7° C for the 1906-1951 period to 16.7° C for the 1952-2006 period. Precipitation decreased from 297 mm for the earlier period to 272 mm for the 1951-2006 period.

While sampling trees, Juday and the other researchers saw clear signs of temperature stress in Interior Alaska white spruce. In some places, they found stands of dead spruce trees. There were also beetle infestations and sparse needles on trees. According to Juday, the warmer temperatures are behind the trees' stress and making them more vulnerable to the insects. But even without the insects or wildfires, spruce is at the threshold for its viability on the warmest sites.

Juday says that some of the implications of their spruce research have to do with economics, since white spruce is currently the most commercially viable species of tree in the Interior. He also points out that the majority of state forests have been selected in the Interior. The Alaska Constitution requires that the state's replenishable resources must be "utilized, developed and maintained on the sustained yield principle."

However, the study notes, "Our results demonstrate that as long as recent high temperatures persist, achieving sustainable forest production will not be possible in the predominant negative response region of central and eastern Alaska when compared to the past two centuries."

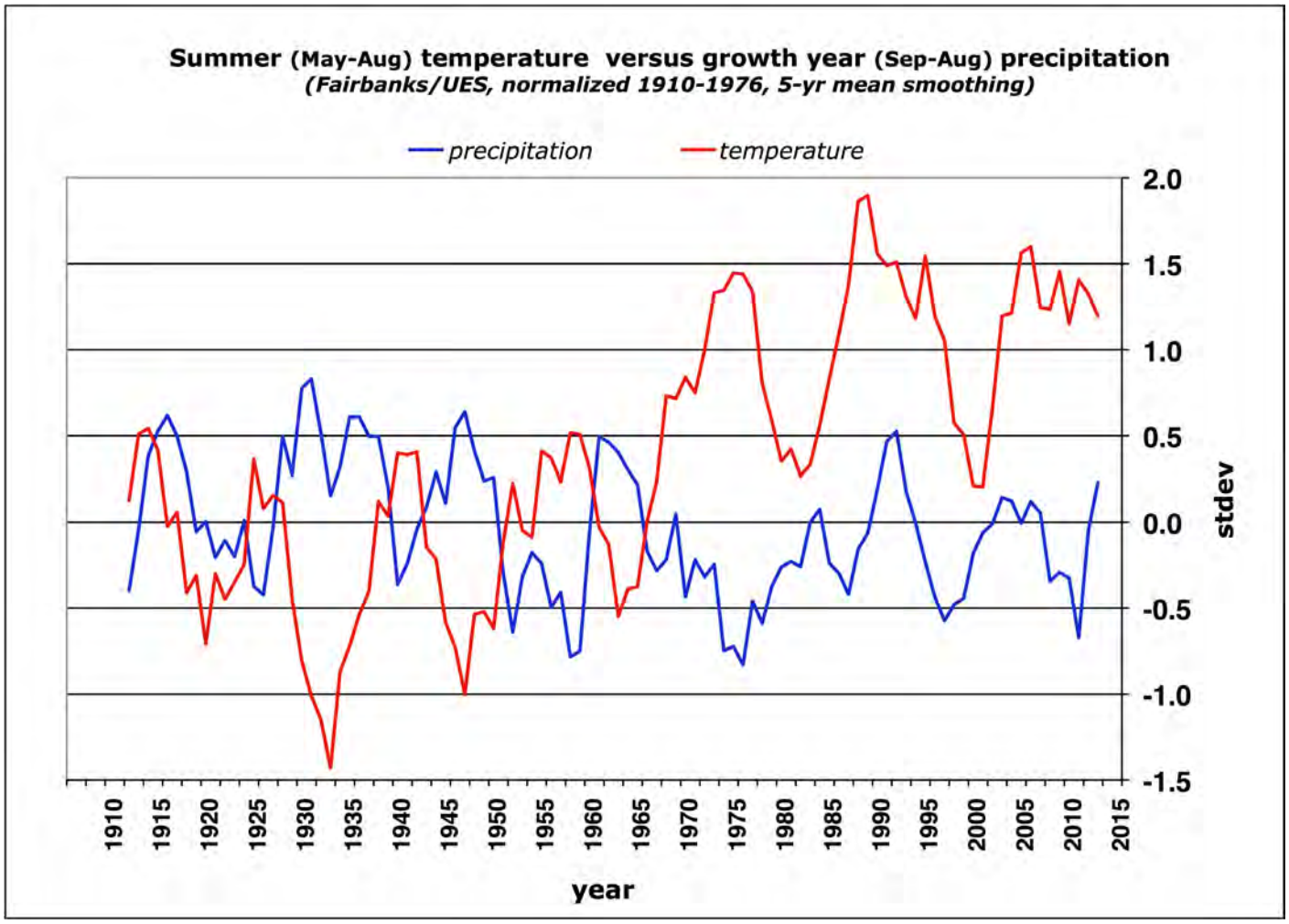


Figure 5: Summer temperature and annual precipitation (smoothed as 5-year running mean) at Fairbanks Experiment Station (1906-1948) and Fairbanks International Airport (1949-present). Interior Alaska white spruce grows best in periods of cool summer temperatures and high annual precipitation. Summer temperatures have become markedly warmer since the 1970s, while precipitation has slightly declined. (Data have been normalized to the mean of 1906-76 and are expressed as departures from the mean in units of standard deviation). Image courtesy of Glenn Juday.

"State land classifications for forest management are concentrated in eastern and central Alaska, but now much of western Alaska has a strong potential for sustainable forest management for the first time, and should receive serious consideration for state forest establishment," the study suggested.

Juday and other researchers with the UAF School of Natural Resources and Extension are already taking the next step, measuring the regeneration of white spruce following wildfires. Juday says the ultimate sign that a species is in trouble is that it fails to regrow following a wildfire. So far, the data do not indicate that.

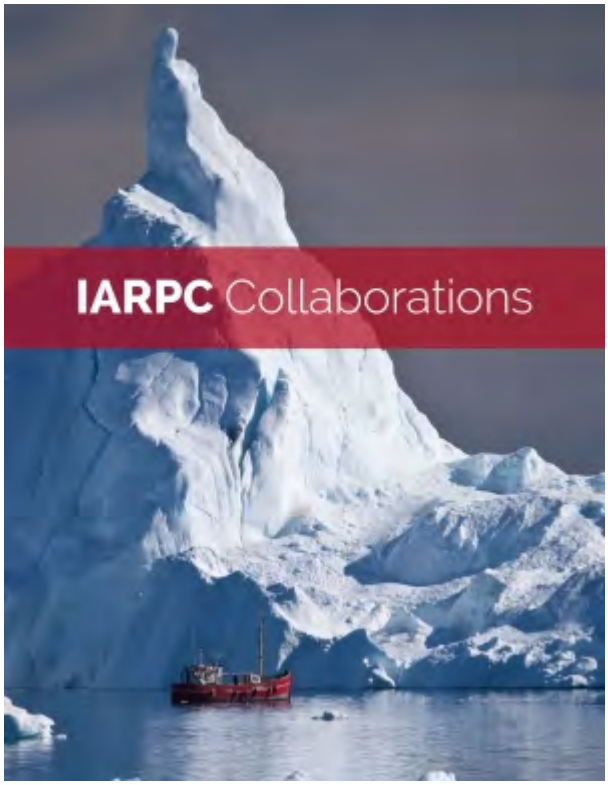
Juday's research has been supported through a variety of funding sources including the French government, McIntire-Stennis forest research funding through the U.S. Department of Agriculture, other USDA funding, the National Science Foundation, and the U.S. Geological Survey.

For further information, contact Glenn Juday at the School of Natural Resources and Extension, University of Alaska, Fairbanks (gpjuday@alaska.edu).

A Recent Conversation with Martin Jeffries about IARPC Collaboration Team Efforts

Jeffries was interviewed by Sara Bowden, Executive Secretary of IARPC for this article in August 2015

Introduction



Dr. Martin Jeffries is the Arctic Science Advisor and Program Officer for Arctic and Global Prediction at the Office of Naval Research (ONR). He also serves as the chair of the Interagency Arctic Research Policy Committee's (IARPC) (http://www.iarpccollaborations.org/) Sea Ice Collaboration Team (SICT) (http://www.iarpccollaborations.org/teams/Sea-Ice) and is on the IARPC Staff Group. He co-chaired the IARPC team leaders' meeting held in November 2014 in Washington, D.C., and was a leading contributor to the IARPC Arctic Research Plan: FY 2013-2017 (http://www.iarpccollaborations.org/plan/) and the Arctic components of the National Ocean Policy (https://www.whitehouse.gov/the-press-office/executive-order-stewardship-ocean-our-coasts-and-great-lakes). In addition, he is the Principal Editor for the "Arctic Report Card," (http://www.arctic.noaa.gov/reportcard/) published annually online, and the Arctic chapter in the State of the Climate Report, (http://www.ncdc.noaa.gov/bams) published annually in the Bulletin of the American Meteorological Society.

The Interagency Arctic Research Policy Committee consists of the principals from 16 agencies, departments, and offices across the Federal government, and is charged with enhancing both the scientific monitoring of, and research on, local, regional, and global environmental issues in the Arctic. In order to meet the Nation's economic, scientific, and environmental needs, IARPC envisions a prosperous, sustainable, and healthy Arctic understood through research coordinated among Federal agencies and domestic and international collaborators. IARPC Collaborations is the structure created by IARPC to implement its 5-Year Arctic Research Plan (https://www.whitehouse.gov/sites/default/files/microsites/ostp/2013_arctic_research_plan_0.pdf). The structure is organized around 12 topical collaboration teams. Many collaboration team activities involve establishing and

enhancing inter-institutional and interdisciplinary conversations. Harnessing diverse talent requires broad participation and, therefore, all collaboration teams are open to the public through the IARPC Collaborations website (http://www.iarpccollaborations.org/about.html).

Interview

Q. What is an IARPC collaboration team?

The twelve IARPC collaboration teams are responsible for implementing different topics and themes in the Arctic Research Plan. They do that primarily by addressing milestones. These milestones describe different activities on which we report periodically throughout the year. Progress on the milestones is reported annually to the IARPC principals, and the Arctic Executive Steering Committee which oversees the implementation of the National Strategy for the Arctic Region. Team membership is not exclusively Federal. Collaboration teams are open to any U.S.-based or international researcher who has an interest in the Arctic and who can contribute to the team and its reporting on the milestones. Non-Federal participation is a great part of the IARPC collaboration experiment.

Q: How can members of the non-Federal science and research community participate on collaboration teams?

At the core of IARPC Collaborations is the website (http://www.iarpccollaborations.org/index.html). There is a public side and a password-protected member side. Much of the work of the collaboration teams goes on within the member side. Each team has its own page with membership, updates, documents, and milestones. Members can go into the website and write a milestone update, report on current research, share information and documents, or advertise an event, workshop, or activity. To get into the password protected side and become an IARPC member is easy. You must submit a brief application with your name, email, and research interest. This is reviewed by the web manager who then will help you become acquainted with the site. You can join as many teams as you wish. You will receive notices of team meetings, agendas, and webinars. Any collaboration team member may participate in the monthly meetings of the various teams and may connect to those meetings via teleconference and/or web link.

Q: Do IARPC collaboration teams make recommendations to Federal agencies related to research funding?

No. They cannot make recommendations. The Federal Advisory Committee Act has rules about making recommendations to Federal agencies. The IARPC collaboration teams are not about making recommendations but rather implementing the Arctic Research Plan.

Q: You chair the Sea Ice Collaboration Team (SICT). Can you describe some of the tasks of that team?

One of the main areas of focus has been the marginal ice zone, an area where the consolidated pack ice meets the

open ocean and is subject to increasing exposure to waves and swells as the pack ice retreats during the summer. An improved understanding of the physics of atmosphere-ice-ocean-wave interactions is important to predicting how the system may change over time. The marginal ice zone work has been undertaken with a series of field campaigns carried out during the 2013 and 2014 field seasons. The goal of the program is to ultimately improve forecast and prediction models.

The SICT has also been implementing a number of remote sensing milestones. This has included the development of algorithms to merge multiple types of remotely sensed data so that we can derive geophysically useful information. A number of new results of these efforts are emerging. For example, as a result of the combined efforts of NASA, the Naval Research Laboratory (NRL), and the Office of Naval Research (ONR), a merged MODIS (http://modis.gsfc.nasa.gov/)-AMSR2 (http://suzaku.eorc.jaxa.jp/GCOM_W/w_amsr2/whats_amsr2.html) remote sensing sea ice edge product has been developed and assimilated into the Navy Arctic Cap Nowcast Forecast System (ACNFS) (http://www.arctic.noaa.gov/SIF/docs /Arctic_Cap_Nowcast_Forecast_System_Rick_Allard.pdf) model to realize a significant improvement in ice edge forecasts. This effort is the result of IARPC collaborations bringing together Federal agencies and scientists to improve our forecasting capabilities.

Another key component of the SICT is Operation IceBridge, (http://www.nasa.gov/mission_pages/icebridge /index.html) a NASA airborne campaign flying LIDARs (http://oceanservice.noaa.gov/facts/lidar.html) and radars over the Arctic basin ice each spring. The data collected by Operation IceBridge will improve algorithms for deriving sea ice information from instruments aboard the CryoSat-2 and ICESat-2 satellites; it literally bridges the gap between the ICESat-1 satellite and ICESat-2 leaving no gap in the long-term dataset.

The Sea Ice Prediction Network (SIPN) (https://www.arcus.org/sipn/background), which is a co-funded effort of NSF, ONR, DOE, NOAA and NASA, brings together a large number of U.S. and overseas researchers who are focused on predicting sea ice primarily at the seasonal time scale. SIPN is one of IARPC's early successes. SIPN was able to get started quickly because IARPC Collaborations was already underway and the SICT was actively bringing together Federal program managers to discuss their projects and future plans. SIPN, which started in the summer 2013, is a good example of how a collaboration team can work at the Federal program level to do more by leveraging activities and resources.

Importantly, the SICT has created an intensity of conversation that we haven't seen before in IARPC.

Q: What are plans for future activities of the SICT?

We plan to carry on implementing our milestones and reporting on our work in due course. One activity which is

currently getting underway is ONR's Sea State and Boundary Physics project. The main field phase will take place in the fall of this year aboard the R/V *Sikuliaq* in the Beaufort and Chukchi seas. This is a multi-institutional and international effort aimed at improving our understanding of the seasonal evolution of sea ice and the affect of increasing open water on the ice and on the atmosphere, at Arctic to hemispheric scales. Also, Operation IceBridge has a fall 2015 campaign coming up, and it will return to the Arctic Ocean in spring 2016 for another extensive effort to measure snow depth and ice thickness.

Q: How do you address new and emerging research questions and ideas which may not be in the Arctic Research Plan?

IARPC is subject to an update every two years. We are embarking on a revision now. However, collaboration teams do not need to wait for a new plan. We are free to add milestones as we go along. We do so because agencies are starting new research efforts all the time. In the fall of 2014, for example, NASA launched the Arctic Radiation and IceBridge Sea and Ice Experiment (ARISE) airborne campaign flying over the Arctic Ocean to investigate Arctic sea ice change and cloud radiative properties. ARISE was taking place at a time when there were other Federally-funded research campaigns going on which complemented ARISE. NASA developed the ARISE project after the Arctic Research Plan was written, but it is related to the overall goals of the plan. Through IARPC Collaborations, Federal program managers have a better idea of what everyone is doing so when an agency develops a campaign like ARISE, it can be coordinated with other agency efforts.

Q: How can the research community stay informed about IARPC Collaboration Team activities?

By becoming a member of the IARPC Collaborations website and affiliating with collaboration teams of interest.

Q: How does participating in IARPC collaboration teams enhance the work that you do as a program manager at ONR?

Through participation with the IARPC staff group and collaboration teams, I am in conversation with colleagues in other agencies on a regular basis. I have a much better awareness of what other agencies are doing and planning. I am able then to consider ONR activities which might complement the work going on elsewhere within the Federal government, internationally, and in the research community. By sharing information and pooling resources agencies, ONR included, can achieve more through combined efforts than can be done on their own. I believe we are better stewards of the taxpayers' dollars through our collaborations.

Challenges and Opportunities of Interdisciplinary Teamwork for Early Career Arctic Scientists

By: Mallory Ladd, NSF Graduate Research Fellow, at Oak Ridge National Laboratory with Stan Wullschleger, Climate Change Science Institute, Environmental Sciences Division, Oak Ridge National Laboratory

High-latitude regions of the world have experienced the greatest warming in recent decades and are projected to warm at a rate twice that of the global average in the coming century. The implications of such warming include disappearance of sea ice, coastal erosion, permafrost thaw and microbial decomposition of vulnerable soil organic matter, and changes in surface and groundwater storage. There are far-reaching consequences of these changes not only for local communities, but for regional and global climate as well.

Research teams are increasingly addressing these concerns through an interdisciplinary approach that brings together expertise from a wide variety of research disciplines. This can be seen in several high-visibility initiatives launched in recent years including Changing Permafrost in the Arctic and its Global Effects in the 21st Century (PAGE21), the Permafrost Carbon Network (PCN), the Arctic Boreal Vulnerability Experiment (ABoVE), and the Next-Generation Ecosystem Experiments (NGEE Arctic) project, which is sponsored by the Department of Energy's Biological and Environmental Research (BER) program. This latter effort is focused on field and laboratory investigations that accelerate predictive understanding of Arctic ecosystems and the inclusion of that knowledge into Earth System Models (see: "Next-Generation Ecosystem Experiment Examines Arctic Landscape's Response to Climate Change" in *Witness the Arctic*Spring, 2013 (http://www.arcus.org/witness-the-arctic/2013/2/article/19952)).

In the NGEE Arctic project, just as with other interdisciplinary activities, there are opportunities and challenges for early career scientists. For example, Mallory Ladd, a National Science Foundation graduate research fellow at Oak Ridge National Laboratory, studies analytical chemistry and its applications to climate science. Ladd's current research involves developing state-of-the-art mass spectrometry techniques that can measure low-abundance, dissolved organic nitrogen compounds from the soil that are vital to plant productivity and microbial decomposition in the Arctic. The high-resolution chemical information obtained from these experiments is then used to help parameterize fine-scale biogeochemical models of nitrogen uptake and distribution, in turn helping us to better understand what controls carbon storage in these systems.

In developing her dissertation work, Ladd regularly meets with chemists, biologists, ecosystem ecologists, and

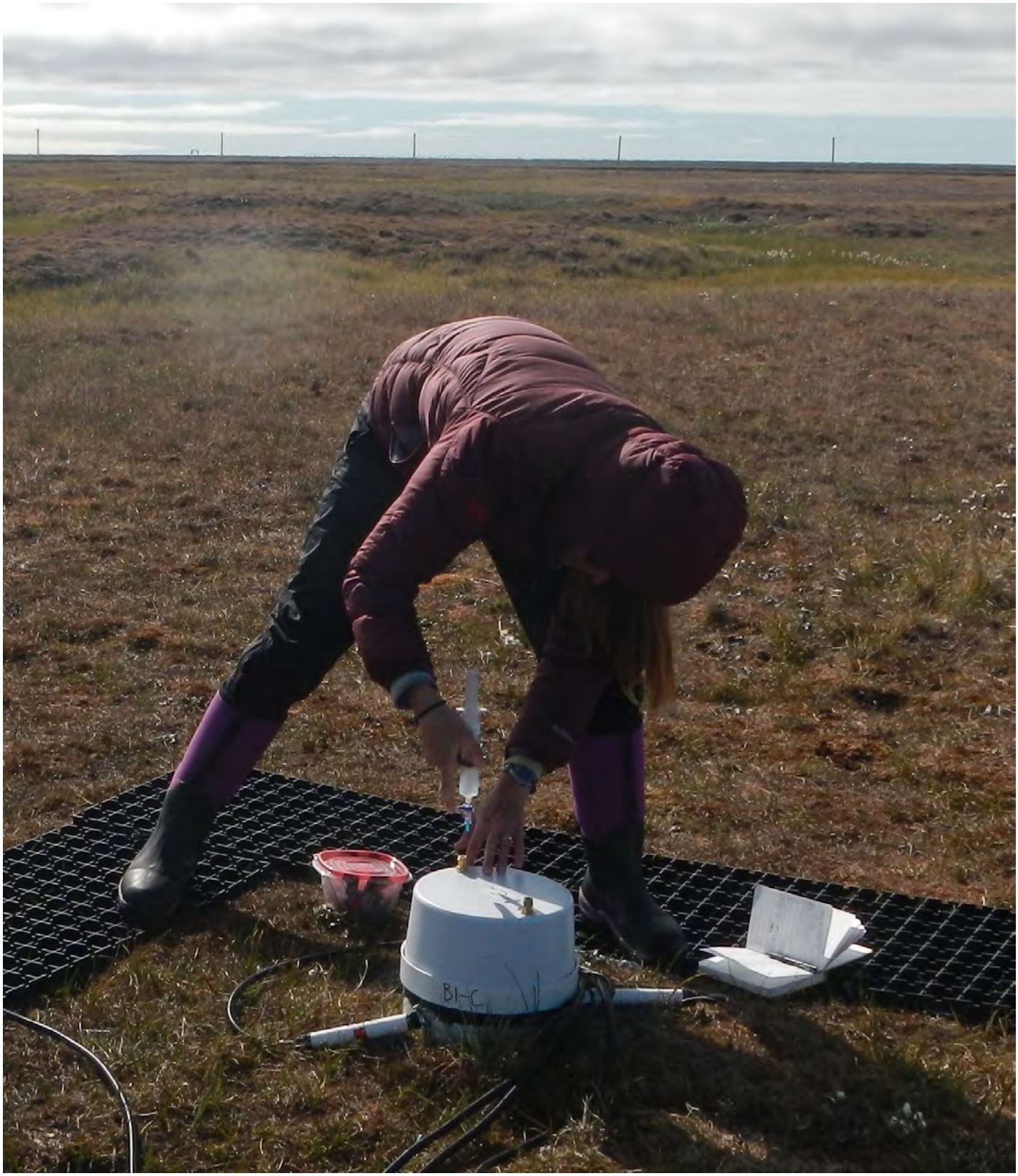
computer scientists to discuss data integration and knowledge gaps in the various disciplines. This interdisciplinary approach "has strengthened my ability to communicate complex information in different ways early on in my career. It has also made me more aware of the capabilities of other disciplines and has helped me better understand and respect the language and research methods of these other areas," she said. One challenge she has run into is to make sure she designs her laboratory experiments to produce data that aligns with both the field measurements and models generated by the NGEE Arctic project. Ladd also emphasizes that the interdisciplinary atmosphere of the project, which involves more than 125 scientists from multiple institutions, has motivated her to better understand her science from different perspectives, and to be creative and flexible in forming new research questions.

Mallory Ladd uses liquid chromatography and high-resolution mass spectrometry to characterize the molecular composition of nitrogen in soil samples from a polygonal tundra near Barrow, Alaska. Photo courtesy of Joy Anderson, ORNL.

Lydia Smith, a graduate student and doctoral candidate who studies terrestrial biogeochemistry at Lawrence Berkeley National Laboratory, has also benefitted from the interdisciplinary research environment of the NGEE Arctic project. She uses close collaborations with geophysicists, microbiologists, hydrologists, and plant physiologists to inform all stages of her research. Smith has used geophysical data from permafrost-dominated

landscapes to design trace gas and isotope measurement schemes; leveraged integrated microbial, geochemical and hydrological data to explain profile-scale observations of CO2 and CH4 emissions; and linked 1D point measurements to broader landscape processes.

In thinking about her experience working with multiple disciplines, Smith said "A challenge for interdisciplinary research is that sampling schemes are often designed according to disciplinary knowledge and questions, which can yield spatially disconnected datasets and incompatible measurement scales." With this challenge in mind, she found that interdisciplinary research has been most successful when different teams organize data collection around common questions and then work to bridge both spatial and temporal scales. By co-locating measurements of stable carbon isotopes and microbial metatranscriptomes, for example, her team has successfully resolved microbial metabolic processes along vertical soil profiles and among microtopographic features across polygonal tundra. By then relating these point measurements to spatially-integrated hydrological and geochemical data, they found that 3D lateral transport helped explain the spatial distribution of these processes. "We would not have made those connections if we had worked within typical disciplinary boundaries," Smith said.

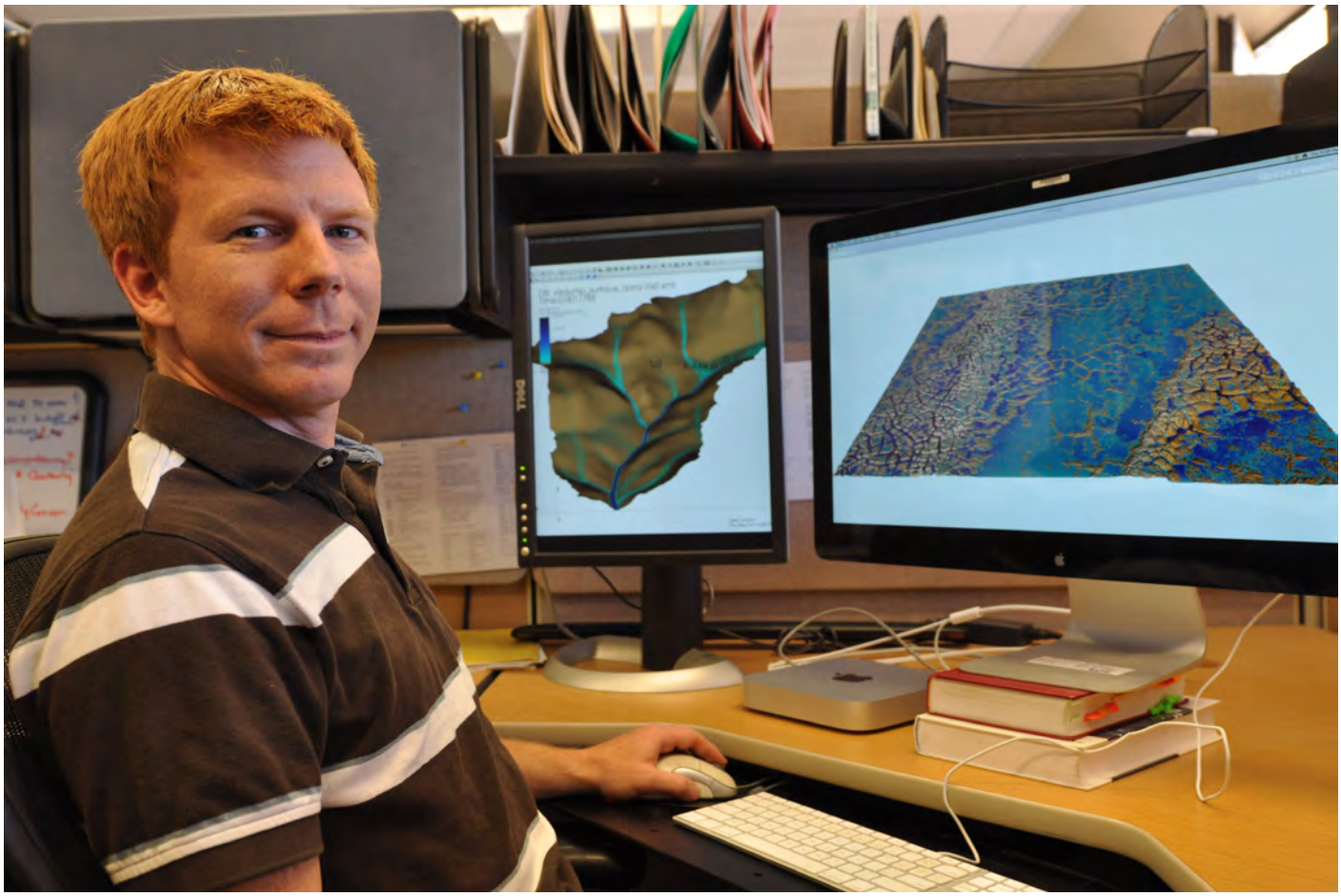


Lydia Smith collects gas samples to measure 13C of ecosystem respiration. Photo courtesy of Oriana Chafe.

The interdisciplinary approach influences not only field and laboratory scientists, but computer modelers too. For Los Alamos National Laboratory Staff Scientist Ethan Coon, a computational mathematician working on

high-resolution modeling of permafrost degradation who began working on the NGEE Arctic project as a postdoctorate research associate, interdisciplinary collaborations are a part of daily work. Coon leads development of the Arctic Terrestrial Simulator, a code that brings together field data from NGEE Arctic field sites, physical process representations from theorists on the team, and mathematical and computational algorithms to predict the dynamics of permafrost under a warming climate.

The biggest difficulty for Coon is making sure that the field scientists and modelers are on the same page. "Field scientists need to know how their data contributes to a given numerical experiment, while modelers need to understand when data is representative of an entire site and how it fits in with other observations," said Coon. He emphasizes that the combined tool, however, is extremely powerful. By combining field work to set up and drive a numerical experiment with mechanistic models, simulations are being run to predict how and how quickly permafrost degrades decades into the future. Coon notes, "The entire process of field and laboratory experiments contributing knowledge to models is greatly accelerated by constant communication within the team."



Ethan Coon uses advanced visualization software to understand simulations of snowmelt in Barrow, Alaska. Photo courtesy of Josh Smith, LANL.

The urgent nature of questions being asked in the Arctic requires a focused effort if progress is to be made in a timely manner. The formation of teams drawing expertise from many disciplines offers one approach to forging a

path forward. For the early career scientist, the interdisciplinary research environment offers many rewarding opportunities, but it also requires a new way of thinking about and executing their respective science. This is true whether that research is conducted in a laboratory, the field, or a numerical simulation.

More information about NGEE Arctic is available here (http://ngee-arctic.ornl.gov/).

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Commissioners Hear From Local Experts During 104th USARC Meeting in Anchorage and Nome

By: John Farrell, USARC Executive Director

The U.S. Arctic Research Commission (USARC) held its 104th meeting on 24-26 August 2015 in Anchorage and Nome, Alaska. The primary purpose of the meeting was for commissioners and staff to hear directly from subject matter experts on a wide range of Arctic research topics. The meeting was also an opportunity for the commission to share with Alaskans the content of the commission's biennial "Report on the Goals and Objectives for Arctic Research 2015-2016," (http://www.arctic.gov/reports_goals.html) was released earlier in the year. The agenda for the three-day meeting is available here (https://arctic.gov/meetings/usarc_104_agenda_8-15-15.pdf).

The half-day session in Anchorage focused on human health, specifically mental and behavioral health including suicidality. Alaska has the highest rate of suicide per capita in the country. It's twice the national rate, and the rate among Alaska Natives is nearly three times higher than the national average. Young males are the demographic at highest risk. Four recent deaths in Hooper Bay (http://www.ktuu.com/news/news/troopers-investigate-series-of-deaths-in-hooper-bay/35672586) are but the latest.

The commission heard from Commissioner Valerie Davidson, of the Alaska Department of Health and Social Services (http://dhss.alaska.gov/Pages/default.aspx), as well as experts from the Mat-Su Health Foundation (http://www.healthymatsu.org/), the Alaska Mental Health Trust (http://www.mhtrust.org/), the National Institute of Mental Health (http://www.nimh.nih.gov/index.shtml), the Alaska Native Tribal Health Consortium (http://anthctoday.org/), and the Aleutian Pribilof Islands Association (http://www.apiai.org/).

Discussion topics included: adverse childhood experiences, how the State of Alaska reimburses for behavioral health services, Medicaid expansion, service delivery models, whole system assessments, treating "upstream" issues (prevention and early intervention) rather than waiting for "downstream" effects, greater support for research to strengthen the evidence base on the efficacy and effectiveness of psychosocial interventions, proximity of the source of care to the patient, better understanding of communities that are resilient to suicidality, social structure differences among communities, and historical cultural trauma.

Despite a variety of approaches, this heart breaking issue remains stubbornly resistant to efforts to prevent such outcomes. Recent USARC efforts include a co-sponsored a workshop on this topic in 2009 and in 2010

Commissioner Warren Zapol co-authored, "Behavioral and Mental Health Research in the Arctic: Strategy Setting Meeting," (http://www.arctic.gov/publications/related/CHS_(5)_netti.pdf) which appeared in Circumpolar Health Supplements 2010(5) to the International Journal of Circumpolar Health (http://www.circumpolarhealthjournal.net/index.php/ijch/pages/view/ch).

The Commission meetings in Nome were held in the local "Mini-Convention Center" on River Street. The six sessions of the meetings were broadly focused on the following subjects: overviews, behavioral and mental health, local science, federal agency research, renewable energy, and local research.

Excellent presentations were given on a variety of subjects ranging from reindeer research programs, to marine mammal co-management issues, to landscape conservation, to a Pacific Walrus mark-recapture program, to rural energy initiatives, to civil infrastructure efforts (e.g., Port of Nome), to climate science.

Fran Ulmer, Chair of the USARC, introduces Robert Rich, Executive Director of ARCUS, prior to his presentation to the Commission in Nome. Photo courtesy of John Farrell.

The information provided at the 104th meeting will be used by the commission in their duties to recommend Arctic research priorities to the President and Congress, and to help build cooperative links in Arctic research within the federal government, with the State of Alaska, and with international partners.

The commission's 105th meeting will be in Fairbanks, in March 2016, in conjunction with Arctic Science Summit Week (https://www.arcus.org/witness-the-arctic/2015/3/article/24379). More information about USARC is available here (http://arctic.gov/).

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Why it Matters to Discuss Why the Arctic Matters

By: Laurie Geller, Senior Program Officer and Julie Brigham-Grette, Chair National Academies' Polar Research Board

The National Academies of SCIENCES • ENGINEERING • MEDICINE

The environmental changes affecting the Arctic region —warming temperatures, shrinking sea ice cover, coastal erosion from melting permafrost, expanding wildfire seasons, shifting ranges of plant and animal species —provide plenty of motivating concern for people living within the Arctic region. However, for the large percentage of humanity that lives outside that region, Arctic change is something we may hear news reports about from time to time, stoking a few moments of interest before we quickly turn back to the other ever-present lower latitude and local issues of concern that seem far more relevant to our lives.

The Conference on Global Leadership in the Arctic: Cooperation, Innovation, Engagement and Resilience (GLACIER) (http://www.state.gov/e/oes/glacier/index.htm), held in Anchorage, Alaska on 31 August 2015, was part of an effort by the U.S. government to help expand international public understanding of how climate change is affecting the Arctic region, and why "what happens in the Arctic does not stay in the Arctic." Fast-paced Arctic change is part of a wide array of global changes that are impacting societies everywhere. The conference and surrounding side events provided an excellent venue for meaningful discussion between people who live and work in the Arctic region. It was also a forum for representatives of many governmental, civic, and academic organizations to share concerns that address Arctic change issues from afar though a phrase often heard at the event was that these people were "preaching to the choir."

The substantial media coverage that resulted from the conference and President Obama's related travel around Alaska did certainly boost the visibility of Arctic change issues for a while. That is an important accomplishment, but sustaining broad public interest requires more. How can we build a much bigger choir?

As one contribution to this long-term goal, the National Academy of Science's (NAS) Polar Research Board is undertaking a public engagement campaign to enhance appreciation of the unique landscapes, ecosystems, and cultures that exist across the region. The campaign will also work to explicitly connect the dots between Arctic change and impacts on the coastlines, the weather, the fish supplies, and the security of people around the world. At the GLACIER conference, we presented the foreign ministers with an overview of National Academies' reports that provide a factual basis for understanding the urgent need to dramatically decrease the use of fossil fuels while still

Members of the Polar Research Board with John Holdren at the recent GLACIER conference. From left, Larry Hinzman, Interim Vice Chancellor for Research, University of Alaska Fairbanks; Julie Brigham-Grette, UMass-Amherst and Chair of the NAS Polar Research Board; John Holdren, Chief Science Advisor, White House Science Office OSTP; and Rafe Pomerance, consultant, formerly with the U.S. State Department. Photo courtesy of Julie Brigham-Grette.

meeting the energy needs of a rapidly expanding global population. We also discussed why strange weather patterns in the lower latitudes very well could be the result of changes in the Arctic cryosphere; and why even if we can decrease future atmospheric CO2 concentrations, some impacts such as sea level rise will, regrettably, not be reversible.

The science behind these reports on Arctic-global linkages can be difficult to convey in an unambiguous, even-handed way given that many such linkages are the focus of ongoing research and are thus far only partially understood. But even without "complete" scientific understanding, the basic evidence is clear—what happens in the Arctic doesn't stay in the Arctic. Broadening public understanding of this concept can help inform important public policy decisions and international agreements about how much investment to make in the mitigation of pollution emissions, in adaptation actions that reduce vulnerability to environmental risks, and in scientific research and observations that allow us understand how and why our environment is changing. Despair or fear about the state of the world is not useful; rather, we must use knowledge and compassion to seek solutions for the greater good and we must better appreciate how "remote" parts of the world, like the Arctic, are relevant to us all.

More information about the National Academies' Arctic Matters Initiative is available here (http://nas-sites.org/arctic/2015/07/04/about-the-arctic-matters-initiative).

The National Academy of Sciences invites the public to attend "Arctic Matters" day on 14 January 2016 in Washington D.C. The day will include a program of engaging presentations and discussions with top Arctic science and policy experts as well as interactive exhibits and displays.

The event is free and open to the public. Visit the National Academy of Science website (http://nas-sites.org /arctic/) to see the agenda, register for the event, and to read about sponsorship and exhibitor opportunities. The suite of Arctic Matters educational resources including a layman-friendly booklet, website, and classroom poster can also be accessed free from this site.

The goal of this event is to reach well beyond the small circle of specialists who typically attend Arctic-themed events in the D.C. area. Please encourage your friends, neighbors, and colleagues to participate!

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Ambitious Program Developing for 2016 Arctic Science Summit Week & Arctic Observing Summit

By: Kristin Timm, Science Communications Lead, Scenarios Network for Alaska and Arctic Planning, Alaska Climate Science Center, University of Alaska Fairbanks

Early morning teleconferences and discussions bursting with ideas have become routine to teams distributed over several continents as they work to develop the program for the 2016 Arctic Science Summit Week (ASSW), Arctic Observing Summit (AOS), and related side meetings and events that will convene 9-20 March 2016 in Fairbanks, Alaska.

Nearly 1,000 scientists, policy makers, technical experts, educators, and other Arctic authorities from around the world will gather during these meetings to develop a better understanding of the Arctic environment and its role in global policy.

"I am delighted with the excitement and enthusiasm that we see at Alaska's universities and throughout the state of Alaska," said Larry Hinzman, Interim Vice Chancellor for Research at the University of Alaska Fairbanks (UAF). "The people of Alaska look forward to welcoming conference participants to Fairbanks."

Central to the event is the annual Arctic Science Summit Week. Coordinated by the International Arctic Science Committee (IASC), ASSW brings scientific organizations from around the world together to coordinate activities and look for opportunities to cooperate and collaborate.

"The National Academies' Polar Research Board (PRB) will convene a joint meeting amongst the U.S. Arctic Research Commission, the European Polar Board, and Polar Knowledge Canada to advance discussions on international cooperation in Arctic studies," explained Volker Rachold, Executive Secretary of IASC. "They have taken a proactive stance in promoting international collaborations."

In addition to working group and business meetings, ASSW will also include discussions about crosscutting initiatives, such as a seminar to discuss communication and collaboration between the humanities, social sciences, and natural sciences.

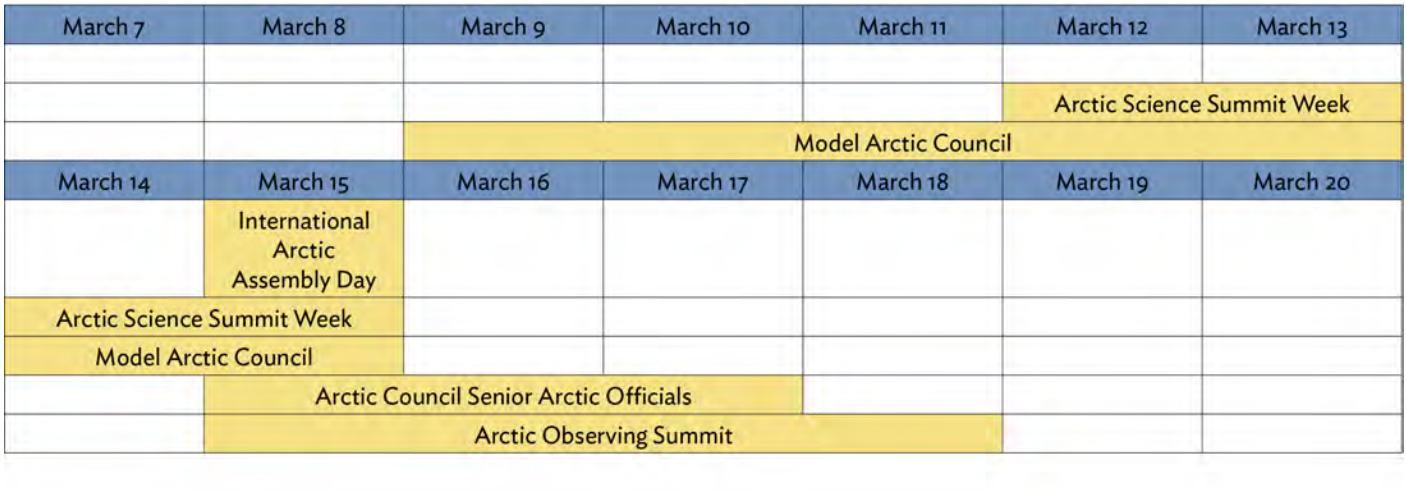
The Arctic Observing Summit meets biennially to provide guidance and foster collaboration on sustained, coordinated observations of rapid Arctic change that can benefit all nations. Led by the International Study of Arctic Change (ISAC) and co-sponsored by IASC and the Arctic Council's Sustaining Arctic Observation Networks Initiative, the third AOS will bring together the research community and a range of partners to advance the implementation of an international observing network.

AOS working groups will convene to address themes that include diverse subjects from technology and innovation for sustained Arctic observations to actor and stakeholder engagement and needs.

"The working groups include coordinators of international research initiatives, funding agency leaders, Indigenous Knowledge experts, and industry representatives, which speaks to the diversity, relevance, and interest in the Summit's topics," explains Hajo Eicken, Interim Director of the International Arctic Research Center and one of the co-chairs of AOS. "The white papers submitted by the international community will lead to important conversations within the working groups."

The University of Alaska Fairbanks is also hosting a meeting of the Arctic Council's Senior Arctic Officials. The meeting is part of the Arctic Council's aim to foster cooperation on issues of mutual concern. It will include updates on associated working groups such as those on Sustainable Development and Emergency Prevention, Preparedness, and Response.

These large meetings will be held simultaneously to promote communication. To that end, UAF is coordinating a special program for all participants on 15 March. The International Arctic Assembly will be an unprecedented opportunity to explore the role of science in both understanding the Arctic system and implementing policy to respond to rapid change.



The 2016 Arctic Science Summit Week will be held in conjunction with the Arctic Observing Summit, the Arctic Council Senior Arctic Officials Meeting, the Model Arctic Council, and side meetings for numerous international Arctic organizations. Planned events will include plenary presentations, panel discussions, open and closed-business meetings, working group sessions, excursions, exhibit hall, cultural events, and an action-packed local program. Image courtesy of the ASSW planning group.

UAF is also developing a program for students and the Fairbanks community. One of these activities is the Model Arctic Council (MAC), an experiential learning exercise where students simulate the work of the Arctic Council. Brandon Boylan, co-chair of the MAC explained, "The program will include simulations of meetings of the Arctic Council Sustainable Development Working Group, Senior Arctic Officials, and Ministers. Students will also have the unique opportunity to hear from high-profile experts and policy makers on Arctic affairs."

Alaska's presence in the Arctic is the reason the United States is an Arctic nation and why UAF is working to guide the local, national, and international dialogue on the challenges and opportunities unique to the Arctic. UAF research is diverse and encompasses most of the sectors, disciplines, and problem areas that matter in the context of rapid Arctic change. By hosting the Summit, related meetings, and community events, UAF is striving to bring together diverse perspectives during the 2016 Arctic Science Summit Week and related events.

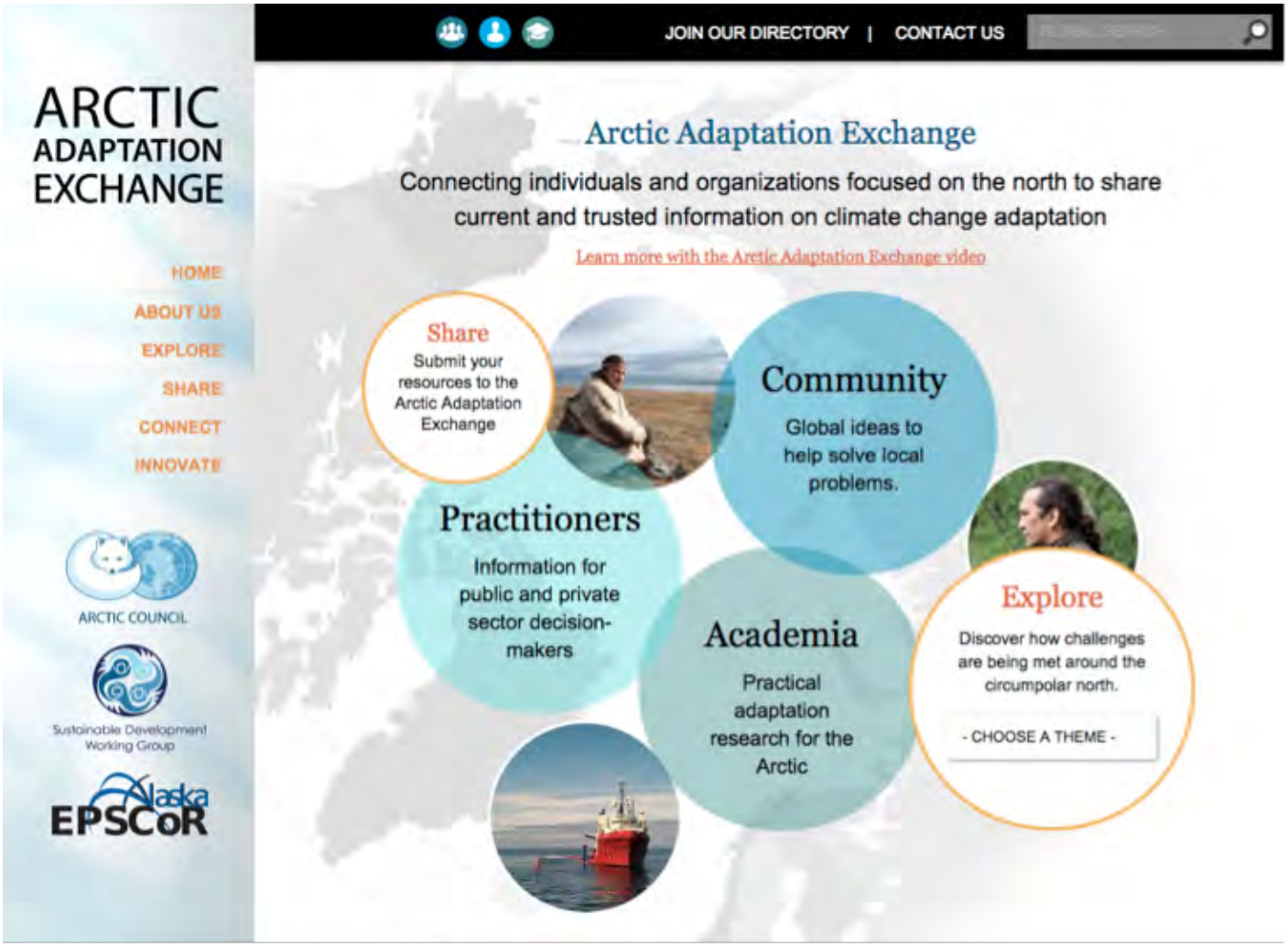
More information about the Summit, online registration, and the developing program is available here (http://assw2016.org/).

Arctic Adaptation Exchange: Where Arctic Communities Explore, Share, Connect, and Innovate

By: Vanessa Raymond, Project Manager, Geographic Information Network of Alaska

Arctic communities possess a wealth of knowledge about landscape and ecosystem changes in their regions. This knowledge is an incredible resource that needs to be shared across the circumpolar North and beyond, to non-Arctic research and policy-making centers. The Arctic Adaptation Exchange portal, a project of theSustainable Development Working Group (http://www.sdwg.org/) and Alaska EPSCoR (https://www.alaska.edu/epscor), is positioned to support the flow of knowledge between Arctic communities for adaptive and resilient capacity building in the face of much change. As an open and web-based platform, this information is also available for concerned researchers and policy-makers.

To truly support resilient Arctic communities the Arctic Adaptation Exchange (AAE) is expanding its existing platform to allow them to share innovations, problems, and solutions for resilient response to climate change. While currently the AAE is a vibrant place to share research of all kinds across a variety of thematic and Arctic regional contexts, it has the capacity to support and engage Arctic community members in a more dynamic role. Through the Community Observation Network for Adaptation and Security (CONAS) and SnowChange the AAE team has identified 16 communities around the circumpolar region who are willing to participate in sharing experience of and solutions to climate change. These include communities in the U.S., Russia, Norway, Sweden, and Finland. The AAE continues to seek community partners across the circumpolar North.



Screenshot of the Arctic Adaptation website.

Through an accessible web platform the planned re-design of AAE serves as both information resource and climate change witness for Arctic communities. This redesign includes adding a user forum for frank discussion, and recalibrating the AAE "Explore" map. The map will be repurposed to directly support community members who want to document their observations of tundra-level changes and share local solutions to these changes.

With the new AAE, users from Arctic communities can:

- **Share** resources and observations on a map. This allows users to document problems at specific locations arising from climate change, and also to share solutions. Shared resources can be in the form of documents, web pages, videos, or photos.
- **Explore** problems and solutions of other Arctic communities. The AAE provides Arctic communities with solution-finding tools to community problems that stem from climate change. These include the Arctic Water Resource Vulnerabilities Index (AWRVI).
- **Connect** through an interactive forum for discussion, solution finding, and problem identification. These

public forums are moderated and can be used for effective research and policy that is sourced from on-the-ground witnesses.

- **Innovate** through discussion, observation, and solution-sharing.

Currently, the Arctic Adaptation Exchange unites 50+ Arctic and northern organizations supporting climate change and presents portal users with 900+ resources on Arctic climate change issues and solutions. These resources are submitted by AAE curators and users, and are shared through the "Explore" circumpolar map. Included in these resources are Arctic datasets from the U. S. Department of the Interior.

History

The Arctic Adaptation Exchange portal is a project of the Arctic Council's Sustainable Development Working Group. The AAE began as a collaborative project between Alaska EPSCoR and the Government of Canada under the Canadian chairmanship of the Arctic Council. These groups built the AAE in response to the need expressed by Arctic ministerial members at the 2011 Arctic Council Ministerial in Nuuk, Greenland for stronger response to Arctic-related adaptation. Nuuk delegates recognized a disconnect between the pace of academic research and the necessary speed at which Arctic communities must develope response capacity.

Alaska EPSCoR, the U. S.'s only Arctic-focused EPSCoR program, was approached as an adaptation partner in 2013. The vision for the current iteration of the Arctic Adaptation Exchange portal came out of a 2014 meeting with Alaska EPSCoR and Canadian representatives.

In 2015, with the transfer of the Arctic Council chairmanship from Canada to the U. S., Alaska EPSCoR and the University of Alaska Fairbanks took on the mantle of the Arctic Adaptation Exchange. Project co-leads within the Arctic Council's Sustainable Development Working Group include the Government of Canada (Natural Resources Canada); the Climate Change Secretariat, Department of Environment, Government of Yukon; the Aleut International Association; and the Gwich'in Council International.

Further information is available on the Arctic Adaptation Exchange (https://www.arcus.org/www.arcticadaptationexchange.com) website and in the Arctic Adaptation Exchange video (http://arcticadaptationexchange.com/video).

Spoon-billed Sandpiper Conservation Project in Chukotka and Kamchatka Russia

By: Dr. Christoph Zockler, Eastern Asian-Australasian Flyway Partnership for the Spoon-billed Sandpiper (EAAFP SBS) Task Force Coordinator Cambridge, U.K.

It is amazing to see how the Spoon-billed sandpiper, a tiny bird no bigger than a sparrow and weighing just 30-45 grams, can raise so much global attention. The tiny shorebird with the charismatic spoon-shaped bill is breeding entirely in the Russian Arctic in Chukotka and Northern Kamchatka. For over 15 years, Birds Russia and the Spoon-billed Sandpiper Task Force (http://www.eaaflyway.net/our-activities/task-forces/spoon-billed-sandpiper/) have been working to save this tiny globally threatened sandpiper from extinction. In 2000 we discovered the population to be in dire condition. Many known breeding sites in Chukotka were found abandoned or declining. The total population was estimated to be less than 1,000 pairs. Ten years later the population declined further to less than 200 breeding pairs and the global conservation community became alarmed. From research on the breeding ground there was increasing evidence that the main cause for the decline is within the flyway (common migration route) in East Asia. Indeed, the main reason for the decline was the trapping of coastal birds in Myanmar, Bangladesh, and China, but the loss of stopover sites in China and other countries in East and Southeast Asia along the flyway also contributed to the decline.

Newly hatched spoon-billed Sandpiper "K3" of the 2015 generation, Chukotka, Russia 2015. Photo courtesy of Pavel Tomkovich.

The small recovery team of six members, established in 2004, merged into a well-established task force of the East Asian Australasian Flyway Partnership (EAAFP) (http://www.eaaflyway.net/our-activities/task-forces/spoon-billed-sandpiper) in 2010, chaired by Dr. Evgeny Syrechkovskiy from Russia.

In 2013 the population of the 12-14 remaining breeding pairs were monitored by a Russian research team near the Chukchi fishing village of Meinypilgyno. Birds were individually colour-marked and chicks reared in captivity to avoid predation and released again as fledglings into the wild. This would give the young birds a good head-start for their long journey south to southern Russia, Japan, Korea, China, and the wintering areas in Southeast Asia. For the second time these head-started birds returned to the breeding population and bred! These new recruitments contributed to the increase observed in 2015 for the first time in 14 years. This is a success of the local research and conservation team in Chukotka, who helped to research and to guard the breeding birds from egg and skin collectors as well as stray dogs and natural predators. This success is also the result of the increasing conservation community along the entire Eastern Asian-Australasian flyway, which include the hunting mitigation work on the

wintering grounds in Myanmar and in Bangladesh, by the local task force members, and the conservation efforts in Thailand and China. These efforts have shown a positive impact on the population.

Furthermore, the Russian scientists found a new site in July this year, not far west of the known population in Meinypilgyno with at least 18 and maybe as many as 25 breeding pairs. This exciting news provides hope and maybe a little more time for the conservation activities as the current total population might indeed be slightly higher than suspected.

Spoon-billed Sandpiper, male '30' leading chicks into the tundra, Chukotka, Russia 2015. Photo courtesy of Pavel Tomkovich.

The Spoon-billed Sandpiper is the rarest breeding shorebird in the world and one of the rarest species in the Arctic region. As a flagship species it is symbolic for the entire flyway and represents the current conservation status along the flyway that Russia shares with Alaska and Canada. Conservation efforts for the species will be beneficial for a huge range of species along the flyway, but also for the livelihoods of local people living along the coast. There is also more and more awareness among Arctic stakeholders that conservation efforts for Arctic migratory species need to take the entire flyway into consideration. The Arctic Migratory Bird Initiative (AMBI)

(http://www.arctic-council.org/index.php/en/our-work2/8-news-and-events/356-caff-ambi) by the Arctic Council's Conservation of Arctic Flora and Fauna (CAFF) (http://www.caff.is/) Programme aims to address exactly that. The Spoon-billed Sandpiper is one of this initiative's few selected flagship species.

Many foundations and international organizations have supported the conservation of the species, including: the Keidanren Fund for Nature (Tokyo) and the Manfred-Hermsen-Foundation (Bremen). Today the main supporters include BirdLife International, the Lighthouse Foundation, the David and Lucile Packard Foundation, the Darwin Initiative, Heritage Expeditions, Wildsounds, the Wildfowl and Wetland Trust and the U. S. Fish and Wildlife Service. There are also many private donors from all over the world.

It is still early days and many issues remain unresolved for the small sandpiper. The threat of coastal reclamation at key stopover sites in China remains the biggest challenge for the survival of the species, but the global conservation momentum created is enormous and very encouraging. It is fascinating to see how the global conservation community across the entire flyway and beyond across continental, national, cultural, and religious boundaries is growing stronger and stronger to save this species.

More information about the East Asian-Australasian Flyway Partnership is available on their website (http://www.eaaflyway.net/our-activities/task-forces/spoon-billed-sandpiper).

Recent news bulletins are available here (http://www.eaaflyway.net/wordpress/new/ouractivities/taskforces/spoonbilledsandpiper/SBS%20Newsletter%20August%202015%20Web.pdf).

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Announcing New Membership Opportunities with ARCUS!

The Arctic Research Consortium of the U.S. (ARCUS) implemented a new membership structure in October 2015, opening membership up to anyone interested in promoting discovery and understanding of the Arctic. There are options for large and small research institutions, indigenous organizations, government agencies, corporations, and individuals.

ARCUS membership (https://www.arcus.org/arcus/member-information) offers a variety of benefits, including a direct connection to our network of contacts and resources, outreach and collaboration services, and access to work space at our Fairbanks and Washington D.C. offices. Most significantly, membership with ARCUS signifies your support of and contributions toward interdisciplinary progress in the fields of Arctic science, outreach, and policy.

Each year, our members are invited to attend an annual meeting where we update the community on our activities and solicit their input on future plans. This year the annual meeting will be held at the American Geophysical Union (AGU) Fall Meeting in San Francisco, California on Wednesday, 16 December 2015 at 5:30-6:30 p.m. Pacific Standard Time. A reception will be held immediately following the meeting. Further details, including the location and agenda, will be posted on the ARCUS website (https://www.arcus.org/annual-meetings) and announced via ArcticInfo (https://www.arcus.org/arctic-info) when available.

ARCUS plays a key role in connecting people across boundaries to support communication, coordination, and collaboration in Arctic research. We invite you to join us in our endeavors by reviewing the membership opportunities (https://www.arcus.org/arcus/member-information) and applying for organizational or individual membership today.

For questions about becoming a member, please contact the ARCUS Director of Community Development, Kristina Creek (creek@arcus.org).

A Newcomer's Guide to the Complex System of U.S. Arctic Research

Robert H. Rich, PhD, CAE

As those who pursue Arctic research know, the Arctic is a complex, interdependent system and there are many boundaries that must be crossed to successfully advance our understanding. There are multiple disciplines of science, engineering, and the social sciences. There are multiple stakeholders involved including academic researchers and administrators, government funders and resource managers, industrial interests, indigenous and community groups, and non-governmental organizations. Researchers from all career stages are involved, and there are international circumpolar issues. Even looking just within the U.S. there are a myriad of relevant federal, state, and local government agencies. There are gaps between the understanding of the scientific and the non-technical communities, and gaps between the experience of Arctic residents and that of the global population.

Bridging these boundaries is the Vision of ARCUS (https://www.arcus.org/arcus): "ARCUS envisions strong and productive linkages among international Arctic researchers, educators, communities, and other stakeholders that promote discovery and understanding of the Arctic and inform sound decisions related to the Arctic." Through our activities and programs, we work every day to help Arctic research advance in this complex landscape.

When I started at ARCUS in May much of this was new to me, and I've focused in the last few months on developing an understanding of the key participants and relationships that make up the Arctic research system. I've been visiting key Arctic research sites, some of the leading researchers, Arctic resident community groups, and other stakeholders. In the coming months and years, I hope to continue these visits and further broaden and strengthen the ARCUS network. In this article, I provide a high-level overview of some of what I've learned:

1. There are limited resources to support research spread across multiple agencies, not always coordinated: Every researcher needs funding. That said, an especially difficult challenge in the Arctic is to identify which agencies might be able to provide such funding. Unlike many other research areas, the Arctic is particularly fragmented in terms of varying agency missions, priorities, and available funding opportunities. There are groups trying to coordinate this, but the current state is still seen as being in need of improvement.

The U.S. Arctic Research Commission does a great job in setting out high-level National priorities based on diverse participation of stakeholders and holding of hearings to solicit a wide range of voices. The Interagency Arctic

Research Policy Committee (IARPC) brings together Federal leaders from the key agencies in regular conversation through 12 collaboration teams, and many of these conversations are open to all those engaged in research. ARCUS helps support IARPC, and everyone is encouraged to participate. You can sign up for a collaboration team in your area of interest on the IARPC Collaborations website (http://www.iarpccollaborations.org/index.html).

Sometimes, there is not as much coordination across agencies as would be desirable. Recently, the ARCUS-supported Study of Environmental Arctic Change (SEARCH) published a position paper (http://www.arcus.org/search-program/aon) with recommendations as to how long-term observation of the changing Arctic environment should be coordinated, based upon extensive community input. These recommendations are now being considered by the affected agencies, and I'm hopeful that the various coordinating groups within the government will address these important issues.

2. The Arctic is increasing in perceived importance as an area to conduct and apply the fruits of research to policy: It is clear from the recent and unprecedented visit of President Obama to the Alaskan Arctic that there are influential parts of the U.S. government which would like to see greater attention to the region. As he discussed environmental change during the trip, the President referred to topics like permafrost, Arctic amplification, sea ice, coastal erosion, and other central concepts of Arctic research. In fact, the stated rationale for the trip was directly aligned with the ARCUS Vision, using recent discoveries to inform sound policy decisions related to the Arctic.

Also, earlier this year, the President established an Arctic Executive Steering Committee, Chaired by the Director of the Office of Science & Technology Policy. What these things will mean for Arctic research in detail remains to be seen. Early indications are optimistic, however, that various agencies will increase the priority given to our region, and increase funding in some areas to enable us to pursue the most important studies.

3. On the ground, there are a lot more great ideas than there is funding to support. There is real value in connecting researchers to available resources: Even with the many Federal, State, Local, and International organizations interested in Arctic research, there is not nearly enough funding to go around. It is always frustrating when I hear about a really insightful approach to advance our knowledge that can't take place because of constrained resources.

At ARCUS, we are striving to help our member institutions take advantage of the available opportunities. In conversations with funders, we seek out the latest priorities they have for research and then communicate those to groups that are able to best respond. We also communicate key priorities from the research community (e.g., through SEARCH) to agencies in order to influence their decisions. Where it makes sense, ARCUS can also help to catalyze and support the formation of teams that cut across institutional and disciplinary boundaries.

ARCUS is currently developing additional opportunities to strengthen the Arctic research community and connect people across boundaries. Recently, we rolled out three new membership categories (http://www.arcus.org/arcus/membership-application), enabling broader participation from indigenous organizations, corporations, and individuals interested in advancing our knowledge of this important region. We have new member benefits, including access to conference/workshop and temporary workspace at both our D.C. and Fairbanks offices. We are constantly looking for opportunities to reduce the complexity of the Arctic research funding system, and to enable researchers at all career stages to pursue meaningful work. We are working to develop a collective voice by which the community can express the importance of Arctic research to policymakers. See additional news about ARCUS membership here (https://www.arcus.org/witness-the-arctic/2015/3/article/24518).

This is a very exciting time to be associated with Arctic research, and the opportunities and challenges are rapidly changing. We must continue to innovate and to adapt. Through it all, ARCUS will continue to be your advocate and your assistant, connecting Arctic research as we've done for more than 25 years. Thank you for the opportunity to work with you.

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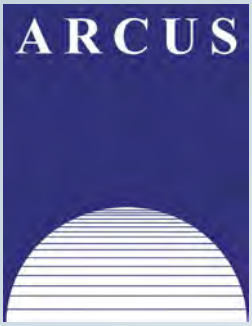

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