Witness The ARCTIC

Chronicles of the NSF Arctic Science Section Spring 2014, Volume 18 Number 2

In this Issue

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Brief SEARCH Update

Since the last SEARCH update in late February (http://www.arcus.org/witness-the-arctic/2014/1/article/20429), the SEARCH Science Steering Committee (SSC) (http://www.arcus.org/search-program) has focused on communications with the National Science Foundation (NSF) on a pending proposal to support SEARCH activities and a new organizational structure (see the main SEARCH website for a PDF for "Summary of the new SEARCH framework"). The SEARCH SSC hopes to be able to announce news soon.

Other activities over the past few months include:

- Members of the SEARCH SSC and Observing Change Panel (http://www.arcus.org/search-program/sciencecoordination/observing) have participated in NSF's webinar series on Long Term Observing Management (https://www.arctichub.net/groups/longtermobservingmgt/webinar_recordings), and have been actively discussing the topics posed via the webinars. A SEARCH position paper that responds to many of these topics is under initial development.
- The Arctic Science Summit Week (ASSW) (http://www.assw2014.fi/) and Arctic Observing Summit (AOS) (http://www.arcticobservingsummit.org/) meetings in April had strong participation from SEARCH. SEARCH representatives are involved in the initial planning for the next AOS planned for 2016 in Fairbanks, Alaska and will seek broad input from the research community on goals and topics for the Summit.
- The 2014 Sea Ice Outlook (now managed under the Sea Ice Prediction Network project) and Sea Ice for Walrus Outlook activities have been launched. Both projects have evolved this year as a result of input from the research and stakeholder communities. See the Sea Ice for Walrus website (http://www.arcus.org/search-program/siwo) and the Sea Ice Prediction Network website (http://www.arcus.org/sipn) for more information.

For more information about SEARCH activities, see the SEARCH website or contact Hajo Eicken, UAF (SEARCH SSC Chair) at hajo.eicken@gi.alaska.edu or Helen Wiggins, ARCUS (SEARCH Project Office) at helen@arcus.org.

Sea Ice Prediction has Easy and Difficult Years

By: Lawrence C. Hamilton, University of New Hampshire; Cecilia M. Bitz, University of Washington; Edward Blanchard-Wrigglesworth, University of Washington; Matthew Cutler, University of New Hampshire; Jennifer Kay, National Center for Atmospheric Research; Walt Meier, National Aeronautics and Space Administration; Julienne Stroeve, National Snow and Ice Data Center; and Helen Wiggins, Arctic Research Consortium of the U.S.

Arctic sea ice follows an annual cycle, reaching its low point in September each year. The extent of sea ice remaining at this low point has been trending downwards for decades as the Arctic warms. Around the long-term downward trend, however, there is significant variation in the minimum extent from one year to the next. Accurate forecasts of yearly conditions would have great value to Arctic residents, shipping companies, and other stakeholders and are the subject of much current research. Since 2008 the Sea Ice Outlook (SIO) (http://www.arcus.org/search-program/seaiceoutlook) organized by the Study of Environmental Arctic Change (SEARCH) (http://www.arcus.org/search-program) has invited predictions of the September Arctic sea ice minimum extent, which are contributed from the Arctic research community. Individual predictions, based on a variety of approaches, are solicited in three cycles each year in early June, July, and August. (SEARCH 2013).

In a recent study done by our team, data from six years of past SIO predictions were compiled and analyzed for overall success in predicting the actual observed minimum ice extent. The analysis revealed that in some years the predictions were very successful. In other years, however, they were not. The years 2008, 2010, and 2011 were relatively easy to predict. Late-summer sea ice followed its long-term downward trend and scientific predictions of September extent averaged out close to the true final values. The years 2009, 2012, and 2013 proved more difficult. Sea ice extent made abrupt one-year excursions above or below its trend, which the predictions often missed. These findings are detailed in our paper, "Predicting September sea ice: Ensemble skill of the SEARCH Sea Ice Outlook," published in Geophysical Research Letters (Stroeve et al. 2014).

The main analysis in our study involved more than 300 predictions and comparisons of those predictions with the observed September ice extent. Figure 1 graphs the median (50th percentile) and interquartile range (25th to 75th percentile) of July SIO predictions. Red lines mark the distance from median predictions to the observed September mean extent. Median SIO predictions are close to the observed ice extent in 2008, 2010, and 2011. In 2009, 2012, and 2013, on the other hand, the median predictions are off by a large margin. June and August SIO predictions followed similar patterns.

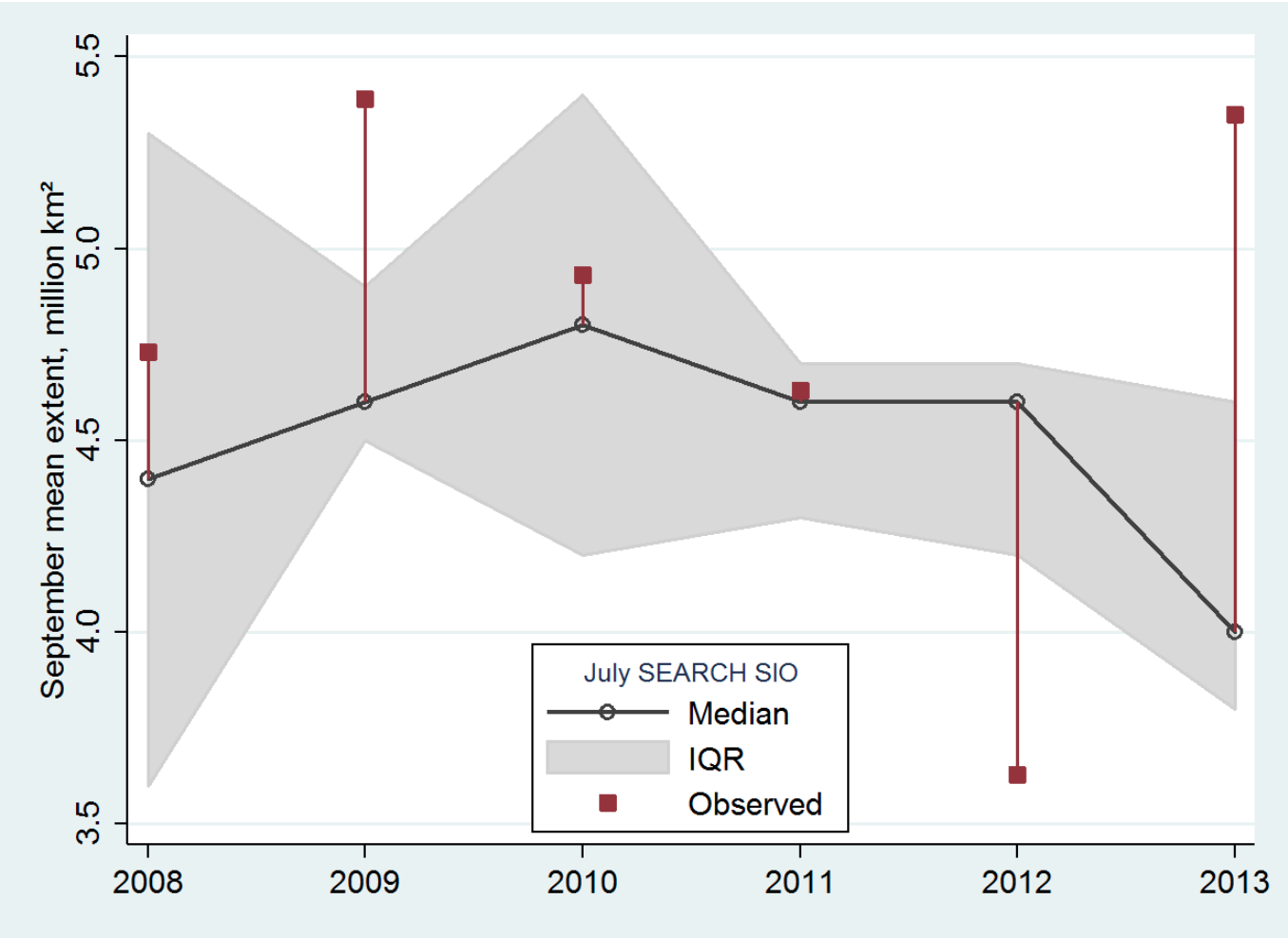

Figure 1: Median and interquartile range of July SIO predictions, compared with observed September mean sea ice extent. Image courtesy of Stroeve et al. (2014)

Two less formal sets of predictions also show this pattern. Since 2008, workers at the National Center for Atmospheric Research (NCAR) (http://ncar.ucar.edu/) have conducted their own early-summer competition to guess the September mean sea ice extent. Losers buy ice cream for the winners. Because this pool is conducted for fun but also engages researchers, the competition could be described as well-informed though not strictly scientific. The left-hand plot in Figure 2 graphs median and interquartile range of 15 to 26 NCAR pool predictions each year. Again, red lines mark distance from median predictions to the observed September extent. This graph repeats the pattern of Figure 1. Median NCAR guesses fall close to the observed September extent in 2008, 2010, and 2011, but far from the observed values in 2009, 2012 and 2013.

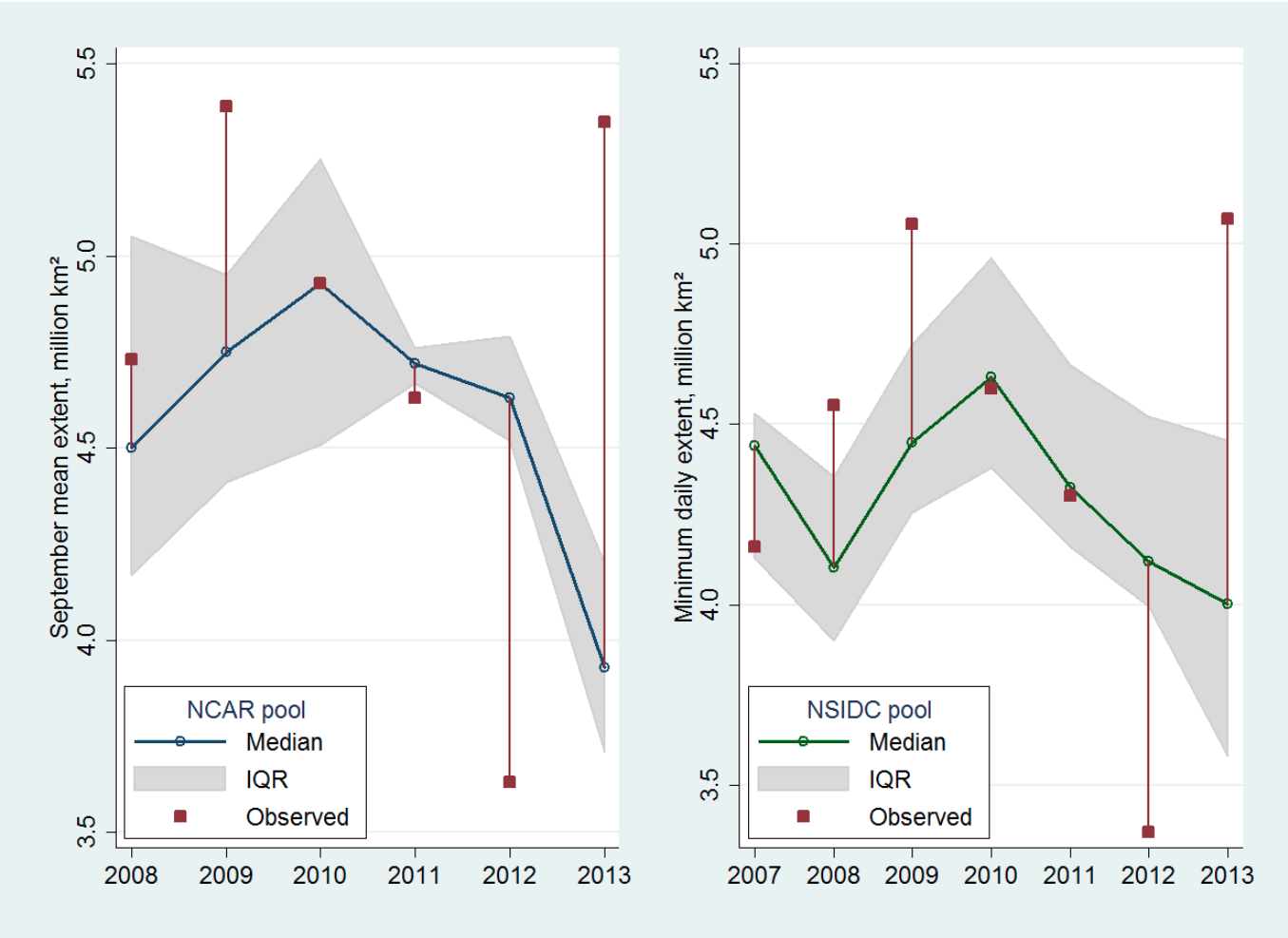

Figure 2: Median and interquartile range of NCAR and NSIDC pool predictions, compared with observed September mean or one-day minimum sea ice extent. Image courtesy of Stroeve et al. (2014)

The right-hand plot in Figure 2 depicts another informal but well-informed office competition, this one from the National Snow and Ice Data Center (NSIDC) (http://nsidc.org/). In early summer, the first to third week of July, employees make guesses about the minimum daily ice extent, which is a slightly lower number than the monthly mean extent targeted by SIO and NCAR. Personnel at NSIDC closely follow sea ice conditions and their office calculates the widely used extent statistics. The NSIDC competition includes scientists directly involved with this research, but other colleagues, family, and friends can participate as well. The NSIDC graph summarizes 17 to 61 predictions each year, beginning in 2007. Again we see a familiar pattern: the median predictions are far from observed values in 2009, 2012, and 2013, but closer in other years.

The informal NCAR and NSIDC data agree with our SIO finding that a wide variety of prediction approaches collectively succeed in certain years, but fail in others. The well-predicted years turn out to be those in which sea ice extent lies close to its long-term downward trend. The difficult-to-predict years occur with abrupt variations above (2009, 2013) or below (2012) this overall trend. The trend reflects climate change, well established by many kinds of data. Variations around that trend at least partly reflect weather events, such as summer temperatures and wind

conditions, which are much harder to forecast. However, new research incorporating additional information, such as the fraction of ice covered by melt ponds in the spring, shows promise for improved future predictions (Schroder et al. 2014).

After the minimum, a new freeze cycle begins: early October sea ice forming near Kotzebue, Alaska. Image courtesy of Larry Hamilton.

On 1-2 April 2014, the Sea Ice Prediction Network (SIPN) (http://www.arcus.org/sipn)—a research effort jointly supported by the NSF, Office of Naval Research, National Oceanic and Atmospheric Administration, National Aeronautics and Space Administration, and Department of Energy—organized a workshop on Sea Ice Prediction. More than 50 international scientists gathered in Boulder, Colorado to discuss the state of the art and ways forward. The meta-analysis of past sea ice predictions described above highlights the challenge remaining as sea ice prediction looks beyond the multi-year downward trend, driven by climate, and focuses on season-to-season variations where weather plays a large role. The SIPN website will post news and information about this initiative.

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Lawrence C. Hamilton

Lawrence Hamilton is professor and senior fellow in the Carsey Institute at the University of New Hampshire. His interdisciplinary research concerns society-environment interactions in the Arctic.

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New Insights on Ice Dynamics

By: Matthew A. Charette, Senior Scientist in Marine Chemistry and Geochemistry at the Woods Hole Oceanographic Institute

Introduction

During the second week of July 2012, satellite-derived estimates of the aerial extent of surface-ice melt on the Greenland Ice Sheet (GrIS) increased from 40% to 97%. Although this event received widespread media attention and public interest, the scientific community lacked direct observations of meltwater controls on ice sheet movement and meltwater geochemistry for such a large-scale melting event. Matt Charette, Senior Scientist of Marine Chemistry and Geochemistry at Woods Hole Oceanographic Institute (WHOI), secured funding through NSF's Rapid Response Research (RAPID) (http://www.nsf.gov/pubs/2009/nsf09034/nsf09034.jsp) program to quantify, under a short time-frame, the impact of this large-scale melting event on the ice sheet dynamics and meltwater biogeochemistry of the Leverett Glacier, a large land-terminating ice stream along the southwestern coast of Greenland.

The project included analysis and synthesis of GrIS dynamics and of samples collected during previous field seasons (2011-12) from the Leverett Glacier catchment. One objective was to help interpret changes driven by the historic melt event of 8-12 July 2012. In addition, Charette and PhD student Ben Linhoff collected a high-resolution time series of radon concentrations in meltwater during the course of the melting season.

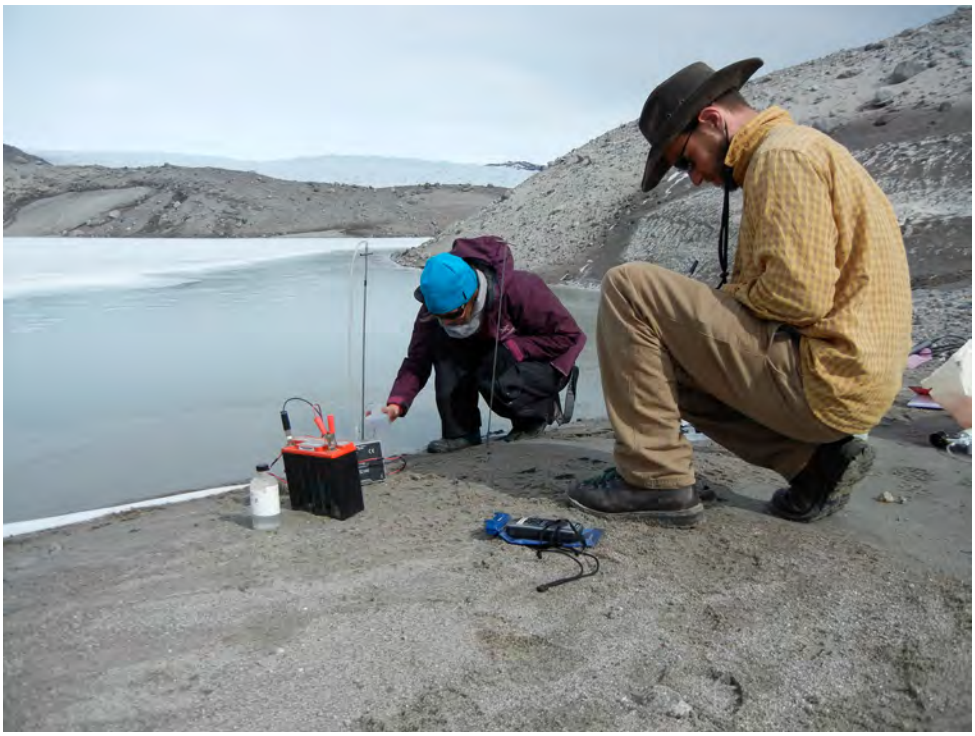

Figure 1. Ben Linhoff (right) and Jemma Wadham collecting groundwater samples for later chemical analysis at the terminus of the Leverett Glacier. Photo courtesy of Matt Charette, WHOI.

Radon is produced from the radioactive decay of naturally occurring uranium in sediments and rocks. Surface snow and ice are assumed to be devoid of radon due to lack of sediment on the ice sheet surface

from which it could be derived; consequently it is assumed that all radon in glacial meltwater must be derived from contact with terrestrial material beneath the ice, a process analogous to recharge of groundwater aquifers via precipitation. Based on these assumptions, Charette and Linhoff hypothesized that radon concentrations in glacial meltwater would be elevated during periods when water was under pressure at the bed (high glacier velocity) and that radon would be low during periods of low pressure (low glacier velocity).

Preliminary Results

Preliminary results based on radon measured in the Leverett proglacial river suggest that meltwater contains a mix of high radon sourced from subglacial groundwater and low radon from water transported quickly through channels at the ice bed interface. The former was enriched during the early season, April and May, when the drainage network beneath the ice was poorly developed. As the melting season progressed during June and July, a series of large, radon-rich meltwater outbursts presumably led to an efficient channelized drainage network that persisted through the remainder of the summer as evidenced by relatively low river radon concentrations.

Figure 2. Late season meltwater discharge from the Leverett Glacier. The river's brown color comes from a high load of suspended sediments. Photo courtesy of Ben Linhoff.

In addition to the contrast between early and late season subglacial meltwater dynamics, interannual variability was of interest given possible enhanced ice sheet melting associated with climate change. The WHOI team was in Greenland when the major melting event took place: between 8-12 July 2012. During this event, the size of the Leverett River swelled to four times the size of the peak flow observed during 2011. Despite this intense warming event, annually averaged Leverett Glacier sliding rates were not appreciably different between the two years as reported by Charette and Linhoff's colleagues at the University of Edinburgh (Tedstone et al. 2013).

These findings have important implications for the effects of surface melt-induced acceleration of land terminating glaciers. There may also be consequences of enhanced melting on trace element and isotope fluxes to the ocean;

analyses of discrete samples collected for this purpose from the Leverett River are currently underway in the team's laboratory. These sample collections and analyses would not have been possible without support from NSF through its RAPID program–encouraged by Polar Program managers contacted by Charette soon after the extreme melting took place in July 2012.

Further details on the 2012 expedition are available in a Scientific American blog written by Linhoff entitled "Following the Ice" (http://blogs.scientificamerican.com/expeditions/tag/following-the-ice/). A video profile (http://www.chrislinder.com/multimedia_greenland_80days.html) and short video on the 2012 extreme melting event (https://www.youtube.com/watch?v=AO24NMkr-rw) are also available.

This project was funded by the Woods Hole Oceanographic Institution's Arctic Research Initiative (http://www.whoi.edu/page.do?pid=97670) and Ocean Ventures Fund as well as the National Science Foundation's Office of Polar Programs.

For further information, contact Matthew Charette (mcharette@whoi.edu).

Figure 3. Early season (May) view inside the meltwater portal at the terminus of the Leverett Glacier prior to the onset of extreme melting later in the summer. The Leverett River originates with meltwater that exits this tunnel. Photo courtesy of Matt Charette, WHOI.

References

Tedstone et al. 2013. Greenland ice sheet motion insensitive to exceptional meltwater forcing. Proceedings of the National Academy of Sciences of the United States of America. Vol. 110, No. 49. http://www.pnas.org/content/110/49/19719.

Matt Charette is a Senior Scientist in the Department of Marine Chemistry and Geochemistry at the Woods Hole Oceanographic Institution. In addition to his recent work in Greenland, he is also interested in chemical fluxes to the ocean associated with submarine groundwater discharge. More information can be found on his lab website (http://www.whoi.edu/groundwater).

Ben Linhoff is a PhD student in the Massachusetts Institute of Technology/Woods Hole Oceanographic Institute (MIT/WHOI) Joint Program in Oceanography (http://mit.whoi.edu/).

Matt Charette (left) and Ben Linhoff (right) atop the snout of the Leverett Glacier in May 2011. Photo courtesy of Jemma Wadham, University of Bristol.

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International Congress of Arctic Social Sciences Hits New Milestones

By: Andrey N. Petrov, IASSA Council Member and Director of the Arctic Social and Environmental Systems Research Laboratory at the University of Northern Iowa

The eighth International Congress of Arctic Social Sciences (ICASS VIII) (http://resweb.res.unbc.ca/icass2014/) was held 22-26 May 2014 on the main campus of the University of Northern British Columbia (UNBC) in Prince George, B.C., which is traditional territory of the Lheidli T'enneh in Canada. The International Arctic Social Sciences Association (IASSA) (http://www.iassa.org/) organizes this international congress every three years, bringing together scholars and others interested in the Arctic and sub-Arctic to share social science and humanities research. ICASS VIII was the largest congress in the history of the organization, attracting almost 500 participants from 26 different countries and at least 15 indigenous nations. The five-day event featured keynote speakers, plenary sessions, cultural activities, and over 100 thematic sessions covering the social sciences, humanities, and multi-disciplinary and interdisciplinary topics.

The focus of ICASS VIII was Northern Sustainabilities. Use of the plural 'Sustainabilities' was inspired by Helena Omma, of the Sami Council, who noted the very diverse interpretations and understandings of the concept during discussions at an Arctic Council Sustainable Development Working Group meeting in 2012. Congress organizers also wanted to underscore different facets of sustainability, such as ecological, cultural, social, economic, and political. The theme of 'sustainabilities' was addressed in the talks of the four keynote speakers: Joe Linklater, Gwichin Council International, Canada; Henriette Rasmussen, Greenlandic Broadcasting, Greenland; Sverker Sorlin, Royal Institute of Technology, Sweden; and Alexander Pelyasov, Centre for Arctic and Northern Economies, Russia.

During the three plenary discussion-panel sessions, researchers and Arctic community members examined a wide range of sustainability issues: definitions of sustainable development, the role of resources as sustainable development tools, and community-based sustainability initiatives at the local level. Conference attendees also participated in an International Conference on Arctic Research Planning III (ICARP-III) (http://icarp.iasc.info/) town hall event sponsored by the International Arctic Science Committee to further develop ideas on the future of social sciences and humanities in Arctic research for the upcoming ICARP decennial meeting in Toyama, Japan in 2015. The social program of the Congress included music performances, a feature film, a gala dinner, and various local tours.

For a moment, Prince George, B.C., became the headquarters of Arctic social sciences. The Congress's location on UNBC campus provided a picturesque and comfortable environment for both scholarly work and social interactions.

Surrounded by the sea of spruce trees, it was a unique setting for 'seeing the forest behind the trees' on various issues in the Arctic social sciences—a rapidly growing interdisciplinary field of study. The Congress was of optimal size to allow participants and presenters to make personal connections. Kudos to co-conveners, Gail Fondahl and Gary Wilson, and to IASSA/ICASS Secretary Cherylyn Mazo on the success of ICASS VIII, its flawless organization, academic rigor, and comfortable atmosphere.

IASSA also bestowed awards on distinguished Arctic social sciences and humanities scholars: Julie Cruikshank, Canada; Igor Krupnik, U.S.; and Oran Young, U.S. Each, in their own way, made outstanding contributions to the development of social science in the Arctic/sub-Arctic.

The IASSA General Assembly, held during ICASS, elected a new Council and location for the next secretariat at Umeå University, Sweden. The newly elected Council includes Alona Yefimenko, Andrey Petrov, Diane Hirshberg, Florian Stammler, Gertrude Eilmsteiner-Saxinger, Grete Hovelsrud, Peter Sköld, Tatiana Vlasova, and Gail Fondahl, IASSA past president and ex-officio member. The Council then appointed Peter Sköld as its next president. New bylaws were passed which in the future will have the General Assembly electing the president directly.

Susan Crate, Professor at George Mason University, poses a question to members of the discussion panel entitled, 'Arctic Futures, Sustainabilities and Strategic Environmental Research.' Photo courtesy of Alona Yefimenko.

More information about ICASS VIII is available here (http://resweb.res.unbc.ca/icass2014/) or by contacting Andrey Petrov (andrey.petrov@uni.edu).

Andrey N. Petrov is Assistant Professor of Geography and Director of the Arctic Social and Environmental Systems Research Laboratory (ARCSES) at the University of Northern Iowa in Cedar Falls, Iowa. He is a member of the IASSA Council and a U.S. representative on the International Arctic Science Committee's Social and Human Sciences Working Group. Andrey's research is mostly related to economic geography, socio-economic impact assessment, human well-being monitoring, and sustainable development in the Arctic.

Extensive Plan of Activities for the Arctic-FROST Research Network

By: Andrey N. Petrov, Assistant Professor of Geography and Director, ARCSES Laboratory, University of Northern Iowa

The National Science Foundation (NSF) recently awarded a five-year Research Coordination Network (RNC) Science, Engineering, and Education for Sustainability (SEES) grant to the University of Northern Iowa (UNI) for support of the project entitled "RCN-SEES Arctic-FROST: Arctic FRontiers Of SusTainability: Resources, Societies, Environments, and Development in the Changing North." Under the direction of Dr. Andrey Petrov, Arctic-FROST is based at the UNI Arctic Social and Environmental Systems Research (ARCSES) center.

Arctic-FROST is an international, interdisciplinary, and collaborative network of environmental and social scientists, local educators, and community members from all circumpolar countries. Its primary purpose is to enable and mobilize research on sustainable Arctic development. The network aims to support improved health, human development, and well being of Arctic communities while conserving ecosystem structures, functions, and resources. The intellectual goal of the project is to contribute to conceptual, applied, and educational aspects of Arctic sustainability science by supporting the dissemination of knowledge and exchange of methodologies across the four Arctic-FROST themes: sustainable regions, economies, cultures, and environments.

Membership in Arctic-FROST is open to anyone with interests in sustainability and sustainable development in the Arctic. Since its inception in September 2013, the network has attracted approximately 180 members from the pan-Arctic region with 55% from the U.S., 31% from Europe and Russia, and 14% from Canada. Alongside seasoned academics and community members almost half of the RCN members are early career scholars or graduate students. The network also involves Indigenous scholars and members of underrepresented groups.

The network has an extensive plan of activities for 2014-2018 consisting of annual meetings, early career scholar workshops, community workshops, the first Arctic Sustainability Education Forum in 2018, and multiple smaller theme-based conferences throughout each year. First-year events include the inaugural Arctic-FROST meeting, which was held in late 2013 at the University of Northern Iowa; coordination and sponsorship of side meetings on different aspects of sustainability at the April Association of American Geographers meeting in Tampa, Florida; convening of sessions, a plenary panel, and a networking event at the International Congress of Arctic Social Sciences in Prince George, British Columbia, Canada in late May; and plans to reach out to the Russian audience by co-sponsoring Arctic-related activities at the European Regional Sciences Association in St. Petersburg, Russia in August. The first annual

meeting and early career scholars workshop entitled "Sustainability and Sustainable Development in the Arctic: Meanings and Means" will take place in Anchorage, Alaska in September of 2014. Future meetings will take place in various locations across the Arctic. Community workshops will be organized in Alaska and northern Russia.

Arctic-FROST members are committed to delivering a number of key products, including two edited volumes devoted to sustainable development in the Arctic, a textbook on Arctic sustainability, other educational materials, academic publications, and a research plan for Arctic sustainability science for the next decade. The initial version of this plan will be presented at the Third International Conference on Arctic Research Planning (ICARP III) in 2015.

Arctic-FROST actively collaborates with other research networks and organizations, including Resources and Sustainable Development in the Arctic (ReSDA), Research Coordination Network in Arctic Urban Sustainability, International Arctic Science Committee (IASC), International Arctic Social Sciences Association (IASSA), Association of Polar Early Career Scientists (APECS), and others.

Information on how to become an Arctic-FROST member is available at www.uni.edu/arctic/frost (http://www.uni.edu/arctic/frost).

For more information about Arctic-FROST, contact Andrey Petrov (andrey.petrov@uni.edu).

Andrey N. Petrov

Andrey N. Petrov is Assistant Professor of Geography and Director of the Arctic Social and Environmental Systems Research Laboratory (ARCSES) at the University of Northern Iowa in Cedar Falls, Iowa. He is a member of the IASSA Council and a U.S. representative on the International Arctic Science Committee's Social and Human Sciences Working Group. Andrey's research is mostly related to economic geography, socio-economic impact assessment, human well-being monitoring, and sustainable development in the Arctic.

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NSF Logistics Workshop Prepublication Report Available

In October 2013, the NSF Arctic Research Support and Logistics (RSL) program funded a workshop on strategies and recommendations for Arctic research support and logistics. A pre-publication draft of the workshop report is now available online (http://www.arcus.org/logistics/2013-workshop/report). The final publication will be released by the end of June and announced via ArcticInfo (http://www.arcus.org/arctic-info) and other information channels.

The 2013 Workshop on Future Directions for Arctic Research Logistics (see *Witness the Arctic - Fall 2013* (http://www.arcus.org/witness-the-arctic/2013/3/article/20195)) was organized by ARCUS, with guidance from an Organizing Committee whose membership is listed at right. The workshop was structured as a working meeting, and its topics and agenda were developed using relevant reports and a survey circulated to the Arctic community in July 2013. Those reports—the 1997 and 2003 Logistics Reports and the 2011 CRREL Analysis of Logistics Recommendations—and other background information are available on the workshop website (http://www.arcus.org/logistics/2013-workshop).

The report summarizes workshop discussions and highlights organized sets of specific, actionable recommendations. It was deliberately kept to a moderate length in order to make the material more easily accessible. The contents are broken down into three major sections: (1) Sustaining and Expanding Logistics Resources, (2) Capacity Building, and (3) Opportunities for Improved Coordination of Resources.

For more information, see the 2013 Logistics Workshop webpage (http://www.arcus.org/logistics/2013-workshop) or contact Kristina Creek at ARCUS (creek@arcus.org).

Workshop Organizing Committee Members

Peter Griffith, NASA Goddard Space Flight Center, NASA Carbon Cycle & Ecosystems Office

James Morison, Polar Science Center, Applied Physics Laboratory-University of Washington

Steven Oberbauer, Department of Biological Sciences, Florida International University

Sophia Perdikaris, Anthropology and Archaeology, The City University of New York

Jackie Richter-Menge, Cold Regions Research and Engineering Laboratory

Matthew Shupe, University of Colorado and NOAA Earth System Research Laboratory

Craig Tweedie, University of Texas at El Paso

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NSF Recommends Fourth Year of Funding for ACADIS

By: ACADIS Community Support Team members Karen Andersen, Toni Rosati, Lynn Yarmey, Lisa Booker, Don Stott, Janet Scannell, Eric Nienhouse, and Sean Arms

ACADIS

The Advanced Cooperative Arctic Data and Information Service (ACADIS) (http://nsidc.org/acadis/) project, funded by the National Science Foundation (NSF), recently completed an NSF panel review of third year accomplishments and progress. ACADIS has been recommended for a fourth year of funding.

ACADIS provides sustainable data management, preservation, and leadership services for the NSF Arctic research community through open data sharing, adherence to best practices and standards, and community support and engagement. ACADIS leverages other pertinent projects, capitalizes on appropriate emerging technologies, and participates in emerging cyberinfrastructure initiatives. Accessible tools and data are available on the ACADIS Gateway (http://www.aoncadis.org/).

The ACADIS team continues to support data management for projects funded by NSF's Division of Polar Programs (PLR) Arctic Sciences Section with data submission, preservation, and sharing services. Recent ACADIS service improvements include:

- Data Citations - Data citations are recognized research 'products' to be included in the biographical sketch section of NSF proposals. They are increasingly encouraged in paper references and enable tracking the reuse and broader impact of dataset(s) directly related to project proposals. ACADIS has implemented a Digital Object Identifier (DOI) system for persistent identification, managing intellectual content, and dataset citation tracking. Contact ACADIS to request a data citation.
- The Arctic Data Explorer (ADE) has increased scope to include over 16,000 Arctic datasets in its search. The ADE, a service of ACADIS, enables users to search for interdisciplinary data across multiple repositories, including:
    - The ACADIS Gateway (https://www.aoncadis.org/home.htm)
    - National Snow and Ice Data Center (NSIDC) (http://nsidc.org/)
    - The Earth Observing Laboratory (EOL) (https://www.eol.ucar.edu/) at the National Center for Atmospheric Research (NCAR) (http://ncar.ucar.edu/)
    - NCAR Research Data Archive (http://www2.ucar.edu/research-resources/data-archive-services)
    - NASA's Earth Observing System Clearing House (ECHO) (https://earthdata.nasa.gov/echo)

- The National Oceanographic Data Center (NODC) (http://www.nodc.noaa.gov/)
- Norwegian Meteorological Institute (http://met.no/English/)
- International Council for the Exploration of the Sea (ICES) (http://www.ices.dk/Pages/default.aspx)

Examples of available archived Arctic data can be found on the ADE website (http://www.nsidc.org/acadis/search).

Initial clean up of ACADIS metadata has been completed. Researchers contributing data to ACADIS are encouraged to check the accuracy of their project online via the ACADIS Gateway.

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; to send feedback; or to submit, retrieve and search data; please visit the ACADIS Gateway (http://www.aoncadis.org/), contact members of the support team (support@aoncadis.org), or call 720-443-1409.

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Influences of Arctic Climate Changes on Weather Patterns in the Mid-latitudes

By: John Walsh, President's Professor of Global Change and Chief Scientist at the International Arctic Research Center, University of Alaska Fairbanks

Several decades ago, the Arctic was an afterthought in climate change research. Today it is at the forefront. The recent acceleration of research on Arctic climate, together with widespread coverage by the media and interest by the public, has come in response to rapid changes in the Arctic over the past few decades. By some measures, these changes are unprecedented. While the changes are driven by warming of the ocean and atmosphere, they are manifested in sea ice, glaciers, ice sheets, permafrost, and other components of the Arctic system. The Arctic changes are even more intriguing because they are expected to play, and may already be playing, a role in further changes that impact middle latitudes and the rest of the globe. For the first time, the U.S. National Climate Assessment (NCA2014) (http://nca2014.globalchange.gov/report/our-changing-climate/melting-ice) has called attention to the Arctic's possible role in variations of the jet stream (now referred to as the "polar vortex") and associated extremes of weather over the contiguous United States. As evidence of the increased public awareness of this topic, Hamilton and Lemcke-Stampone (2013) have recently reported results showing that a clear majority (60%) of surveyed members of the public now accepts that there is a connection between Arctic warming and mid-latitude weather. President Obama's Science and Technology Advisor, John Holdren, invoked the Arctic as a player in the past winter's severe cold and snow over much of the central and eastern United States (https://www.youtube.com/watch?v=GLEccFhNanU). Is such acceptance of the Arctic connection justified?

The present state of the science provides mixed answers to such questions about Arctic-mid-latitude linkages. On the one hand, there is indisputable evidence that the Arctic has warmed over the past several decades at more than double the global rate of warming, and Arctic sea ice coverage has declined precipitously, especially in the past decade. The warming of the Arctic atmosphere (relative to the mid-latitude atmosphere) has led to changes in the configuration of upper-air pressures in the Arctic, as shown by Overland and Wang (2010) and others. Upper-air pressures drive the winds in the atmosphere, and the jet stream (polar vortex) is a prominent feature of the upper air winds. But are the regional changes in Arctic upper-air pressures linked to the extremes of weather in middle latitudes? Here is where we encounter the scientific debate. In a landmark paper on this topic, Francis and Vavrus (2012) presented results supporting the argument that Arctic warming favors increased waviness of the jet stream and that the larger-amplitude waves move more slowly. "Waviness" in the jet stream can refer to either the north-south extent of the waves or to the ratio of the north-south (meridional) wind to the west-to-east (zonal) wind. The larger this ratio becomes, the more

prominent the waves or the greater the "waviness." The slower movement of the larger amplitude waves would favor periods of extreme cold or extreme warmth, depending on whether a particular location is under a southward dip (trough) or a northward bulge (ridge) in the jet stream. (See Figure 1 (http://www.giss.nasa.gov/research/news/20120313/629341main_Earth_jet_stream.jpg) However, subsequent studies by Elizabeth Barnes (2013), James Screen and Ian Simmonds (2013) have found that this conclusion is very sensitive to the metrics of atmospheric "waviness," so the robustness of the linkage to mid-latitude weather is open to question. Part of the problem is that there is no widely accepted measure of atmospheric "blocking," in which atmospheric circulation features become locked in place. However, even when alternative definitions of blocking are used, trends in blocking are elusive to detection (Barnes et al., 2014). "Blocking," as used by Barnes and collaborators, involves the number of persistent reversals of atmospheric (mid-tropospheric) pressure, either for a particular longitude or over a band between two prescribed latitudes. An additional obstacle to firm conclusions about the Arctic's impacts on mid-latitudes is the absence of a known dynamical mechanism linking Arctic warming to mid-latitude circulation anomalies. As example, Arctic warming is strongest in September-November and the extreme weather over the contiguous United States (and Eurasia, as well) has occurred primarily in January and February. Finally, the "new regime" of a largely seasonal sea ice cover has only been prominent since 2007, and a seven-year period may be simply too short for the detection of a robust statistical signal. The latter problem is compounded by the large natural variability that characterizes the atmospheric circulation, especially in the winter season.

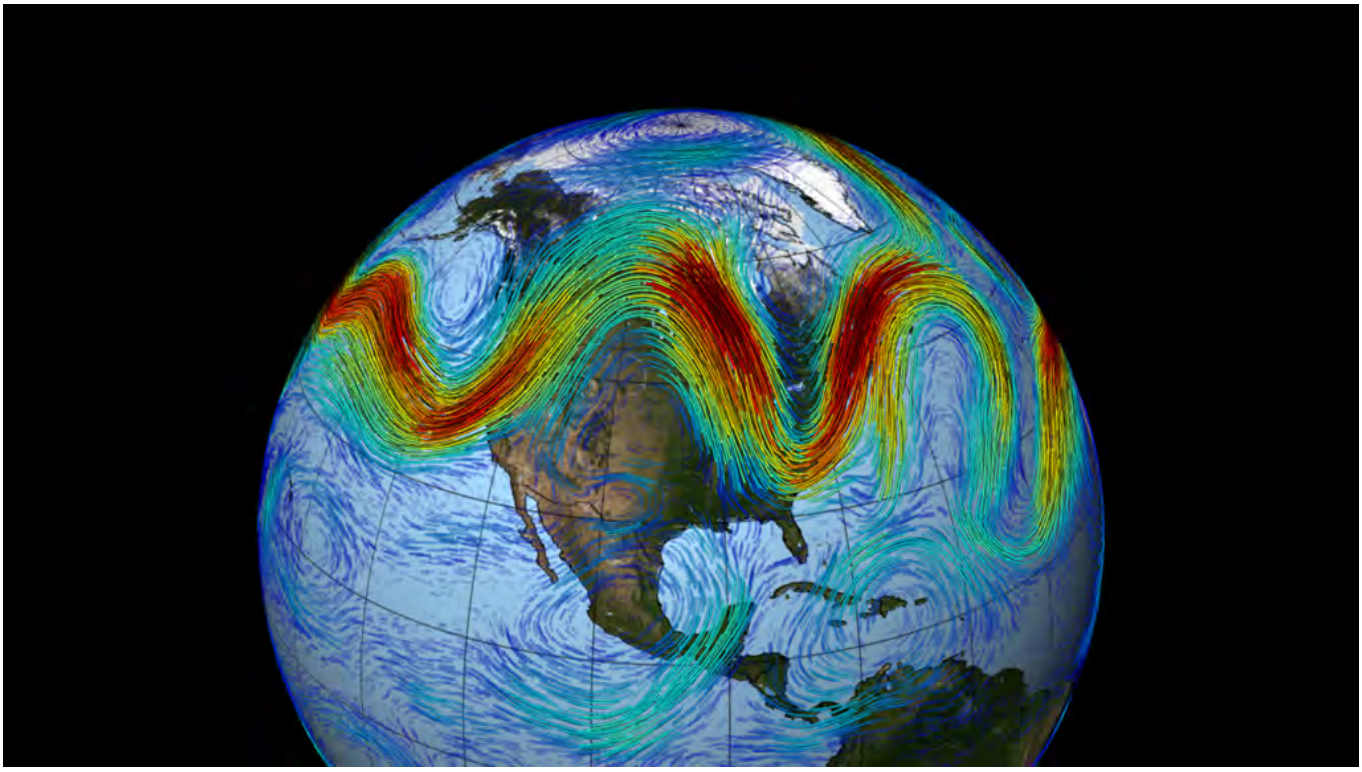

Figure 1. Schematic depiction of the jet stream, with troughs (southward excursions above cold air at the surface) and ridges (northward excursions above warm air at the surface) that amplify in regimes of atmospheric "blocking". The pattern of waves normally progresses from west to east, but becomes nearly stationary in instances of blocking. Image courtesy of NASA.

The notion of mid-latitude weather and climate impacts arising from the changing Arctic is appealing to the Arctic research community, but it essential that we "get the science right" before the Arctic/mid-latitude connection can be widely accepted and used in applications such as seasonal forecasting. The need for further scientific research on this topic has been recognized in recent "Arctic linkages" workshops held by the National Research Council (NRC) (http://www.nap.edu/catalog.php?record_id=18727) in 2014 and the National Oceanic and Atmospheric Administration (NOAA) (http://www.esrl.noaa.gov/psd/events/2014/arctic-predictions-science/). What is now clear is that this high-visibility topic has created exciting opportunities for scientific research and new challenges in communication with the public and the media.

For further information, contact John Walsh (jwalsh@iarc.uaf.edu).

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John Walsh

John Walsh has been active in Arctic climate research for the past 40 years. He is presently a Research Professor at the University of Alaska Fairbanks, which he joined in 2001 after several decades at the University of Illinois. His particular interests are weather-climate linkages and the interactions among different components of the Arctic system.

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A Week as an Arctic Council Delegate in Arkhangelsk, Russia

By: Alexandra L. Giese, PhD Candidate in Earth Sciences at Dartmouth College

Alexandra L. Giese, U.S. student delegate to the 2014 Model Arctic Forum in Arkhangelsk, Russia. Photo courtesy of Alexandra L. Giese.

During the last week of February 2014, I had the privilege of representing the United States and Dartmouth College (http://dartmouth.edu/) at the 2014 Model Arctic Council (http://narfu.ru/en/projects/mac/), a role-playing program with the same goals as the better-known Model UN: to expose students to high-level policy negotiations through experience and participation. The Model Arctic Council was held at the Northern Arctic Federal University (NArFU) (http://narfu.ru/en/) in Arkhangelsk, Russia. Thirty graduate students from more than ten countries participated in simulated proceedings of the Arctic Council (http://www.arctic-council.org/index.php/en/), a high-level intergovernmental forum for promoting cooperation, coordination, and interaction among the Arctic States, with the involvement of Arctic indigenous communities, on common Arctic issues.

The four-day program (http://narfu.ru/en/projects/mac/) of the Model Arctic Council began with a day of lectures and round-table diplomacy discussions led by prominent government figures, including U.S. Embassy Public Affairs Officer Steven Labensky; Russian International Affairs Council Deputy Program Director Timur Makhmutov; and Lev Levit, senior researcher at the Arkhangelsk Scientific Centre of the Russian Academy of Sciences. Other lectures covered the history of the Arctic Council, international relations, and security strategies.

The following days involved simulations of the three types of meetings run by the Council: a biannual meeting for one of the six Working Groups (http://www.arctic-council.org/index.php/en/about-us/working-groups), which implement research and projects related to specific interests such as sustainable development; the biannual meeting of Senior Arctic Officials; and the biennial meeting of Arctic Ministers (http://www.arctic-council.org/index.php/en/events/meetings-overview/kiruna-ministerial-2013) (the Secretary of State represents the U.S. in this meeting). Each was a progressively higher-level meeting to which participants passed along information discussed and resolved at the lower-level meeting the previous day. The Arctic Council's Rules of Procedures were followed by student participants as they represented delegates from the eight Arctic Member States (http://www.arctic-council.org/index.php/en/about-

us/member-states), six Permanent Participants (http://www.arctic-council.org/index.php/en/about-us/permanent-participants) groups, four of the six Working Groups (http://www.arctic-council.org/index.php/en/about-us/working-groups), and three of the twelve non-Arctic Observers (http://www.arctic-council.org/index.php/en/about-us/arctic-council/observers) . Each role was assigned prior to the meeting, and students prepared written position papers as well as oral statements or presentations for the meetings.

In my role as chair of the Protection of the Arctic Marine Environment (PAME) (http://www.pame.is/) working group, I was responsible for ensuring that environmental management, pollution control, and ecosystem protection issues entered the conversations. Specifically, I updated Senior Arctic Officials on the progress of a new Arctic Marine Shipping Plan, a collaborative sustainable tourism initiative, and potential special designation of Arctic marine areas.

The Model Council's task and final product was the "Arkhangelsk Declaration." Emulating those produced every two years at the Arctic Council Ministerial Meetings, this document highlighted progress and outlines future goals we agreed upon by consensus. The declaration summarized our work creating and designing initiatives to revitalize indigenous language, facilitate international electronic sharing of historical archives and data, stimulate product development within the reindeer herding industry, and address the incidence of suicide in northern communities. Overall, the discussions were engaging, the negotiations successful, and the resulting plan both compelling and achievable.

The exercise was also characterized by some of the challenges the real Council faces: miscommunications resulting from varying levels of English proficiency, gridlock due to conflicting interests and opinions on financial obligations, and vastly different relevance of issues to each country or participant. At the end, I left with a far better understanding of the operating procedures and current priorities of the Arctic Council than I could have acquired through lectures or reading. More importantly, however, I departed Arkhangelsk with a profound, almost humbling, sense of optimism about the potential for even greater international collaboration and the commitment of my generation of students to ensuring a profitable, peaceful, and thoughtfully developed future for the Arctic region.

I was able to attend the Model Arctic Council thanks to the generosity of Dartmouth's Institute of Arctic Studies (http://dickey.dartmouth.edu/research/arctic-studies) at the Dickey Center for International Understanding and NArFu.

The Model Arctic Council program agenda is available as a pdf here (http://narfu.ru/upload/medialibrary/c1a/mac_program.pdf). More information about the Arctic Council, its membership, and working groups is available here (http://www.arctic-council.org/index.php/en/). Information about the Dartmouth IGERT program is available here (https://www.dartmouth.edu/~igert/). For more information, contact (Alexandra.L.Giese.GR@dartmouth.edu).

Alexandra Giese

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U.S. and Chile Initiate Antarctic Science Education Effort

By: Lynn Foshee Reed, Einstein Educator Fellow for NSF's Division of Polar Programs

The first Joint Antarctic School Expedition (JASE) (http://www.nsf.gov/news/news_summ.jsp?cntn_id=130090), a collaborative venture of the National Science Foundation's (NSF) Division of Polar Programs (http://www.nsf.gov/geo/plr/about.jsp) and the Chilean National Antarctic Institute (Instituto Antártico Chileno (INACH)) (http://www.inach.cl/?lang=en), brought high school students and teachers to Punta Arenas, Chile, in February 2014. This pilot program aimed to provide participants with hands-on experience with Antarctic environments and ecosystems research. For ten years INACH has sponsored a program for secondary school students aimed at promoting awareness and appreciation of Antarctica in young Chileans. INACH holds a national competition in which small student groups perform experimental or bibliographic research. Winning teams are awarded an expedition to the Chilean research station on King George Island, Antarctica. In 2013, INACH invited the United States to participate in the Antarctic School Expedition.

NSF's Division of Polar Programs accepted the invitation to participate and, working jointly with the Arctic Research Consortium of the United States (ARCUS) (http://www.arcus.org/), selected student participants from a pool of competitive applicants. They also selected Juan Botella, a science teacher from Monona Grove High School in Wisconsin. Juan is a PolarTREC (http://www.polartrec.com/) alumnus with Antarctic experience and speaks English and Spanish fluently. The three student participants—11th graders Anna Caldwell-Overdier and Luke Maillefe and 12th grader Claire Hacker—were from his school. Lynn Foshee Reed, Einstein Educator Fellow for the Division of Polar Programs, accompanied the U.S. group. Lynn has experience with international student science education projects through her work in 2012 and 2013 as co-lead in of the successful NSF funded Joint Science Education Project (JSEP) (http://www.arcus.org/jsep) in Greenland and will return to JSEP in summer of 2014.

The U.S. team joined eleven students and five teachers from Chile on 16 February 2014 in Punta Arenas, a gateway city to Antarctica and location of INACH headquarters. The five winning Chilean teams gave presentations about their own research as well as about their schools and regions of Chile. The U.S. team gave a presentation on IceCube (http://icecube.wisc.edu/), the NSF funded neutrino observatory at Amundsen-Scott South Pole station, a natural choice with Anna's experience as a student intern with the project at the University of Wisconsin (UW) Madison (http://www.wisc.edu/). Working with Dr. James Madsen, an IceCube collaborator, the U.S. team decided to explain some of the ideas behind neutrino detection through a hands-on activity using cosmic rays as an analogy. Students from both countries practiced communicating in both English and Spanish.

Claire noted, "One of the most memorable experiences from my time in Punta Arenas is the afternoon we spent at the INACH microbiology laboratory. After a short tour we divided into groups to learn about different ways to detect specific proteins called cryoproteins, which are responsible for keeping some Antarctic plants from freezing. Because I knew very little about this subject, and because I was learning about the new procedures in Spanish, my experience in the lab was both exciting and challenging. Our work involved concepts that I would have had many questions about in English; so grasping them in Spanish was a struggle. Fortunately, Reynalda, a student in our group from Santiago and passionate about science, was willing to explain anything to me in either language. Between Reynalda and others, I managed to get most of my questions answered and learned quite a bit about the lab processes we were using to detect the proteins. I hope some of the knowledge I gained finds its way into my future career."

After their presentation on the IceCube observatory, Claire Hacker and Anna Caldwell-Overdier demonstrate cosmic-ray detector equipment to a couple of the Chilean students. Photo courtesy of Lynn Foshee Reed.

After the initial seminars and presentations in Punta Arena, the plans for this JASE program were to move to King George Island where students would stay at the INACH Escudero station (https://www.comnap.aq/members/inach/SitePages/Home.aspx), have opportunity to work with Antarctic scientists in the field, and learn about subjects ranging from glaciology to ecology. Unfortunately, due to an outbreak of gastrointestinal illness affecting about 30% of the group the Antarctic expedition was not completed as planned. INACH made the difficult decision to cancel the trip to avoid the potential of carrying the "bug" to the Antarctic stations. Although disappointed, all the teachers and students understood and supported the decision.

Juan Botella wrote: "We were all looking forward to doing research in Antarctica. I wanted to learn more about the research techniques that Dr. Mauricio Rondanelli from Universidad de Concepción (http://www.udec.cl/pexternoe/) uses for identifying pollen that arrives from South America to King George Island. This study might become even more important as climate change modifies the environmental conditions of the islands to the point that new plant species are

able to establish there. Other plans were to collect the vascular plants that grow in King George Island and later isolate and identify the proteins that protect them from the cold—a laboratory experience that would have been led by Dr. Jorge Gallardo Cerda, from INACH. Nevertheless, I came out of this experience inspired to help my students engage in fairly complex scientific projects after seeing how Chilean teachers with fewer resources are able to guide their students. I was very impressed by the complexity of the Chilean student projects and their willingness to share their work."

The Chilean students will go to Escudero station later in the year, perhaps at the winter holidays, but it is not clear if the U.S. team will be able to return. Therefore, INACH helped arrange alternate natural science experiences for the U.S. group including a trip to Torres del Paine National Park.

In Luke's words, "At the centerpiece of the park are three massive granite towers jutting up from the ground at impossible angles. It was amazing to learn how millions of years ago sedimentary layers of the earth accumulated and solidified and after years and years of glacial erosion only the resilient granite peaks remained. Another day we took a two-hour boat ride to Isla Magdalena. The island is home to some 3,000 pairs of Magellanic penguins. To see penguins burrowing, swimming, and waddling in their natural habitat was amazing."

Megellanic penguin on Isla Magdelena. Photo courtesy of Luke Maillefer.

The Torres del Paine National Park. Photo courtesy of Luke Maillefer.

After leaving Punta Arenas the U.S. team traveled to Santiago, Chile , which Anna described: "We visited an eighth-grade science class at Nido de Aguilas International School in Santiago as well as the U.S. embassy. Our group presentation was well received by both audiences; the embassy staff held an additional dialogue with us and shared information about their specific roles in the embassy and how science relates to what they do. We described our experiences working with researchers at UW-Madison with the IceCube Neutrino Observatory and with the Chilean science fair winners in Punta Arenas."

ASE members pose during a walking tour of Punta Arenas. (L-R, standing) Roxana Nahuelcura Lobos, Romina Andrea Quiroga Sanzana, Reynalda de Jesus Zarate Avila, Luke Maillefer, Anna Caldwell-Overdier, Claire Hacker, Estrella Constanza Calderon Almonacid, Catalina Dominique Sanhueza Monsalves, Felipe Kabir pino Novoa; (kneeling) Lynn Foshee Reed, Constanza Villaseñor Parada. Photo courtesy of Lynn Foshee Reed.

The JASE team kept an online journal (in both English and Spanish) where they related their experiences and shared photographs. The journals and the webinar that the team held on 25 February are available on the PolarTREC website (http://www.arcus.org/www.polartrec.com/expeditions/joint-antarctic-school-expedition-2014).

For more information about the 2014 JASE program, see the NSF press release (http://www.nsf.gov/news/news_summ.jsp?cntn_id=130090) or contact Lynn Foshee Reed (lreed@nsf.gov).

Córdova Sworn in as 14th Director of NSF

France A. Córdova was sworn in as the 14th director of the National Science Foundation (NSF) on 31 March 2014. President Obama nominated her to the six-year term in August 2013 and the U.S. Senate confirmed her nomination on 12 March 2014. She succeeds Subra Suresh, who stepped down in March 2013. Cora B. Marrett was acting director at NSF during the interim.

Córdova is president emerita of Purdue University, where she served from 2007 to 2012. From 2002 to 2007, she led the University of California at Riverside as chancellor and was a distinguished professor of physics and astronomy. Previously, Córdova was the vice chancellor for research and a professor of physics at the University of California at Santa Barbara from 1996 to 2002, and head of the astronomy and astrophysics department at the University of Pennsylvania from 1989 to 1993. She was NASA's chief scientist from 1993 to 1996 and on staff at Los Alamos National Laboratory from 1979 to 1989, the last two years as deputy group leader in the Earth and Space Science Division.

NSF Director France A. Córdova. Photo courtesy of NSF/Sandy Schaeffer.

Most recently, Córdova served as chair of the Board of Regents of the Smithsonian Institution and as a member of the National Science Board, where she chaired the Committee on Strategy and Budget. She received a Bachelor of Arts degree from Stanford University and a PhD from the California Institute of Technology.

Córdova met with the NSF Advisory Committee for the Geosciences during the spring meeting held 3-4 April 2014. According to a recent report in EOS , Advisory Committee members addressed several issues including concerns regarding the progress of the reintegration of the Polar Program into the Directorate of Geosciences (GEO). A specific concern mentioned was the quick succession in NSF leadership since the merger of Polar Programs with GEO and related uncertainty about how that may affect the polar research community. Director Córdova stated that the agency would take a close look at the merger to ensure it is the right approach. She noted that NSF has to be prepared to meet the broader concerns related to stewardship in the polar regions, that the hope is incorporating polar programs in GEO will benefit those programs, and that the agency will be flexible should it be necessary to go a different direction.

NSF's annual budget is about $7.2 billion. The agency's budget request for FY15 is $7.3 billion, an increase of 1 % over the 2014 enacted level. NSF's annual budget represents 24% of the total federal budget for basic research conducted at U.S. colleges and universities, and this share increases to 60% when medical research supported by the

National Institutes of Health is excluded. In many fields, NSF is the primary source of federal academic support.

For further information, and to read source material for this article, please see: https://www.nsf.gov/news/news_summ.jsp?cntn_id=130931 and http://cen.acs.org/articles/91/i31/Astrophysicist-Tapped-New-NSF-Directo....

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Committee of Visitors Offers Recommendations to NSF's Arctic Sciences Section

According to NSF policy, each program that awards grants and cooperative agreements must be reviewed once every three years by a Committee of Visitors (COV) comprised of qualified external experts. The Committee reviews program portfolio activities and assesses the quality and integrity of the review process and program management related to proposal funding decisions as well as providing comments on how the results of funded research contribute to the advancement of NSF's mission and goals. Directorate advisory committees select members of each COV. Programs in the Directorate for Geosciences were reviewed in 2013.

Arctic Science Section programs were reviewed 16-17 September 2013 by a COV which included Chair Douglas MacAyeal, University of Chicago and members Paul Bierman, University of Vermont; John Farrell, U.S. Arctic Research Commission; Janet Intrieri, NOAA Earth System Research Laboratory; Martha McConnell, International Union for Conservation of Nature (IUCN); Liesel Ritchie, University of Colorado Boulder; and Rebecca Woodgate, University of Washington. They reviewed 120 proposal decisions during the review period to evaluate the quality and effectiveness of the merit review process, the selection process of the reviewers, and program management and responsiveness to recommendations from previous COVs. They also reviewed program management for the Arctic System Science, Arctic Observing Network, and Arctic Research Support & Logistics programs.

The FY 2014 COV report on the Arctic Sciences Section includes several recommendations in response to specific questions. To download the full report, go to: http://www.nsf.gov/geo/adgeo/advcomm/fy2013_cov/geo-plr-arctic-cov-2013.pdf.

The formal response to these recommendations from NSF is available to download at: http://www.nsf.gov/geo/adgeo/advcomm/fy2013_cov/geo-plr-arctic-cov-respo....

For further information about the COV and to read recommendations from previous years, please go to: https://www.nsf.gov/od/iia/activities/cov/covs.jsp.

Reflections on Arctic Research Coordination

By: Brendan P. Kelly, currently Executive Director of the IARPC and Assistant Director for Polar Science in the White House Office of Science and Technology Policy

My friend and colleague John Farrell, Executive Director of the Arctic Research Commission (http://www.arctic.gov/), recently surfaced a publication from a couple of decades back by a former Chair of that Commission. John noted that many of the same issues we are tackling now in Arctic research were current back then. On the other hand, I would argue that our understanding of many of the topics has advanced tremendously in the past couple of decades, because there are a lot of very talented people working hard on those issues. ARCUS (http://www.arcus.org/), the Study of Environmental Arctic Change (http://www.arcus.org/search-program), the Arctic Research Commission, and other organizations have become more and more adept at promoting and coordinating the efforts of a creative and hard-working research community.

A favorite field assistant accompanies Brendan P. Kelly, whose research career has spanned three decades and included studies of Arctic marine mammals, their sea ice environment, and the cultural significance of the ecosystem to indigenous communities. Photo courtesy: Melanie Duchin.

What has changed even more, I think, is the degree of communication between disciplines and the emphasis on integrating traditional knowledge and science. To be clear, we are far from proficient at that integration, but its importance is more consistently appreciated even as we struggle to make it a reality.

Within the Federal government, there have been substantial advances in coordination of research and other issues in the Arctic. The Interagency Arctic Research Policy Committee (IARPC) (http://www.arcus.org/iarpc-research-collaborations) was given a great boost when the President's science advisor made it a subcommittee in the National Science and Technology Council (http://www.whitehouse.gov/administration/eop/ostp/nstc) and when the National Science Foundation increased staffing support for the committee. With that boost, IARPC produced the Arctic

Research Plan: FY2013 – 2017 (http://www.nsf.gov/geo/plr/arctic/iarpc/arc_res_plan_index.jsp) and stood up 12 teams to implement the plan. Thanks to cat herder par excellence, Sara Bowden (serving as IARPC's Executive Secretary); Sandy Starkweather; and dedicated team leaders, the teams are advancing the milestones spelled out in the research plan. There are somewhere on the order of 300 people (and growing) involved the effort, and I forever marvel at what Sara and Sandy keep moving.

Recently, we expanded the implementation teams to include non-Federal collaborators and have been convening meetings of these broader "collaboration teams (http://www.arcus.org/iarpc-research-collaborations/collaboration)." From time-to-time it is necessary, for reasons of fairness and legalities, to convene only the Federal implementation teams. For example, developing solicitations for Federal funding must not include people from outside of the Federal government. Most often, however, the teams convene to communicate and coordinate all of the talent (Federal or otherwise) working in their topic area, and for those we want to harness all of the available talent wherever it resides; hence, collaboration teams. We continue to seek involvement of researchers wanting to contribute to the combined efforts. The full list of teams can be seen online here (http://www.arcus.org/iarpc-research-collaborations). The website is soon to be enhanced to support the collaboration teams and communicate with wider audiences. Sara, Sandy, Helen Wiggins, and others on the ARCUS staff are doing excellent work to make the website a powerful tool.

Research planning is necessarily iterative, and IARPC is planning to update its research plan. To that end, IARPC agencies sponsored the recently released Polar Research Board study on emerging issues in the Arctic (The Arctic in the Anthropocene: Emerging Research Questions) (http://www.nap.edu/catalog.php?record_id=1872) . That excellent report will help bring the thinking of the greater research community in to IARPC planning.

All of which is to say, this is a good time to sneak out of my role as Assistant Director for Polar Science in the White House Office of Science and Technology Policy (OSTP). In that position, I have served as Executive Director of the IARPC and had the very great pleasure of seeing the Arctic research community make great strides not only in understanding the Arctic system but also in pulling together so that they realize the benefits of coordination.

I have used the analogy of harnessing dogs to sleds to describe what it takes to get scientists to coordinate their efforts (lest my colleagues not appreciate being likened to dogs, I hasten to point out that my best field companions were very smart Labrador retrievers, so I mean the analogy with the greatest respect). Tandem hitches—dogs harnessed closely to one another pulling in two parallel lines—are efficient in that they enforce pulling in one direction. Fan hitches, in contrast, have each dog on their own trace connected to the sled; the dogs are fanned out in front and pull only in the same general direction. The loss of efficiency in the fan hitch, however, tends to be compensated by the fact that the arrangement is more consistent with dog sociality. Dogs like to preserve some interpersonal distance. The independence of scientists, likewise, is preserved when they are not tied to a single direction. Forcing them along a single trajectory (as if anyone could!) would stifle important creativity. On the other hand, tough problems like many

of those faced in the Arctic are well served by groups pulling in the same general direction. The person on the back of the sled generally gets a terrific ride, although occasionally finds him or her self untangling some traces.

OSTP hopes to bring on a new Assistant Director for Polar Science soon, and in the meantime, Simon Stephenson, Section Head for Arctic Science at NSF (http://www.nsf.gov/geo/plr/arc/), will take on the role of Executive Director of IARPC. That is especially appropriate given that Simon has consistently provided the big-picture vision for IARPC. And, he is adept at fan hitches.

After June 20, 2014, I shall be at the address below and keen to aid the overall efforts in a new role.

Thanks for all of your patience and support.

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NOAA Launches Arctic Action Plan

The National Oceanic and Atmospheric Administration (NOAA) (http://www.noaa.gov/) launched its Arctic Action Plan (http://www.arctic.noaa.gov/NOAAarcticactionplan2014.pdf) in April 2014.

This plan provides an overview of NOAA's Arctic programs and describes how they implement NOAA's Arctic Vision and Strategy (http://www.arctic.noaa.gov/docs/NOAAArctic_V_S_2011.pdf) and the agency's roll in implementing the National Strategy for the Arctic Region (http://www.whitehouse.gov/blog/2013/05/10/national-strategy-arctic-region-announced).

NOAA's Arctic Action Plan

NOAA's Arctic Action Plan targets six strategic goals identified in the Arctic Vision and Strategy. These goals advance NOAA's agency priorities of advancing U.S. security interests, enhancing Arctic region stewardship, and strengthening international cooperation. The strategic goals are to:

1. Forecast sea ice.
2. Strengthen foundational science to understand and detect Arctic climate and ecosystem changes.
3. Improve weather and water forecasts and warnings.
4. Enhance international and national partnerships.
5. Improve stewardship and management of ocean and coastal resources in the Arctic.

6. Advance resilient and healthy Arctic communities and economies.

The plan describes linkages to other agency and interagency plans including the National Ocean Policy (http://www.boem.gov/National-Ocean-Policy/) and the Interagency Arctic Research Policy Committee (IARPC) Five-Year Research Plan (http://www.nsf.gov/geo/plr/arctic/iarpc/arc_res_plan_index.jsp). It also identifies specific actions that NOAA will take in the next two years to support Arctic-related missions and mandates and to further scientific understanding of the Arctic region, which includes the Arctic Ocean and the Beaufort, Bering, and Chukchi Seas as well as the terrestrial portions of northern and western Alaska.

For more information about the National Strategy for the Arctic Region, see: "White House Announces National Strategy for the Arctic Region" (http://www.arcus.org/witness-the-arctic/2013/2/article/19962) in *Witness the Arctic - Spring 2013*).

For more information about the NOAA Arctic Vision and Strategy, see: "NOAA Releases Final Arctic Vision and Strategy" (http://www.arcus.org/witness-the-arctic/2011/2/article/1659) in *Witness the Arctic - Spring 2011*.

NOAA's Arctic Action Plan is available here (http://www.arctic.noaa.gov/NOAAarcticactionplan2014.pdf). A fact sheet for the plan is available here (http://www.arctic.noaa.gov/NOAAarcticactionplanflyer2014.pdf).

For further information about the Arctic Action Plan and the source material for this article, see the NOAA announcement (http://www.arctic.noaa.gov/features/action-plan.html).

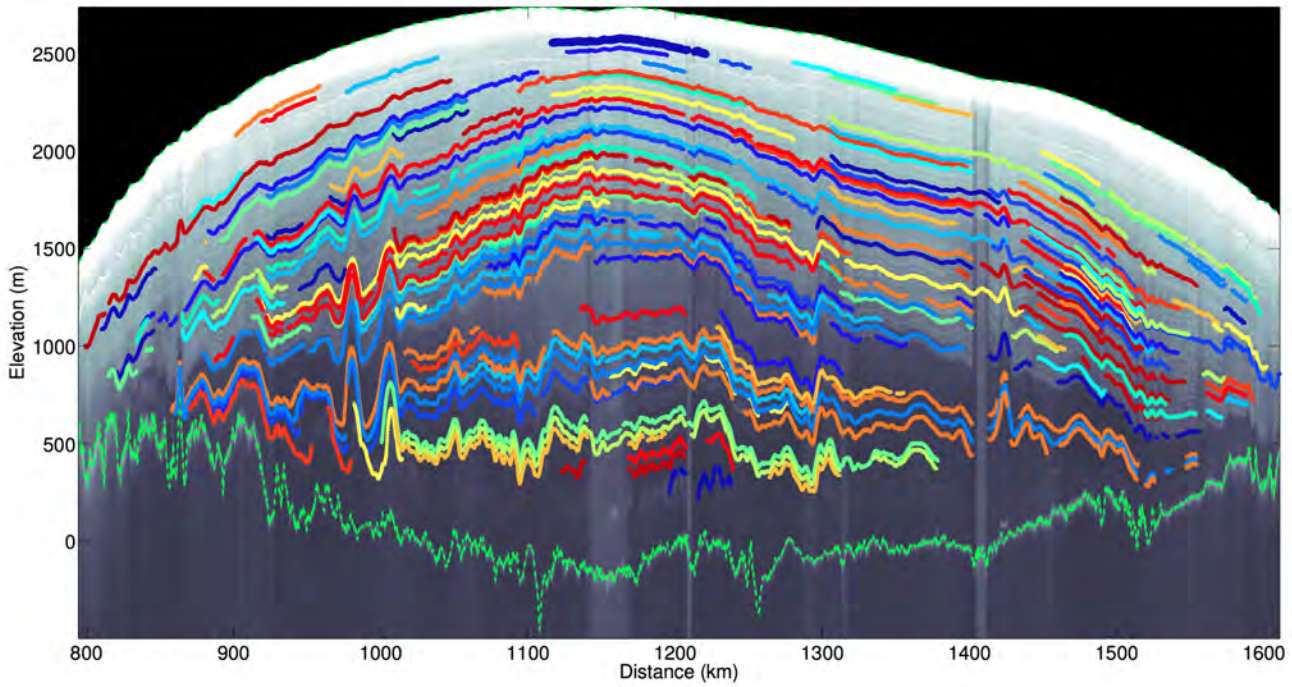
NASA Cryospheric Sciences MVP Awarded to Joseph MacGregor

By: Tom Wagner, Cryosphere Program Manager, Earth Science Division, Science Mission Directorate, National Aeronautics and Space Administration

The 2014 winner of the National Aeronautics and Space Administration (NASA) Cryospheric Sciences (http://ice.nasa.gov/) Most Valuable Player award is Joseph A. MacGregor of University of Texas at Austin's Jackson School of Geosciences (http://www.jsg.utexas.edu/), for his work synthesizing ice penetrating radar (http://www.ig.utexas.edu/people/staff/gcatania/greenradar.html) records to produce a 3-dimensional age map of the Greenland Ice Sheet. The work represents a substantial contribution to Arctic research. The results will constrain ice sheet models and assist in the interpretation of paleoclimate information to improve our understanding of the Greenland ice sheet's contribution to sea level change.

Background

The NASA Cryospheric Sciences program awards a Most Valuable Player award annually at its Program for Arctic Regional Climate Assessment (PARCA) meeting. The award recognizes outstanding individual accomplishment by a NASA-supported scientist working in the cryospheric sciences. It is intended to encourage and celebrate creative or original work, especially that which exemplifies Thomas Edison's maxim "Genius is one percent inspiration, ninety-nine percent perspiration." The award considers any contribution, but especially those that involve synthesis of large or multidisciplinary data sets.



A radargram collected across northern Greenland on 29 May 2011 during NASA's Operation IceBridge. Colored lines indicate reflectors that are thousands to tens of thousands of years old, with deeper reflectors being older. Image courtesy of Joseph A. MacGregor.

More information about MacGregor's project, "Radiostratigraphy of the Greenland Ice Sheet" is available here (http://www.ig.utexas.edu/people/staff/gcatania/greenradar.html) or by contacting Joseph MacGregor (joemac@ig.utexas.edu).

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USARC Delegation Visits Finland

By: John Farrell, USARC Executive Director

In early April 2014, a delegation of the U.S. Arctic Research Commission (USARC) traveled to Finland to investigate opportunities to further advance international scientific cooperation and to facilitate U.S.-Finnish coordination in implementing recently updated Arctic research policies.

In Helsinki, the Commission participated in meetings associated with the annual Arctic Science Summit Week, the Arctic Observing Summit, and preparation of the upcoming Third International Conference on Arctic Research Planning (ICARP III). They also visited Aker Arctic Technology (http://www.akerarctic.fi/company.htm), a company in the Helsinki shipyard that has designed 60% of the world's icebreakers, many polar research vessels, cargo vessels, and offshore structures. Managing Director Mikko Niini gave a presentation to the commission, including a discussion of Aker's role in helping to design the USCG Cutter *Healy* and the R/V *Sikuliaq*, followed by a tour of the Aker facility, which included the world's only private water/ice tank that is used to test the designs of icebreakers and other structures for Arctic operations.

Meeting of the U.S. Arctic Research Commission and the Finnish Prime Minister's Arctic Advisory Board in Helsinki, 10 April 2014. From left: Edward Itta (USARC Commissioner), Fran Ulmer (USARC Chair), State Secretary Olli-Pekka Heinonen (Chair of Finland's Arctic Advisory Board), Ambassador Hannu Halinen (Executive Secretary of Arctic Advisory Board), and Esko Lotvonen (Mayor, City of Rovaniemei). Photo courtesy of John Farrell.

On 10 April, Finland's Arctic Advisory Board hosted USARC for a formal meeting to discuss Arctic issues of mutual interest. This committee's mandate is to monitor and coordinate Finland's activities in the Arctic and to implement Finland's Strategy for the Arctic Region 2013 (http://vnk.fi/julkaisukansio/2013/j-14-arktinen-15-arktiska-16-arctic-17-saame/PDF/en.pdf), which was adopted in 2013. The Arctic Advisory Board pays close attention to a wide variety of Arctic issues and supports Finland's role and positions in international contexts. The Board has 17 members appointed by the Finnish Prime Minister, and 10 experts representing different ministries, leaders of northern cities, the private sector, universities, and research institutions.

During the meeting, Finnish Ambassador Hannu Halinen stressed international cooperation as a major priority. He highlighted the need for sustainable development in the North and said that the Finns can help lead the way in areas such as offshore and maritime industry, search and rescue, renewable energy, clean technology, mining, traffic systems,

data communications, and digital services. Fran Ulmer, USARC Chair, laid out the five major research themes of USARC for 2013-2014, noting the commonalities of U.S. and Finnish strategies. The Arctic Advisory Board and the USARC both expressed strong interest in continuing to work together toward common goals.

The Commission also visited the Technical Research Center of Finland (VTT), which is the largest multi-technological applied research organization in Northern Europe. It provides high-end technology solutions and innovation services. VTT is a part of the Finnish innovation system under the domain of the Ministry of Employment and the Economy and is a not-for-profit organization. Dr. Jaakko Heinonen, Principal Scientist, hosted the Commission. He and colleagues introduced the commission to a wide range of VTT's Arctic and cold climate research projects.

Traveling north to the Arctic town of Inari in northern Finland provided opportunities for the Commission to learn more about traditional practices of the indigenous Sami people, such as reindeer husbandry. The USARC delegates were hosted by Director Paula Kankaanpää and colleagues at the University of Lapland's Arctic Center in Rovaniemi. This Center of Excellence conducts multidisciplinary Arctic research in three main themes: global change, environmental and minority law, and sustainable development.

The visit successfully provided the Commission with a broad range of information on Finnish arctic research and, at the same time, provided Finnish colleagues with an opportunity to speak to U.S. leaders on Arctic research policy and to share strategies and goals. The similarities between U.S. and Finnish Arctic research strategies, the successive chairmanships of the Arctic Council, and historically strong relations provide an excellent opportunity to consider longer-term approaches to issues in coordination.

Further information is available on the U.S. Arctic Research Commission (http://www.arctic.gov/) website or contact John Farrell.

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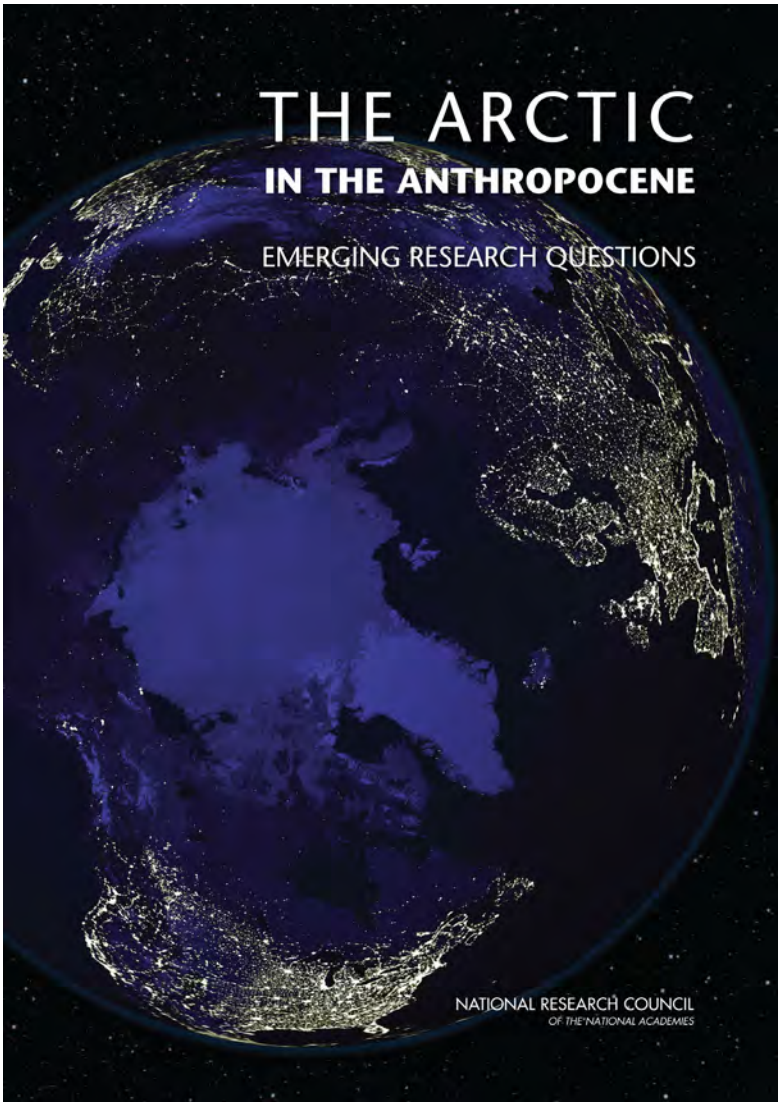
PRB Report Released—The Arctic in the Anthropocene: Emerging Research Questions

By: Lauren Everett, associate program officer with the Polar Research Board and the Board on Atmospheric Sciences and Climate at the National Academy of Sciences

In April 2014, the Polar Research Board (PRB) (http://dels.nas.edu/prb) of the U. S. National Academy of Sciences (http://www.nationalacademies.org/) issued the report, *The Arctic in the Anthropocene: Emerging Research Questions* (http://www.nap.edu/catalog.php?record_id=1872), which identifies the key scientific questions that are emerging in different realms of Arctic science and provides guidance on future research questions in the Arctic over the next 10-20 years. Sponsored by the U.S. Arctic Research Commission (USARC) (http://www.arctic.gov/), the Department of Energy (DOE) (http://energy.gov/), the National Aeronautics and Space Administration (NASA) (http://www.nasa.gov/), the National Oceanic and Atmospheric Administration (NOAA) (http://www.noaa.gov/), the National Science Foundation (NSF) (http://www.nsf.gov/), and the Smithsonian Institution (http://www.si.edu/), this report addresses the urgency for understanding the rapidly changing Arctic by connecting the dots among future science opportunities and the infrastructure needed to make best use of them through collaboration and coordination, sustained observations, increased human and operational capacity, actionable and accessible information, and innovative funding approaches.



The Arctic in the Anthropocene: Emerging Research Questions

With rapid change unfolding throughout the Arctic, the need for actionable Arctic science has never been greater. Arctic changes have global implications, and this report identifies emerging research questions important for

understanding how environmental and societal transitions will affect the Arctic and the rest of the world. It also assesses what is required to address these questions, and points to the need to translate research findings into practical information that can help guide management and policy decisions.

Henry Huntington, Report Committee Co-Chair. Photo courtesy of Henry Huntington.

What happens in the Arctic—to ecosystems, people, and climate—has far-reaching implications for the entire planet. One tenth of the world's fish catch comes from Arctic and sub-Arctic waters; an estimated 13% of the world's remaining oil reserves are in the Arctic; and the region is home to indigenous peoples whose cultures have endured for thousands of years. Arctic processes, including atmospheric and ocean circulation, are essential to the functioning of the entire Earth system. But this important region is changing rapidly, a hallmark of the Anthropocene epoch. Climate change is happening faster in the Arctic than anywhere else on Earth, causing loss of ice and snow, thawing of permafrost, and shifts in ecosystems. At the same time, interest is growing in the Arctic's fossil fuel deposits, minerals, and fisheries. The region's governance systems are evolving as the Arctic's indigenous peoples exercise greater political influence—yet northern populations will face new challenges in years to come as change threatens many traditional practices and food sources. Building the capability to mitigate harmful actions and impacts wherever we can, as well as predict and understand the effects of global climate change, will help us prepare to successfully adapt to changing conditions.

With input from the scientific community, agency personnel, diplomats, and the citizens of the Arctic region, the report's authoring committee identified emerging research questions for study over the next two decades. These questions are those that have arisen as rapid change has pervaded the Arctic system, have not yet received the attention they likely deserve, and/or can only now be addressed given technological or other advances—in other words, the questions that in five or ten years' time we would kick ourselves for not asking now. The report assesses not only what is needed to address today's questions, but also to be ready for those emerging in the future. It underscores the importance of translating research findings into practical information that can help guide management and policy decisions.

The report's authoring committee, co-chaired by Stephanie Pfirman and Henry Huntington, identified emerging research questions that fall under five categories:

- **Evolving Arctic**. The rapid pace of Arctic change is raising new questions and driving new interactions. The *Evolving Arctic* focuses on the transition to the "new normal" of reduced ice and snow and the cascade of impacts this will have on systems that depend on frozen ground and water. Arctic societies are also changing rapidly,

especially in the political realm as indigenous people achieve greater autonomy in some regions.

- **Hidden Arctic**. The *Hidden Arctic* explores what could be found as ice barriers diminish—and what could be forever lost amid rapid change. Many aspects of the Arctic have been unknowable, in large part because ice cover has blocked access and presented a major barrier to research. Loss of sea ice, the retreat of glaciers, and technological advances now allow research in new fields, new geographical areas, and throughout the year. At the same time, rapid change can lead to the loss of sites, features, and phenomena.
- **Connected Arctic**. The Arctic is connected to the rest of the world by air and water currents, by animal migrations and invasive species, and by societal interactions. Changes occurring in the Arctic do not stay in the Arctic, but affect the rest of the northern hemisphere and beyond. Climatic and meteorological connections in particular have far-reaching implications globally; for example, through rising sea level due to mass loss of the Greenland Ice Sheet, and through weather patterns potentially affected by sea ice loss. Outside pressures influence Arctic residents and the experiences of Arctic cultures can inform and be informed by those of indigenous peoples elsewhere.

Stephanie Pfirman, Report Committee Co-Chair. Photo courtesy of Stephanie Pfirman.

- **Managed Arctic**. Questions of societal changes, conflict and cooperation, and proactive vs. reactive decision making are raised in the *Managed Arctic*. Humans have lived in the Arctic for millennia, shaping their surroundings and making use of what the Arctic has to offer. In recent decades, the human environment has shifted greatly, including political and economic integration with nation-states and less obvious trends such as the urbanization of Arctic peoples. Looking forward, human activity and interventions are likely to increase in frequency, magnitude, and scale in the Arctic. Research is essential to understand the drivers of change, their implications, and options for response.
- **Undetermined Arctic**. The *Undetermined Arctic* addresses how we can be prepared to detect and respond to the unexpected. Leaving room for new ideas and making it possible to identify new research directions when the need arises requires research to better assess new topics, long-term observations to identify changes and surprises without delay, and flexibility in funding to move quickly when a significant event occurs.

The committee suggests a number of strategies to help meet these challenges:

- **Enhancing Cooperation**. No single agency, organization, or country can take on all research topics in the Arctic. Some research questions are too broad, or involve such extensive field efforts that they cannot be resolved solely by researchers from a single country, or supported by a single funding source. In some cases comprehensive data sets of numerous field processes must be collected simultaneously in coordinated expeditions or cruises requiring collaboration among many nations. Cooperation is essential: among researchers, between agencies, among nations, across disciplines, between Arctic residents and visiting scientists, and with the private sector.
- **Sustaining Long-term Observations**. Long-term observational data are essential for detecting change and for putting research findings into context. There are, however, insufficient long-term observation efforts underway and little coordination among those that do exist. Instead, available records are often a collection of ad hoc efforts conducted with different time scales, in different areas, and for different purposes. It is thus difficult to distinguish large-scale patterns from localized ones, or to connect findings in one discipline to those in another.
- **Managing and Sharing Information**. Data management requirements have often been underfunded, resulting in poor quality metadata, a lack of long-term archiving, or other shortcomings that greatly reduce the utility of data. Our understanding of the Arctic as a system has evolved through the ability to compare data sets from disparate fields and regions in order to see connections and commonalities. But data management is often left to individuals or to separate efforts depending on agency, program, discipline, or other parameters.
- **Maintaining and Building Operational Capacity**. New technologies allow new approaches to research in many fields. Among the most promising recent developments is a host of autonomous mobile sensors for the ocean and atmosphere that can be deployed relatively easily and inexpensively. At the same time, it is critical that current capabilities are sustained, including ships, satellites, and research stations.
- **Growing Human Capacity**. Arctic research depends on sufficient human capacity, including scientists trained in the necessary fields who are capable of interdisciplinary collaboration. During the International Polar Year, concerted efforts were made to involve young researchers, and those opportunities help to retain scientists in Arctic research. Additionally, Arctic residents can offer a great deal to research efforts. To avoid "research fatigue" it is important to make sure that Arctic residents have the chance to act on what is learned from research, and to use knowledge gained to enhance the adaptive capacity of their community.
- **Investing in Research**. Society's ability to address emerging research questions in the Arctic is closely tied to the way research funding is organized. Given the emerging research questions and implementation challenges identified in this report, pressures are growing for support of comprehensive systems and synthesis research, non-steady-state research, social science, stakeholder-initiated research, international research, and long-term observations. Other approaches are used in different countries, and the tradeoffs involved are worth considering to assess whether some of those approaches might be adopted or adapted in the United States.

Getting more from Arctic research may best be pursued by enhancing the ways we make use of that research. To build knowledge and solve problems, collaboration is needed—not just among scientific disciplines, or between scientists and those who live in the Arctic, but also with and between decision makers to better understand what they require and how scientific results are factored with other considerations to produce decision outcomes. Fostering a sense of shared purpose to manage change to the best of our abilities is essential, as is a continued commitment to studying what exists, what is emerging, and what awaits us in the Arctic.

The report is available as a free PDF at: http://www.nap.edu/catalog.php?record_id=18726. To purchase paper copies, please contact the National Academies Press at: 800-624-6242.

The PRB is a unit within the National Academies and is responsible for studies related to the Arctic, Antarctic, and cold regions in general. More information about the PRB and other related activities is available here (http://dels.nas.edu/prb/) or contact Lauren Everett (LEverett@nas.edu).

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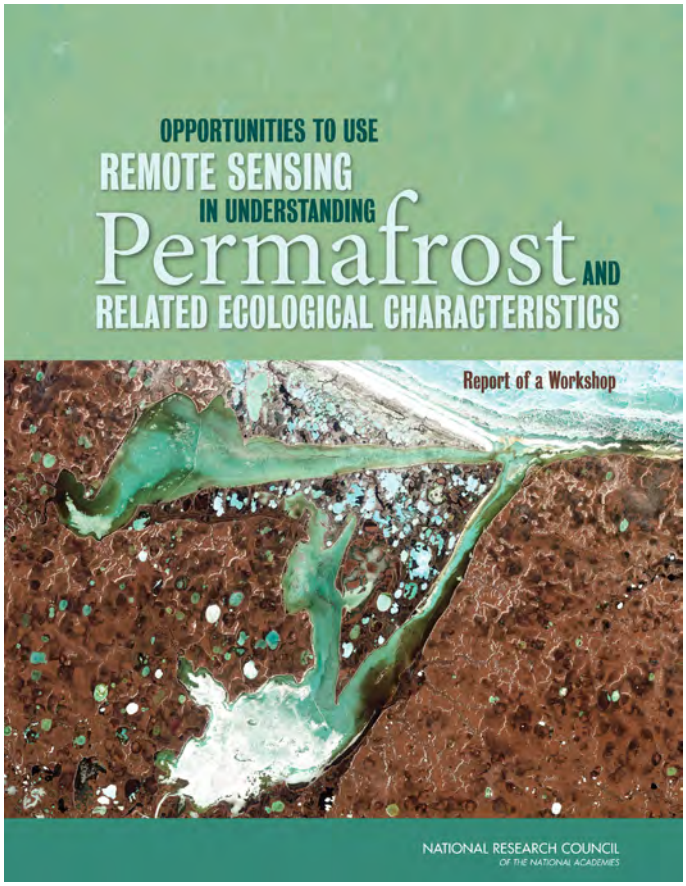
Recent Reports from the National Academy of Sciences

By: Lauren Everett, Associate Program Officer, National Academy of Sciences, Polar Research Board

In early April 2014 the Polar Research Board (PRB) and the Ocean Studies Board (OSB) of the U.S. National Academy of Sciences released a number of reports related to Arctic issues. They are summarized below.

Opportunities to Use Remote Sensing in Understanding Permafrost and Related Ecological Characteristics (http://www.nap.edu/catalog.php?record_id=18711)

Permafrost is a thermal condition—its formation, persistence and disappearance are highly dependent on climate. General circulation models predict that, for a doubling of atmospheric concentrations of carbon dioxide, mean annual air temperatures may rise several degrees over much of the Arctic. In the discontinuous permafrost region, where ground temperatures are within 1-2 degrees of thawing, permafrost will likely ultimately disappear as a result of ground thermal changes associated with global climate warming. Where ground ice contents are high, permafrost degradation will have associated physical impacts. Permafrost thaw stands to have wide-ranging impacts, such as the draining and drying of the tundra, erosion of riverbanks and coastline, and destabilization of infrastructure (roads, airports, buildings, etc.). There are also potentially significant implications for ecosystems and the carbon cycle in the high latitudes.

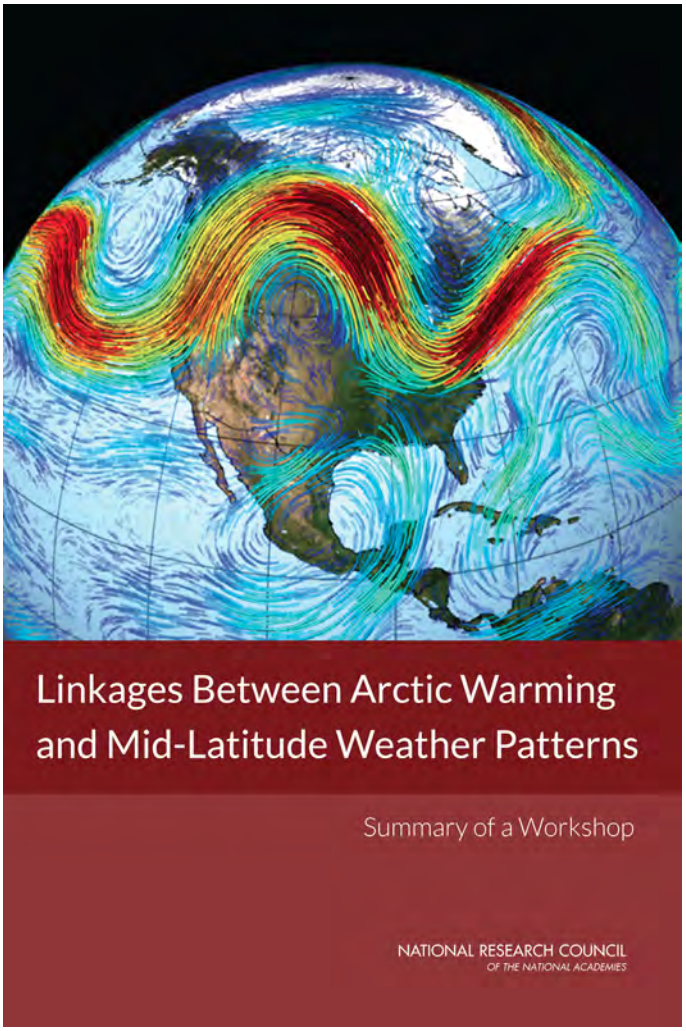


Opportunities to Use Remote Sensing in Understanding Permafrost and Related Ecological Characteristics

Opportunities to Use Remote Sensing in Understanding Permafrost and Related Ecological Characteristics (http://www.nap.edu/catalog.php?record_id=18711) is the summary of a workshop convened to explore opportunities for using remote sensing to advance our understanding of permafrost status and trends and the impacts of permafrost change, especially on ecosystems and the carbon cycle in the high latitudes. The workshop brought together experts

from the remote sensing community with permafrost and ecosystem scientists. The workshop discussions articulated gaps in current understanding and potential opportunities to harness remote sensing techniques to better understand permafrost, permafrost change, and implications for ecosystems in permafrost areas. This report addresses questions such as how remote sensing might be used in innovative ways, how it might enhance our ability to document long-term trends, and whether it is possible to integrate remote sensing products with the ground-based observations and assimilate them into advanced Arctic system models. Additionally, the report considers the expectations of the quality and spatial and temporal resolution possible through such approaches, and the prototype sensors that are available that could be used for detailed ground calibration of permafrost/high latitude carbon cycle studies.

Linkages Between Arctic Warming and Mid-Latitude Weather Patterns (http://www.nap.edu/catalog.php?record_id=18727)



Linkages Between Arctic Warming and Mid-Latitude Weather Patterns

The Arctic has been undergoing significant changes in recent years. Average temperatures are rising twice as fast as they are elsewhere in the world. The extent and thickness of sea ice is rapidly declining. Such changes may have an impact on atmospheric conditions outside the region. Several hypotheses for how Arctic warming may be influencing mid-latitude weather patterns have been proposed recently. For example, Arctic warming could lead to a weakened jet stream resulting in more persistent weather patterns in the mid-latitudes. Or Arctic sea ice loss could lead to an increase of snow on high-latitude land, which in turn impacts the jet stream resulting in cold Eurasian and North American winters. These and other potential connections between a warming Arctic and mid-latitude weather are the subject of active research.

Linkages Between Arctic Warming and Mid-Latitude Weather Patterns (http://www.nap.edu/catalog.php?record_id=18727) is the summary of a workshop convened in September 2013 to review our current understanding and to discuss research needed to better understand proposed linkages. A diverse array of experts examined linkages between a warming Arctic and mid-latitude weather patterns. The workshop included presentations from

leading researchers representing a range of views on this topic. The workshop was organized to allow participants to take a global perspective and consider the influence of the Arctic in the context of forcing from other components of the climate system, such as changes in the tropics, ocean circulation, and mid-latitude sea surface temperature. This report discusses our current understanding of the mechanisms that link declines in Arctic sea ice cover, loss of high-latitude snow cover, changes in Arctic-region energy fluxes, atmospheric circulation patterns, and the occurrence of extreme weather events; possible implications of more severe loss of summer Arctic sea ice upon weather patterns at lower latitudes; major gaps in our understanding, and observational and/or modeling efforts that are needed to fill those gaps; and current opportunities and limitations for using Arctic sea ice predictions to assess the risk of temperature/precipitation anomalies and extreme weather events over northern continents.

Responding to Oil Spills in the U.S. Arctic Marine Environment (http://www.nap.edu/catalog.php?record_id=18625)

U.S. Arctic waters north of the Bering Strait and west of the Canadian border encompass a vast area that is usually ice covered for much of the year, but is increasingly experiencing longer periods and larger areas of open water due to climate change. Sparsely inhabited with a wide variety of ecosystems found nowhere else, this region is vulnerable to damage from human activities. As oil and gas, shipping, and tourism activities increase, the possibilities of an oil spill also increase. How can we best prepare to respond to such an event in this challenging environment?

Responding to Oil Spills in the U.S. Arctic Marine Environment (http://www.nap.edu/catalog.php?record_id=18625) assesses the current state of science and engineering regarding oil spill response in the Arctic region north of the Bering Strait, with emphasis on potential impacts in U.S. waters. This report describes the ecosystems and environmental conditions of the Arctic and makes recommendations to provide an effective response effort in these challenging conditions. According to *Responding to Oil Spills in the U.S. Arctic Marine Environment*, a full range of oil spill response technologies is needed in order to

Responding to Oil Spills in the U.S. Arctic Marine Environment

minimize impacts on people and sensitive ecosystems. This report identifies key oil spill research priorities, critical data and monitoring needs, mitigation strategies, and important operational and logistical issues.

The Arctic acts as an integrating, regulating, and mediating component of the physical, atmospheric, and cryospheric systems that govern life on Earth. Not only does the Arctic serve as regulator of many of the Earth's large-scale systems and processes, but it is also an area where choices made have substantial impact on life and choices everywhere on planet Earth. This report's recommendations will assist federal, state, local, and tribal policymakers; non-governmental organizations; industry; academia; and anyone interested in the future of this special region to protect it from the impacts of damaging oil spills.

Theses reports are available as free PDFs here (http://www.nap.edu/). To purchase paper copies, please contact the National Academies Press at: 800-624-6242.

The PRB and OSB are units within the National Academies Division on Earth and Life Studies. More information about the PRB and OSB and other related activities can be found here (http://dels.nas.edu/prb/) and here (http://dels.nas.edu/osb) or contact Lauren Everett (LEverett@nas.edu).

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Recommendations from 2014 Arctic Observing Summit

By: Mikko Strahlendorff, Finnish Meteorological Institute

The second Arctic Observing Summit (AOS) (http://www.arcticobservingsummit.org/) was held 9-11 April 2014 in conjunction with the Arctic Science Summit Week (ASSW) (http://www.assw2014.fi/) in Helsinki, Finland. Both events surprised the organizers with more participants than expected. Attendance totaled 493 with almost half participating in AOS-2014. The feedback received and the high number of participants clearly showed that the integration of ASSW and AOS was well received. Following this model, the third AOS will be arranged at the ASSW 2016.

Discussions at the summit built on results from the first AOS, held spring of 2013 in Vancouver, British Columbia, and expanded to include new topics such as remote sensing and Arctic technology innovations. Peter Schlosser, Co-Chair of the AOS Organizing Committee, along with Eva Krümmel and Mikko Strahlendorff, presented the following preliminary draft recommendations to a high-level panel of decision makers at the conclusion of the five AOS-2014 sessions:

Stakeholders and Arctic Observation

- Create more inclusive and iterative communication platforms for planning Arctic observations.
- Establish improved dialogue between traditional knowledge holders and science.
- Example case from European Arctic: studying land-use history for Arctic observation information.

Coordination for Improved Arctic Observing

- Establish internationally coordinated funding with common calls for research and common review of proposals.
- Use Belmont Forum as pilot for multi-nation project funding.
- Establish funding mechanisms for research and stakeholder observation campaigns.
- In addition, identify funding sources for sustained operational observations for climate time series.

Technology and Innovation

- Share technology and technology development to reduce cost.
- There must be high-risk investments into technology and room for failure in development of new technology.
- Enhance cooperation between industry and scientific community in technology development.

Remote Sensing Solutions

- Arctic user requirements should be included in prioritizing Low Earth Orbit missions and to motivate specific polar missions.
- Start preparing for real-time service.
- Priorities: carbon cycle, permafrost, and snow cover monitoring.

Data Management

- Open access to data in itself is not sufficient. Data uptake should be increased through appropriate easy-to-use data interfaces.
- Data system designers have to be informed better by needs of data holders and data users.
- Build on knowledge and data systems that already exists.
- Develop interoperable data infrastructures to save cost.

The full report of the AOS will be published in summer 2014. It will also include the following recommendations from AOS-2013:

- Improve cross-sector and collaborative approaches to the collection and maintenance of data.
- Create a stakeholder advisory group to provide advice on observational need.
- Better utilize and adopt modern technology for Observing System Design to more closely cooperate with global systems observation initiatives during the design phase.

Attendees enjoy coffee break during Arctic Observing Summit. Photo courtesy of Mikko Strahlendorff.

Further information about the Arctic Observing Summits is available on the AOS website (http://www.arcticobservingsummit.org/aos-2014-0) or contact Mikko Strahlendorff (Mikko.Strahlendorff@fmi.fi).

Mikko Strahlendorff

Mikko Strahlendorff works as space adviser for the Finnish Meteorological Institute (FMI) and the Ministry of Transport and Communications. He represents Finland in European Union space and research related committees guiding the development of remote and in-situ observation networks. Previously he worked for the European Commission planning the EU Earth Observation program Copernicus and before that he lead the Information System development at FMI. His research interests include global observation capabilities in relation to climate adaptation needs.

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New ARCUS Vision and Mission Statements

In January 2014 the Board of Directors adopted new Vision and Mission statements for ARCUS. These statements were the result of approximately 18 months' worth of discussions during which the board and staff took a self-critical look at the organization. The board embarked on this mission as it became clear that a clean mission statement was needed to effectively focus ARCUS activities. This evaluation of ARCUS started with a facilitated discussion between the board and staff in the spring of 2012 to review the history of ARCUS, its strengths, and its perceived challenges. The outcome of that meeting was a summary document of the current state of and perspectives from the board for the future direction of the organization. A board sub-committee met with the staff in Fairbanks in early 2013 to draft a Vision and Mission statement. The draft was refined during subsequent board meetings and the final version was approved in January 2014. The ARCUS Vision and Mission Statement (http://www.arcus.org/arcus) is publicly available.

Rapid changes in the Arctic environment led to rapid increases in the scope and complexity of activities in the Arctic. Several government agencies now have an increased presence in Arctic research, even as industrial activities are increasing. The number of researchers interested in the Arctic is increasing, amongst them people from and communities in the Arctic. The board assessed ARCUS strengths in facilitating interdisciplinary collaborative programs, education, and outreach. The new Vision and Mission statements seek to build on these strengths while somewhat adjusting the focus.

ARCUS is envisioned as serving Arctic researchers, be they academic, agency, industry, or others. Our goal is for ARCUS to be the go-to place for researchers seeking to develop and manage interdisciplinary projects; support and enable their out-reach to Arctic communities, policymakers, industry, and other decision-makers; and support efforts to inform the Arctic literate public. To succeed in these goals ARCUS must have an actively engaged member population. The board is committed to working with the staff to strategically focus ARCUS activities so that ARCUS will be a catalyst for interdisciplinary thinking, acting, and education leading to the development of highly collaborative partnerships.

This is an exciting time for ARCUS. With the board fully engaged and a clear mission statement the excellent ARCUS staff can now focus on what they do best: bringing the Arctic research community together in small and large interdisciplinary projects.

Johannes (Hans) Verlinde
Secretary, ARCUS Board of Directors

Meet the Board of Directors — Jay Gulledge

Jay Gulledge

Jay Gulledge was elected to the ARCUS Board of Directors in 2011 and currently serves as Treasurer.

Jay is the Director of the Environmental Sciences Division and a member of the Climate Change Science Institute (CCSI) at Oak Ridge National Laboratory. CCSI administers the Department of Energy's Next Generation Ecosystem Experiments (NGEE) Arctic research project, a major 10-year investment toward understanding how carbon rich soils in the permafrost respond to a rapidly warming Arctic. He is also a Senior Advisor at the Center for Climate and Energy Solutions, specializing in the application of scientific knowledge of climate change and its impacts to policy- and decision-making. Jay is a Certified Senior Ecologist with two decades of teaching and research experience in the biological and environmental sciences. He received a PhD in biological sciences at the University of Alaska Fairbanks, was a Life Sciences Research Foundation Postdoctoral Fellow at Harvard University, and held faculty posts at Tulane University and the University of Louisville.

Jay observes that, "Climate change is turning the Arctic into a new international space where governance is largely absent. The impacts of this change are poorly understood but are likely to have significant influence on the climate, weather, ecosystems, fisheries, geopolitics, and economies of the world. Arctic research is essential to understanding the potential environmental, social, economic, and political risks and opportunities that an opening Arctic will bring. With its strong vision for promoting research to inform sound decisions related to the Arctic, ARCUS is an invaluable convener and facilitator of the Arctic research community."

Jay Gulledge can be contacted via email (jgulledge@ornl.gov).

Meet the Board of Directors — John Payne

John Payne

John Payne is a Member-at-Large of the Executive Committee of the ARCUS Board of Directors. He was elected to the Board in 2013.

John retired from federal service in December 2012 after serving 37 years in many different positions and functions including range conservationist, wildlife biologist, pilot, law enforcement officer, program manager, and Executive Director of the North Slope Science Initiative (NSSI) (http://www.northslope.org/). His retirement was short-lived and within a few weeks of leaving federal service he took a position with Michigan Technological University (MTU) as a senior scientist specializing in Arctic science. At the same time, he was approached by the Oversight Group of NSSI and asked to return to his former position as Executive Director. He welcomed both opportunities to stay connected to the Arctic.

John is also the U.S. representative on the Circumpolar Biodiversity Monitoring Program (CBMP) (http://www.arctic-council.org/index.php/en/environment-and-people/biodiversity/circumpolar-biodiversity-monitoring-program), which operates under the Conservation of Arctic Flora and Fauna (CAFF) (http://www.arctic-council.org/index.php/en/about-us/working-groups/conservation-of-arctic-flora-and-fauna-caff) Arctic Council Working Group. He serves as a co-lead of CBMP along with representatives from Greenland/Denmark. This program brings together marine, terrestrial, coastal, and freshwater experts from within the Arctic to enhance long-term Arctic biodiversity monitoring, and to facilitate detection, interpretation, and communication of significant ecological trends.

Having spent most of his career in Alaska and the Arctic, John has seen ecological change as well as changes in how people view the Arctic. He comments, "Not too many years ago, the Arctic was a dark, cold desert that generated little interest from anyone except scientists. Today, the Arctic is buzzing with potential development and alternate transportation opportunities between Europe and Asia, and is a hot spot for a changing climate.

I am pleased to serve on the Board of Directors of ARCUS. ARCUS provides a sustained opportunity to build networks across the Arctic and bring forward research that the decision-makers of today need for better decisions tomorrow."

John Payne can be contacted via email (jfpayne@mtu.edu).

Meet the Board of Directors — David Cairns

David Cairns

David Cairns is a Member-at-Large of the Executive Committee of the ARCUS Board of Directors. He was elected to the Board in 2013.

David is a Professor and the Assistant Department Head of the Geography Department at Texas A&M University. His primary research interests are on the impacts of climate change on vegetation at short and long time scales in a variety of environments. The focus of his work is on ecotones, the transition zones between different vegetation types. Most of his fieldwork has been accomplished at tree line in the western United States, Alaska, and in northern Sweden. He also has projects in two other sensitive environments: saltmarshes on the coasts of Denmark and Texas, and tundra environments on the North Slope of Alaska. Dave uses a variety of approaches—including population genetics, dendroecological methods, and simulation modeling—to answer questions about how these environments respond to climate change.

Dave remarks that, "I came to research in the Arctic later in my career and found the community of researchers active in the Arctic to be both cohesive and welcoming. I've been very pleased with the degree of integration among individual researchers and their willingness to work together to solve difficult system-wide problems. Sometimes, I think we forget how special this interaction is within our community. ARCUS has been fundamental in facilitating that interaction. The programs and initiatives that ARCUS runs, for example ArcticInfo (http://www.arcus.org/arctic-info) and PolarTREC (http://www.polartrec.com/), are critical to this interaction. ARCUS-sponsored meetings like the Arctic Forum (http://archive.arcus.org/annual_meetings/arctic_forum_online.html) were a key component of interaction among the community, and I hope that they will be again soon."

David Cairns can be contacted via email (cairns@tamu.edu).

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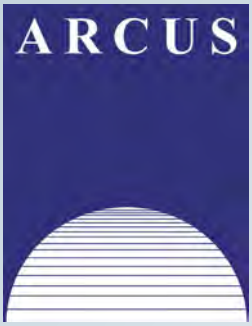

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