Witness the ARCTIC

Chronicles of the NSF Arctic Science Section | Fall 2013, Volume 17 Number 3

In this Issue

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Study of Environmental Arctic Change (SEARCH) News

SEARCH Implementation Proposal

The SEARCH Science Steering Committee (SSC) (http://www.arcus.org/search/sciencecoordination/ssc-committee) is awaiting results of a proposal that the SEARCH SSC and the Arctic Research Consortium of the U.S. (ARCUS) submitted to NSF and other SEARCH Interagency Program Management Committee (http://www.arcus.org/search/sciencecoordination/ipmc) agencies in support of a new organizational structure and framework (see the main SEARCH website (http://www.arcus.org/search) for a PDF summary of the new SEARCH framework). The results of the proposal and next steps will be announced via ArcticInfo (http://www.arcus.org/arctic-info) as they are known.

SEARCH at Fall AGU

The Interagency Arctic Research Policy Committee (IARPC) (http://www.nsf.gov/geo/plr/arctic/iarpc/start.jsp) and SEARCH are co-hosting a Town Hall Meeting at the upcoming AGU Fall Meeting (http://fallmeeting.agu.org/2013/) in San Francisco on Monday, 9 December, 12:30-1:30 pm. The Town Hall will:

- Provide updates on IARPC and SEARCH missions and activities.
- Present and discuss how IARPC and SEARCH are working together.
- Discuss how researchers can participate in IARPC and SEARCH and benefits gained from participation.
- Gather input from the community on the future direction of IARPC and SEARCH.
- Address questions and concerns.

Members of the Arctic science, education, and policy communities are invited to attend; students and early career scientists are especially encouraged to participate. SEARCH will also present two posters on Wednesday, 11 December—one a broad overview, the other focusing on collaboration with the European Arctic Climate Change, Economy and Society (ACCESS) Program (http://www.edcsm.jussieu.fr/en/index.html) for sea ice prediction efforts (Poster Hall, Moscone South, Papers C31B-0648 and C31B-0645). In addition, an open meeting will be held on a newly funded Sea Ice Prediction Network project (details to be announced).

Arctic Observing Network

Planning has begun for an Arctic Observing Network (AON) Open Science Meeting, which will be held in 2014, pending funding. The AON Open Science Meeting will be designed to:

- Share information on current AON efforts, science findings, and results.
- Share information on future plans and pursue opportunities for collaboration.
- Network to identify and pursue cross-cutting activities and areas for multiagency coordination.
- Help establish the AON science community identity as multi-agency, extending beyond NSF-funded researchers.

More information will be provided as it becomes available. In addition to the initial planning for an AON Open Science Meeting, SEARCH has been following up on the "showcase projects" that were developed last year at the U.S. Arctic Observing Coordination workshop, and has been working with agencies on interagency AON planning and implementation.

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

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Is it ARCSS?

By: Neil R. Swanberg and Robert Max Holmes, NSF's Arctic System Science Program Directors

Neil Swanberg, Arctic System Science Program Director, NSF. Photo courtesy of Michelle Steindl.

"Does my idea for a proposal fit the Arctic System Science (ARCSS) program?" This is probably the most common question we hear from prospective researchers. Often the question is asked in a binary fashion—does it fit ARCSS or Arctic Natural Sciences (ANS)? In fact it was the frequency of this particular question that prompted us in the Arctic Sciences Section (then Division) to experiment for a few years in blurring the boundaries between ARCSS and ANS by holding a joint Arctic environmental competition. The intent was to make it easier for investigators to submit whatever ideas they wanted without worrying too much about programmatic boundaries. Moreover, we sought to avoid the situation of a proposal submitted to ARCSS that might have fared better in the broader review of an ANS panel.

An unintended and unexpected consequence of this experiment, however, was that we received far fewer proposals that attempted to fit ARCSS. Although as ARCSS Program Directors it is not our place to define what fits ANS, the fact is that many ARCSS proposals could fit ANS. So why submit to ARCSS? We think that question and the drop in ARCSS proposals over the past few years when ARCSS and ANS held joint competitions lie at the core of why there is an ARCSS program.

The results of the experiment demonstrate that if there were not a defined home for projects that are trying to look at the Arctic as a system, then that research would not happen, or at least not at the pace needed to advance the science. The existence of ARCSS serves as a beacon for those willing to make the extra effort that it takes to develop a project to study the Arctic as a system. This is the primary reason that ARCSS exists—so that the science of the complex Arctic system can advance.

What research is it that we think needs to occur? Let's be blunt. Almost everything you can think of in Arctic science is part of the Arctic system, so why shouldn't everything be included? The conversation usually goes like this, "My Topic (fill in anything) is terribly important. We don't understand aspect A of My Topic, and obviously cannot understand the Arctic system if we don't, so that is what we want to pursue." However, even though a particular topic may be an important part of the system, it is not necessarily a study of Arctic system science. ARCSS is trying to study the Arctic system itself, a complex system with emergent properties. A complex system is a set of interconnected components that have sufficiently complex interactions, which make the collection more than just the sum of its parts—that is, it demonstrates properties that emerge from the interaction of the parts and which cannot be predicted from the separate properties of the parts.

Such a system has behavior, can be self-regulatory, and very often behaves in surprising ways when perturbed. ARCSS is an earth-system science program, trying to explore the Arctic region as a system that possesses some particularly important properties in the context of the global Earth system. Following is a list of some of those properties as well as some comments, examples, or questions they prompt:

Robert Max Holmes, Arctic System Science Program Director. Photo courtesy of Chris Linder.

- Small changes in Arctic processes may lead to profound changes in the ways in which the Earth system operates. There are 'switches' or threshold responses. Examples are: loss of multi-year sea ice and its impact on various parts of the system, changes in precipitation, freshwater outflow and their potential impact on surface ocean layers, and the meridional overturning circulation.
- There are multiple uni- and bi-directional linkages between the Arctic region and the global system.
- Though there is forcing from outside the Arctic, the region functions somewhat as an entity and that functioning might change. There is self-regulation and emergent behavior. What processes keep the Arctic within its normal environmental 'envelope' and how are those processes changing in ways that will move it out of those bounds?
- Just like the Earth system, there are linkages in the Arctic that defy their study along disciplinary scientific boundaries. Changes in one parameter or process can have sweeping and sometimes unpredictable effects in other parts of the system. The scientific problems in the Arctic system transcend disciplinary boundaries across natural and social sciences and address all relevant aspects of marine, terrestrial, atmospheric, social, economic, and cultural components and processes within and across the Arctic region.

So what makes an ARCSS proposal? You probably can't address all of these things in every proposal and most of us are, at some level, disciplinary scientists exploring some addressable phenomenon. So how do you reconcile the scale of the individual science approach with the grand challenge from ARCSS? The classic science model is that each researcher does their bit of research, describes the results, and discusses them at the end of a paper. It is left to 'the community' to ingest that new knowledge. Global change programs realized long ago that this approach was not sufficient to address the really large complex problems on any reasonable time scale, which is why they pushed so hard to build networks of researchers with agreed-upon goals and coordinated synthesis activities. ARCSS too has emphasized this approach and will continue to do so. Another approach, also used by ARCSS, is multi-project, coordinated activities that address large aspects of the Arctic system. In this approach it is easier for an individual project to focus on a disciplinary problem while the organized effort addresses the system context. ARCSS funded numerous coordinated activities in the Freshwater Integration Study, which is an example of this approach. Other examples can be found in self-organized groups of Principal Investigators who write linked or collaborative proposals that collectively address the Arctic system. In this model, it is critical that at some point the collective results of the individual projects be synthesized rather than just collated.

However, ARCSS is not about big expensive projects, it is about big questions that address the Arctic as a system. Small projects can employ approaches that pro-actively study the system just as well as large ones. These may well look more disciplinary and local in nature, but still need to put their research in system context to be ARCSS

proposals. This can be achieved by paying attention to several things, such as:

- Thoroughly document how important the process is that you are studying. All too often we see a paragraph in the introduction that explains how an important process is part of the system, and that is the last the Arctic system is mentioned. The proposal needs to demonstrate that it will actively bring the results back into system context (see below).
- One way to put your work in a system context is to explore feedbacks among system components. Which feedbacks related to the process being studied are negative and which positive, and what other parts of the system are affected? These approaches can lead to the discovery of emergent behaviors of the system and identify previously unrecognized linkages among parts of the system. They can also uncover potential surprises in system behavior such as threshold responses.
- If you are studying impacts of change on some compartment or process, consider its overall vulnerability by examining multiple interacting drivers. For example, examine how warming, increased CO_2, and changes in moisture can all combine to affect plants differently than each one would separately; or how surface water heating combined with changes in aerosols and snow cover conspire to affect sea ice. This can reveal much more complex interactions than looking at just one driver.

- Ask truly interdisciplinary questions. Do not just use multiple disciplines to address a disciplinary question.

How can an individual project put its new knowledge back into our system understanding?

- Consider including or collaborating with modelers to improve Arctic system or Earth system models based on the results of your project. Alternatively, have a plan to reach out to the communities that can use the new knowledge in a system context, maybe by holding a synthesis or outreach workshop.

- Demonstrate that some other community is in need of the new knowledge. Don't just say, "This will help the modelers," show how it will.

- Identify what the new system understanding tells us about priorities for new research directions.

It is probably obvious by now that what makes a proposal ARCSS revolves around the questions it asks and how it approaches them. For this reason it is probably most important that you think about the 'ARCSS bit' well before you write the proposal. Retrofitting a proposal to fit ARCSS by inserting some text up front about the Arctic system is probably not an effective way to be successful. If the proposal is really about a specific disciplinary, or even interdisciplinary phenomenon, it may fit ANS better than ARCSS. If it directs its questions at how the system functions with regard to the phenomenon in question, then it may be ARCSS.

As always, we are eager to speak with investigators about their ideas for advancing Arctic system understanding. Please contact Neil R. Swanberg (nswanger@nsf.gov) or Robert Max Holmes (rholmes@nsf.gov).

Understanding the Response of Greenland's Marine Terminating Glaciers to Oceanic and Atmospheric Forcing

By: Fiamma Straneo, Associate Scientist, Physical Oceanography, Woods Hole Oceanographic Institution

Introduction

Mass loss from the Greenland ice sheet between 1992-2011 resulted in a net contribution to sea-level rise of approximately 7.5 mm, roughly twice the Antarctic contribution (Shepherd et al. 2012). Half of this loss is associated with increased melt and run-off caused by rising air temperatures over the ice sheet, and is well reproduced by models (van den Broeke et al. 2009). The remaining loss was caused by the accelerated retreat of marine-terminating glaciers located in southeastern and western Greenland, which began in the late 1990s (Howat et al. 2007; Rignot and Kanagaratnam 2006) and continues today (Moon et al. 2012) (see Figure 1). This accelerated retreat is neither well understood nor fully captured by models (Vieli and Nick 2011). Beyond the challenges of understanding the complexity of the glacial dynamics that lead to the retreat (Price et al. 2008), one important issue yet to be resolved is identifying the external climate forcing that triggered the initial retreat, and the mechanisms through which it acted. The emergence of oceanic forcing as a lead candidate for a possible mechanism (Vieli and Nick 2011) makes ice sheet-ocean interactions a research frontier that is critical to understanding the Greenland ice sheet's evolution and its contribution to global sea level rise (see reviews by Straneo et al. 2013; Joughin et al. 2012; Vieli and Nick 2011).

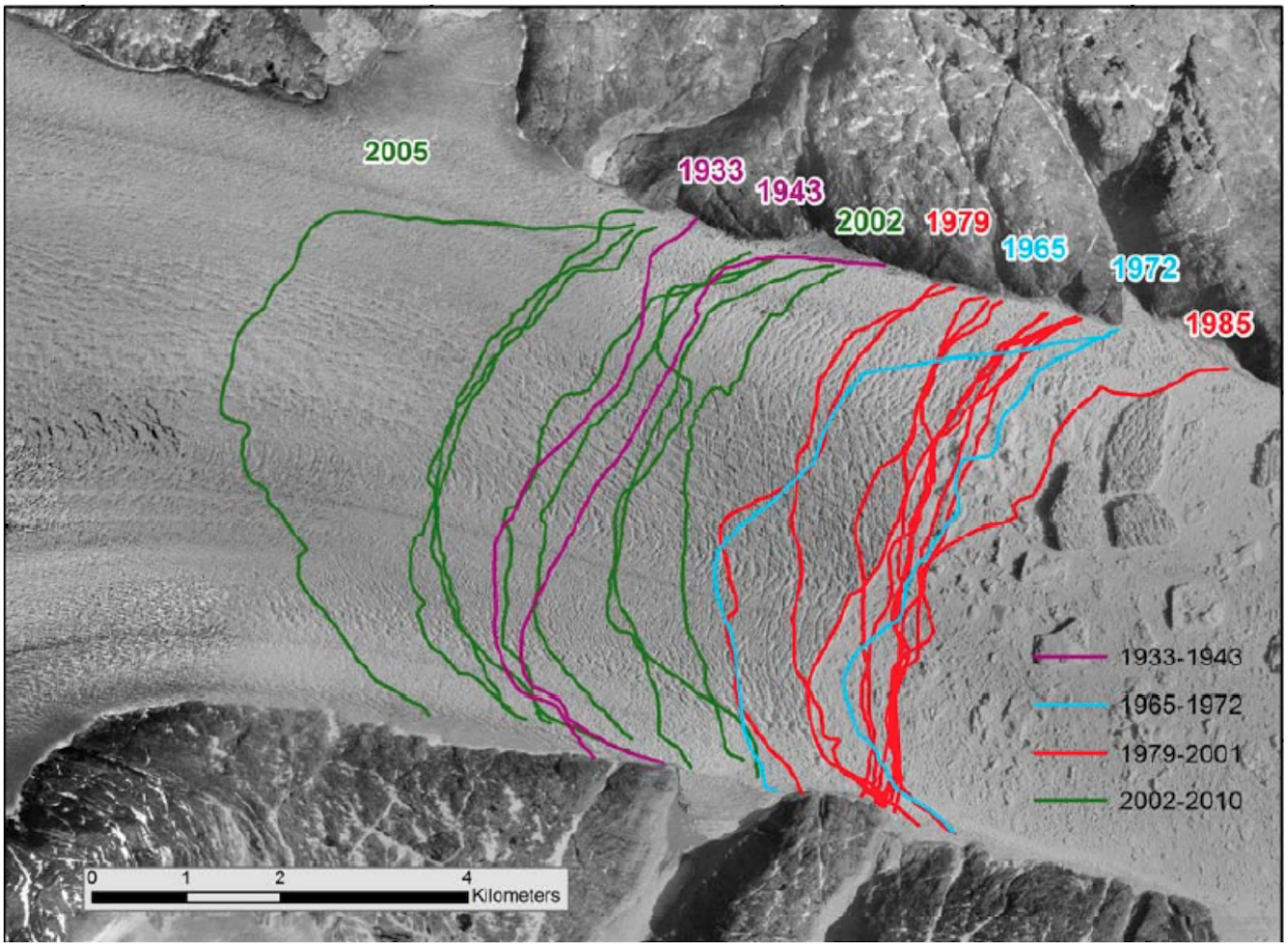

Figure 1. Many of SE and W Greenland's marine-terminating glaciers sped up and retreated over the last two decades, contributing to rapid mass loss from the ice sheet and to global sea-level rise. Helheim Glacier (shown) retreated several kilometers, almost doubled its flow rate, and thinned over 100 m from 2002 to 2005. The 2005 retreat is a minimum on the limited available record and, in general, the front position over the last decade is inland of the recorded positions since the 1930s. Image courtesy of Andresen et al. 2012.

Understanding ice sheet-ocean interactions in Greenland is far from trivial. Investigating the extent to which oceanic forcing triggered glacial retreat poses major observational challenges. Greenland's largest glaciers terminate in deep, long fjords that are remote, inaccessible, and choked with large icebergs whose calving and drift pose a major challenge to scientists and instrumentation (see Figures 2, 3, and 4). The records of oceanic changes near the glaciers—or even on the Greenland shelves where the fjords terminate—are almost non-existent, especially from the period preceding the glacier acceleration. Furthermore, the processes through which the ocean may impact the glacier (e.g., submarine melting or a weakening of the ice mélange or sea-ice in front of the terminus) are complex, involving a wide range of time and space scales as well as multiple components including the ocean, the atmosphere, the sea ice, and the glacier itself. Progress on this complex topic will require a cross-disciplinary and multi-faceted approach involving the broad international community.

Figure 2. A local ship, turned into a research vessel, heads for the edge of the ice mélange of Helheim Glacier to sample oceanic conditions. Photo courtesy of A. Korablev, Norway.

Figure 3. Researchers push ice away from a line that measures conductivity, temperature, and depth. Photo courtesy of F. Straneo.

Figure 4. Recovery of a mooring next to an iceberg in Sermilik Fjord, SE Greenland. Photo courtesy of F. Straneo.

The Workshop

A first successful effort in assembling such a community and in making progress on this topic was a workshop held 4-7 June 2013, in Beverly, Massachusetts, entitled: 'Understanding the Response of Greenland's Marine Terminating Glaciers to Oceanic and Atmospheric Forcing.' (http://www.usclivar.org/meetings/griso-workshop) The workshop brought together approximately 100 oceanographers, glaciologists, and atmospheric and climate scientists; it also included observationalists, modelers, and theoreticians; plus interested program managers from NSF and NASA (see Figure 5). A whitepaper (http://www.usclivar.org/working-groups/greenland-ice-sheet-ocean-interactions) initiated by the U.S. CLIVAR Working Group on Greenland Ice Sheet Ocean (GRISO) interactions (Straneo et al. 2012) served as background to this workshop.

Figure 5. Participants at the GRISO workshop held in Massachusetts 3-7 June 2013. Photo courtesy of J. Reisdorf, UCAR/JOSS.

The workshop was structured around review talks by invited speakers that laid the foundation for the ensuing discussions, science presentations in the form of brief oral introductions, and posters and moderated discussions. The sessions (http://www.usclivar.org/sites/default/files/meetings/Schedule_GRISO_v10.pdf) were organized around themes ranging from 'Evidence of glacier variability' to 'What can the paleo record teach us?' and ended with a half-day discussion on identifying the prioritized questions. Key recommendations on future collaborative observational, analysis, and modeling needs and opportunities were identified. Many of these different communities met at the workshop for the first time, underlining the importance of fostering cross-disciplinary exchange through specialized events. The workshop was also particularly successful in engaging early career scientists (including graduate students), who made up over one-third of the participants and who benefited from travel support. Funding for the workshop was provided by U.S. CLIVAR and the NSF Division of Polar Program; the U.S. CLIVAR and UCAR/JOSS staff were instrumental in organizing the workshop. A report containing the recommendations that emerged from the workshop's discussions will be made available in December and presented at the 2013 Fall AGU Meeting in San Francisco.

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For further information, see the U.S. CLIVAR website (http://www.usclivar.org/), or contact Fiamma Straneo (fstraneo@whoi.edu).

Photo courtesy of Kjetil Våge (UoiB)

Fiamma Straneo is a tenured scientist in the Physical Oceanography Department of the Woods Hole Oceanographic Institution. Her research focuses on the polar oceans and their role in climate and climate variability.

Motivated by the rapid and ongoing ice loss from the Greenland Ice Sheet, much of Straneo's most recent work is aimed at understanding the interaction between ice sheets and the ocean. Measurements she and her colleagues collected indicated, for the first time, the widespread presence of warm waters of tropical origin at the margins of Greenland's glaciers.

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Ethnographic Study Considers Yup'ik Combat Soldiers of Southwestern Alaska

By: Linda B. Green, Associate Professor, School of Anthropology and Director, Center for Latin American Studies, University of Arizona

The Yukon-Kuskokwim Delta is home to some 21,000 Yup'ik people living in fifty-six small and geographically isolated villages. The city of Bethel is the regional hub for economic, political, and cultural exchange. The Yukon-Kuskokwim Delta is an area of approximately 30,000 square miles and is roughly triangular, with the Yukon River along its northern border, the Kuskokwim River along the southeast and the Bering Sea on the southwest.

Linda Green's research interests include structural and political violence, medical anthropology, historical anthropology, indigenous peoples, migration, gender, human rights, anthropology of development, militarization, and war, with focuses in Guatemala, the U.S./Mexico border, and Alaska. Photo courtesy of the University of Arizona.

The Yup'ik communities in this area are the focus of a current research project, funded by NSF and entitled "The Invisible Wounds of War: An Ethnographic Investigation of Yup'ik combat veterans' problematic reintegration transitions into communities in southwestern Alaska." This project is an ethnographic investigation that explores the human and social consequences of war on one group: Yup'ik men who have served in combat in the U.S. military. Ethnography is a qualitative research method of gathering and synthesizing empirical data on human societies and cultures. This study examines the multidimensional aspects of reintegration of Yup'ik solders into their communities from three eras—the Vietnam War, the First Gulf War, and the ongoing conflicts often referred to as "the global war on terror." By placing the individual lives and stories of combat veterans in the currents of history and in their social realm, this research provides a lens through which to view a wide range of cultural transformations, the distribution of social opportunities, and the generational struggles that these Native men confront in their everyday lives, which simultaneously impact the well-being of their kin and communities.

Some of the key issues explored with this community are:

- The stresses and losses as a result of combat induced trauma alongside socially induced trauma.
- The lived experiences of inequality and marginalization, including race, class, and gender issues.
- Behavioral, mental health, and cultural coping mechanisms in rural villages in the Yukon-Kuskokwim Delta and in the regional hub of Bethel.

The research utilizes several data collection methods—including participant observation, oral history, key informant interviews, and historical and archival research—to test proposed hypotheses that seek to address:

- Individual experiences of trauma, loss, and reintegration, some of which may only be partially visible.
- The influence of generational ties, kin, cultural beliefs, and locale on the reintegration process over time.
- The role of the political, economic, cultural, and social factors that may inhibit or enhance seeking treatment for distress and loss.

The study is currently in its third and final phase of data collection and analysis. Preliminary findings suggest that although combat veterans and community members know full well the personal and social difficulties of returning from war, many Yup'ik youth enthusiastically sign up for active duty military service or as members of the Alaska National Guard. They do so for several significant reasons. One reason is to follow in the footsteps of kin and community members. In particular, many of the soldiers interviewed mentioned their elders and ancestors who served as Territorial Guard scouts on the tundra during World War II. They were quite literally defending their homeland as the Japanese occupied several islands along the Aleutian Chain. They also join for economic reasons, such as opportunities for jobs, education, and skills training, which are severely curtailed within their own communities. Additionally, the minimal state social protections that have been available to Yup'ik communities for decades have now been further eroded. The impact of climate change is particularly evident in the Arctic where increasingly the quantity and quality of marine and freshwater species—resources that are crucial to Yup'ik subsistence way of life—have diminished. Within this context wage considerations have become more urgent. For many, military service holds the promise of creating a future for themselves and their families.

This study will contribute to an understanding of the kinds of problems Native veterans are facing, the effects on kin and families, and the variety of coping strategies that are utilized by communities. The data produced by this project will help community residents and leaders, as well as social service organizations responsible for assisting them, to better understand the social needs that are crucial to helping veterans, kin, and communities cope with this added layer of social stress, loss, and trauma.

For further information about this project, contact Linda B. Green (lbgreen@email.arizona.edu).

Future Directions for Arctic Research Logistics – Workshop Summary

The "Future Directions for Arctic Research Logistics" workshop (http://www.arcus.org/logistics/2013-workshop), funded by the NSF Research Support and Logistics (RSL) program (https://www.nsf.gov/geo/plr/arctic/res_log_sup.jsp), was held 7-9 October in Arlington, Virginia (see also the spring Witness article (http://www.arcus.org/witness-the-arctic/2013/2/article/19965)).

The workshop was held to discuss strategies and recommendations for future Arctic research support and logistics. Despite the U.S. government shutdown, 62 participants attended from a diverse range of disciplines and perspectives. The workshop was structured around breakout group discussions on:

- A shared vision of future logistics support.
- Logistics needs for Arctic domains (terrestrial, marine, ice sheets, atmosphere, and social sciences).
- Platforms and regions (Alaska, Greenland, marine operations, ice camps, and autonomous platforms).
- Cross-cutting issues (interagency coordination, international coordination, coordination of field opportunities and assets, capacity building, and maximizing safety/minimizing risk).
- Synthesis and prioritization.

The goal of the discussions was to develop a suite of specific, actionable steps for developing logistics support to best serve Arctic science over the next decade. Products from the workshop will include a workshop report, a brief highlights flyer, and an open webinar that summarizes the workshop findings.

More information about the workshop, including the final agenda, participant list, plenary presentations, and background information, can be found through the workshop website (http://www.arcus.org/logistics/2013-workshop).

For questions, contact Helen Wiggins (helen@arcus.org) or Kristina Creek (creek@arcus.org) at ARCUS.

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ACADIS Data Management Services Expanded

The Advanced Cooperative Arctic Data and Information Service (ACADIS) (http://www.aoncadis.org/) team continues to support the data management needs of projects funded by NSF's Division of Polar Programs (PLR) Arctic Sciences Section with data submission, preservation, and sharing services. Recent ACADIS team activities focused on updating Principal Investigator support tools. The ACADIS team continuously improves the Gateway functionality to meet stakeholder and user needs. Highlighted improvements include:

Members of the ACADIS Community Support Team

Toni Rosati
Lisa Booker
Don Stott
Janet Scannell
Eric Nienhouse
Sean Arms
Lynn Yarmey

- A new phone number for contacting the ACADIS Community Support team. The line will be staffed Monday-Friday from 10:00 a.m. – 5:00 p.m. Mountain Time. To speak to a team member, call 720-443-1409.
- An updated Data Management Plan template, which is available to scientists preparing NSF proposals. All such proposals require a Data Management Plan and this documentation will assist proposers in meeting NSF preparation requirements. ACADIS Community Support staff is available to discuss and review Data Management Plans for any upcoming proposal submissions.
- The Arctic Data Explorer (ADE) has greatly increased in speed and efficiency. The ADE, a service of ACADIS, enables users to search for data sets across multiple repositories, currently including the National Snow and Ice Data Center (NSIDC); the ACADIS Gateway; the Earth Observing Laboratory/Computing, Data, and Software Facility; the National Oceanographic Data Center (NODC); and the Norwegian Meteorological Institute. For examples of the Arctic data archived and available, go to the ADE website (http://www.nsidc.org/acadis/search).

ACADIS, funded by NSF, is a joint effort by the National Center for Atmospheric Research (NCAR), the University Corporation for Atmospheric Research (UCAR), and the National Snow and Ice Data Center (NSIDC).

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

Toni Rosati is one of the ACADIS Community Support Team members. Photos of other team members will be featured in future updates. Photo courtesy of Toni Rosati.

"Cyberinfrastructure for Polar Sciences" Workshop Report

By: Jonathan Pundsack, Managing Director of the Polar Geospatial Center

NSF Workshop on Cyberinfrastructure for Polar Sciences group participants at the University of Minnesota McNamara Alumni Center. Photo courtesy of Mark Parsons, Rensselaer Polytechnic Institute.

In mid-September, the Polar Geospatial Center hosted the NSF-Sponsored Workshop on Cyberinfrastructure for Polar Sciences (http://www.pgc.umn.edu/meetings/cyber2013/main) at the University of Minnesota McNamara Alumni Center. The workshop featured invited talks, plenary discussions, and breakout sessions, and was attended by approximately 60 in-person participants. In addition, community members were invited to participate virtually. Plenary talks (downloadable as a PDF document) and recorded video presentations are available on the workshop website (http://www.pgc.umn.edu/meetings/cyber2013).

Workshop Background and Goals

The Polar Cyberinfrastructure Program (http://www.nsf.gov/funding/pgm_summ.jsp?) at NSF (http://www.nsf.gov/) has the potential to transform polar research by facilitating the transmission and integration of data and knowledge across the polar and cyberinfrastructure (CI) communities. Community input is essential to the process of realizing these goals to ensure that the infrastructure investments meet the on-the-ground requirements of scientists working in each domain. For the program to meet the needs of the science community, stakeholders from the broadest range of science domains must be engaged in defining and communicating their cyberinfrastructure needs and desires.

In order to support a strategic vision of the NSF Polar Cyberinfrastructure Program and to build on the EarthCube (http://earthcube.ning.com/) experience, a workshop on Cyberinfrastructure for Polar Sciences was held 10-12 September 2013 at the Polar Geospatial Center in St. Paul, Minnesota. The goal of this workshop was to engage scientists and engineers to ensure that the cyberinfrastructure needs for this community are aligned with the overall plans and design of a Polar Cyberinfrastructure Strategic Plan.

Workshop Products

The third day of the workshop was reserved for the Organizing Committee and select participants to begin framing and drafting a workshop report. The completed report will address connections between computer and polar sciences concerning what can be accomplished in the short-term (1-5 years) and long-term (5-10+ years). The outcomes of this workshop will support community-driven design and architecture of a polar science CI that is aligned with the following end-users' needs:

- Long-term sustainable curatorship, standardization, management, and discovery of data and metadata; visualization; manipulation; and analysis.
- Use of high performance computing (HPC) for direct and sustainable advances in current polar research.
- Big data and data access.
- Interoperability with data from other domains.
- E-learning and educational tools based on cyberinfrastructure components.
- Virtual organizations.

Workshop Recommendations

The workshop participants were surveyed for the top priorities of polar cyberinfrastructure component needs. The survey results were then categorized and collated. Four of the priorities stood out as requirement recommendations for the coming two years. These are:

1. Data as a Service (DaaS) – DaaS is clearly a common denominator and should be emphasized in program opportunities within the next two years. The goals are to provide on-demand data sharing through discovery, access, transportation, and delivery service to the end-user. The DaaS recommendation includes both data production and consumption, since the interface between the two requires interoperability on each side and this should be viewed, managed, and implemented according to system engineering best-practices to ensure openness and platform independence.

2. Education and Training – A variety of training forms ranging from informal workshops to formal education is essential to maintain a sustainable and cutting-edge polar CI to enable polar sciences.

3. Communication and Networking – Networking continues to be a major bottleneck in polar sciences. This includes syncing data with data centers when conducting fieldwork and freely moving data for polar research across data centers.

Workshop Organizing Committee Members

Alberto Behar - Arizona State University
Robin Bell - Lamont-Doherty Earth Observatory
Geoffrey Charles Fox - Indiana University, Bloomington
Jeff Dozier - University of California, Santa Barbara
John Helly - University of California, San Diego
Wenwen Li - Arizona State University
Paul Morin - University of Minnesota
Mark Parsons - Rensselaer Polytechnic Institute
Jonathan Pundsack - University of Minnesota
Andrew Roberts - Naval Postgraduate School
Marco Tedesco (ex officio) - NSF
Chaowei Yang - George Mason University

4. Community Building and Community Portals – Polar CI is an emerging community crossing many disciplines, and the community needs proper mechanisms to improve the awareness, advance the building and utilization, and sustain the evolution of Polar CI. Polar cyberinfrastructure is recommended for:

    - Fostering smart phone sensor polar network communication.
    - Increasing satellite bandwidth for scientists conducting polar field trips to move the data from/to the polar regions.
    - Suppling fast and reliable Internet connection for polar research.
    - Sharing and standardizing tools for moving data to/from polar regions.

Other components, notably modeling and data analysis including visualization, algorithms, and software, will be addressed by subsequent workshops. Their planning horizons will be blended with these recommendations.

A report from the workshop will be made available prior to the 2013 American Geophysical Union Fall Meeting and distributed via the workshop website and other channels.

For more information, visit the workshop website (http://www.pgc.umn.edu/meetings/cyber2013/main) or contact Jonathan Pundsack, Managing Director of the Polar Geospatial Center (pundsack@umn.edu).

Jonathan Pundsack has more than a decade of experience in science program management, primarily related to the Arctic and Antarctic. Prior to joining the Polar Geospatial Center in April 2012, he served as a Program Manager at the Arctic Research Consortium of the U.S., and before that as the Executive Director of the Arctic-CHAMP Science Management Office at the University of New Hampshire. Photo courtesy of Scott Feeney.

Considerations for Data Management in the "Cloud"

By: Heather Fiebing and Sarah Wolfe, through support provided by the SPAWAR Office of Polar Programs, are the Information Security Lead and the Polar Contract Program Manager for the NSF Division of Polar Programs

(See: Information Security and Risk Management Program for Arctic Sciences (http://www.arcus.org/witness-the-arctic/2012/3/article/19454) in Witness, Fall 2012.)

Heather Fiebing, through support provided by the SPAWAR Office of Polar Programs, is the Information Security Lead for the NSF Division of Polar Programs Arctic Sciences Section, Photo courtesy of Andrew Archer.

Cloud computing—using a set of hardware, networks, storage, services, and interfaces that combine to deliver data storage and management over the internet—presents a paradigm shift in how we think about information technology (IT) services, solutions, and risks. The Space and Naval Warfare Systems Command (SPAWAR, security arm of the U.S. Navy) is working with the NSF Arctic Sciences Section Information Security and Risk Management Program to help protect the confidentiality, integrity, and availability of information supporting and generated by the Arctic research community.

Sarah Wolfe, through support provided by the SPAWAR Office of Polar Programs, is the Polar Contract Program Manager for the NSF Division of Polar Programs, Photo courtesy of Heather Fiebing.

Aside from the technology considerations, cloud services require thorough evaluation of business and contracting options to determine the best fit for your needs. The Information Security and Risk Management Program offers the following advice.

Step 1: Have your own house in order

- *Document requirements*: Clearly define what you require from a cloud solution and why the cloud is the best approach to addressing your needs. How will the system be used, what information will be stored, who will be using it, and how will the data and services be managed?
- *Understand the data*. Know what information you'll be sending to the cloud and how that information should be protected. Evaluate the potential outcomes of lost, deleted, stolen, or misused data.
- *Recognize that the responsibility is ultimately yours*. Even with a thorough contract and service level agreement (SLA), the integrity, confidentiality, and availability of information is ultimately your responsibility, so always have a backup plan.
- *Protect information in transit and at rest*. All information should be encrypted when transmitted via the internet, including when traveling to and from the cloud. Be sure the cloud service provides a secure mechanism for transmitting information. Additionally, encrypt individual files stored in the cloud that require privacy and confidentiality.

Step 2: Select a cloud deployment model and service

Deployment Models:

- *Private*: For use by a single organization.
- *Public*: For use by the general public.
- *Community*: For use by a specific community of organizations with a shared purpose.
- *Hybrid*: A composition of two or more models (public, private, community).

Cloud Services and Responsibilities:

- *Infrastructure as a Service (IaaS)* - Provider is responsible for the cloud infrastructure. Customer is responsible for all aspects of system and application management and security.
- *Platform as a Service (PaaS)* - Provider is responsible for the cloud infrastructure. Provider and customer are responsible for different aspects of system and application management and security depending on the service.
- *Software as a Service (SaaS)* - Provider is responsible for the cloud infrastructure, systems, and hosted applications. Customer is only responsible for limited, application-level preference configurations and administrative settings.

Step 3: Review agreements and contract

Every cloud service provider requires end user agreements and terms of use, and every customer should require their provider to adhere to an SLA. The SLA should define performance expectations, how performance will be measured (response time, resolution/mitigation time, availability, etc.), and what enforcement mechanisms will ensure the SLA is met (timely notification of a failure to meet a requirement, and evidence that problems have been resolved or mitigated). Usually providers have an SLA that covers services rendered for all customers rather than agreeing to a unique SLA for each customer they serve. Therefore you should review SLAs from numerous providers to identify the level of service your solution requires. Other details to consider:

- Defined delineation between the responsibilities of the customer and provider.
- Agreed upon standards for cloud service procurements and performance.
- Requirements for provider responsibilities to maintain the security and integrity of data.
- If managing privacy data, identify potential privacy risks and responsibilities. How and when will you be notified in the case of a suspected breach of confidentiality?
- If the provider outsources some services to a third party, protections should be equally strong regardless of who is providing the service.
- How data is handled in the cloud environment when deleted/removed by the customer. Are there any restrictions for how customers remove data and files from the cloud ?
- Conditions for canceling services and switching providers. Ensure the provider agrees to delete all of your data from their environment if services are canceled.
- By default most SLAs do not address penalties if the agreement is not met. Ensure the service provider agrees to an appropriate consequence in the case of a failure to provide services.

Step 4: Review provider ability to provide services

- Research the ability of the service provider to meet your expectation for services. Request details from the provider on the size and capabilities of their infrastructure and storage capacity, and the method they use to determine the amount of resources to dedicate to individual customers.
- The provider suite of services should include a clear plan for business continuity and disaster recovery. Be sure to understand the scenarios this plan applies to, the roles and responsibilities of the provider and customer, and the mechanisms the provider uses to respond to and recover from a disaster.
- Research the history, financials, and quality of provider services. Request references and perform internet searches to inquire with other customers. Also inquire if the provider undergoes independent audits and is willing to provide audit results to customers.
- Where will your data reside? How do they respond to government inquiries for information on customers? How do they respond to complaints regarding their services?

For further information, please contact Heather Fiebing (fiebing_heather@bah.com) or Sarah Wolfe (wolfe_sarah@bah.com).

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Innovative Field Course Offers Climate Change Lessons for Classroom Teachers

Nine classroom teachers traveled to interior Alaska in July of 2013 for an innovative teacher-training course in climate change. The four-day field course, entitled "Climate Change: Seeing, Understanding, and Teaching" and held in Denali National Park, was facilitated by the Arctic Research Consortium of the U.S. (ARCUS) in partnership with Alaska Geographic and the National Park Service. Participants traveled throughout the park to view evidence of climate change in the ecosystem including tundra dynamics, receding glaciers, and shifting habitats. The course was co-taught by Sarah Bartholow, PolarTREC education project manager at ARCUS, and Dave Shirokauer, physical and social science manager at Denali National Park and Preserve.

National Park Service physical and social science manager Dave Shirokauer leads a lecture on current tundra conditions. Photo courtesy of Sarah Bartholow.

A goal of the field course was to provide classroom teachers with experience and information about climate change, which they could integrate into existing science education curricula. For example, retreating glaciers on the north side of the Alaska Range provided an illustration of the impacts of climate change. Shirokauer presented photographs taken in 1931 and 2004 to compare with what is visible today. This comparison illustrated nearly 800 ft. of ice depth lost in the past 80 years. A sample lesson plan, based on these ecosystem changes, is posted on the PolarTREC website (http://www.polartrec.com/resources/lesson/an-introduction-to-repeat-photography).

An innovative feature of this field course was the role of PolarTREC alumni Susan Steiner as a teacher-leader. Steiner, a classroom teacher, had previous experience as a PolarTREC teacher working on a changing seasonality of tundra nutrients project (http://www.polartrec.com/expeditions/tundra-nutrient-seasonality) at Toolik Field Station, Alaska. This experience helped foster her understanding of the impacts of climate change, which she shared with other participants helping them to incorporate climate change science in their lesson plans.

Additional science education and communication resources for educators and researchers are available via the ARCUS PolarTREC (http://www.polartrec.com/) program, the Association of Polar Early Career Scientists (APECS) (http://www.apecs.is/), and Polar Educators International (PEI) (http://www.polareducator.org/).

For further information about the July 2013 field course, please contact Sarah Bartholow (sbartholow@arcus.org).

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Spring Break on Ice: U.S. Naval Academy Polar Science Program Field Activities in Barrow, Alaska

By: Lieutenant Commander John Woods, U.S. Naval Academy (USNA) Polar Science Program (PSP)
Gina Henderson, U.S. Naval Academy (USNA) Polar Science Program (PSP)
Cathy Geiger, University of Delaware (UD) Geography Department
Ignatius Rigor, University of Washington APL (Applied Physics Lab) Polar Science Center (PSC)
Tracy DeLiberty, University of Delaware (UD) Geography Department

For the majority of undergraduate students, the term "spring break" is synonymous with sun, surf and, sand. However, this was not the case for five students from the United States Naval Academy (USNA) this past March. The newly developed and fast-growing Polar Science Program (PSP) (http://www.usna.edu/PSP) of the USNA's Oceanography Department conducted its first Naval Academy Ice Experiment (NAICEX), based out of Barrow, Alaska, from 8-16 March 2013. NAICEX's goals were to: deploy a pair of Arctic Observing Platforms (dubbed "IceKids") to obtain visual, atmospheric, and underwater acoustics data for future analysis; introduce future Navy and Marine Corps Officers to the polar regions through field activities tied closely to course work; and to assist collaborators with sea ice and snow measurements.

Preparation for NAICEX

NAICEX was used as part of a senior capstone research project for engineering and oceanography students. In fall 2012, the midshipmen began working together to outline scientific parameters, such as underwater sound and atmospheric conditions, that are useful for understanding the rapidly changing Arctic environment. Two solar-powered autonomous Arctic observing platforms, the IceKid2-Acoustic and IceKid3-Temperature (http://usna.datatransport.org/monitor#icekid-3/camera0), were designed, built, and tested over the fall and early spring semesters in preparation for deployment during the field exercises (see Figure 1). Data collected by these platforms will be analyzed by midshipmen in future research projects.

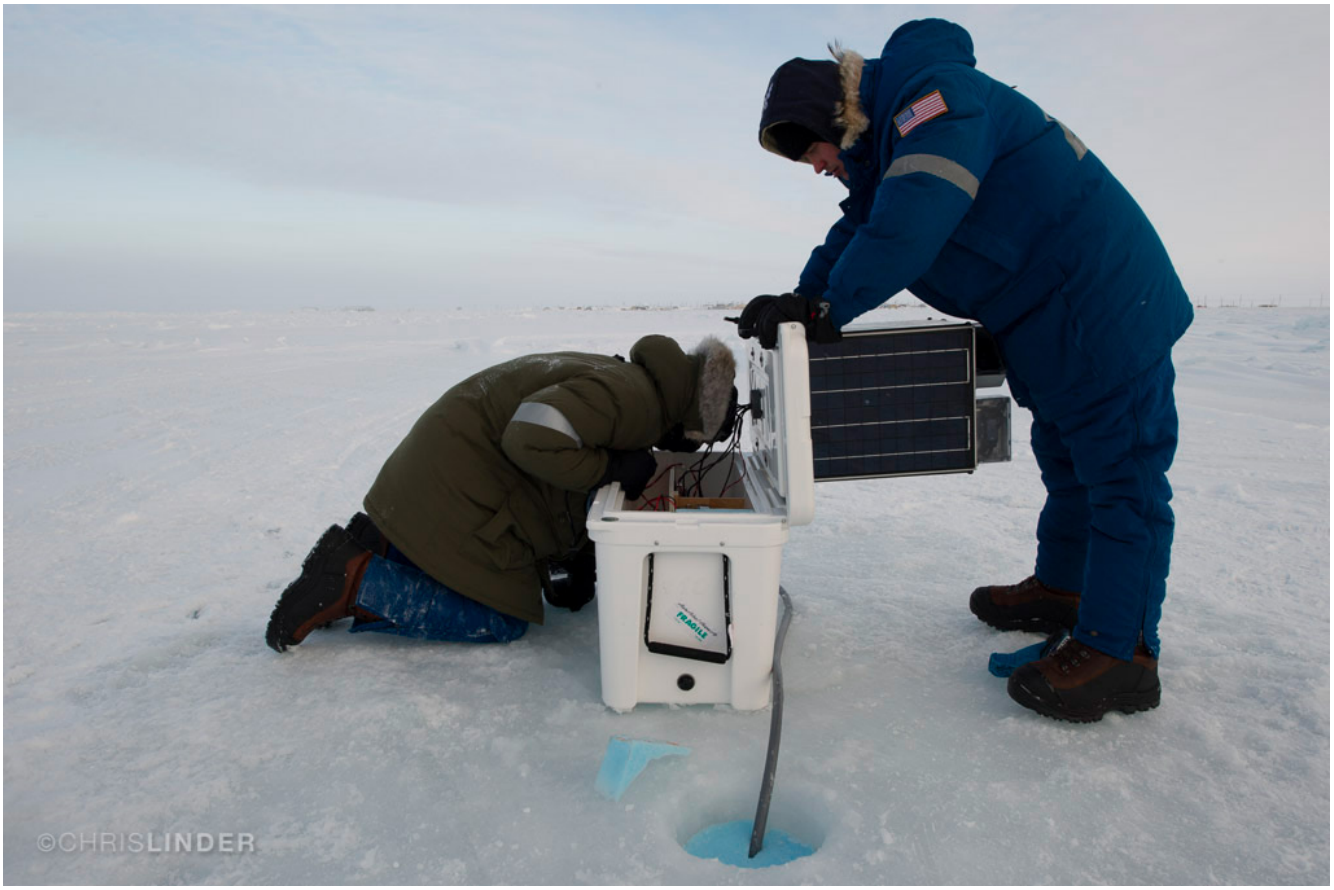

Figure 1. USNA Midshipmen Charles Newnam and Morgan Oblinsky troubleshoot the IceKid2-Acoustic (IK2A) Arctic Observing Platform. The IK2A autonomously collected over 12 hours of under ice sounds via a hydrophone. The data was transmitted back to USNA by Iridium Satellite Communications. Photo courtesy of Chris Linder.

Field and Outreach Experience

Five midshipmen from USNA collaborated with researchers from the University of Delaware (UD), the Polar Science Center (PSC) at the University of Washington, and a Naval Research Laboratory (NRL) team onboard a Twin Otter aircraft. USNA students directly participated in one over-flight on the NRL aircraft as well as ground measurements of snow and sea ice thickness to help better understand the relationship between aircraft data and in situ measurements (see Figures 2 and 3).

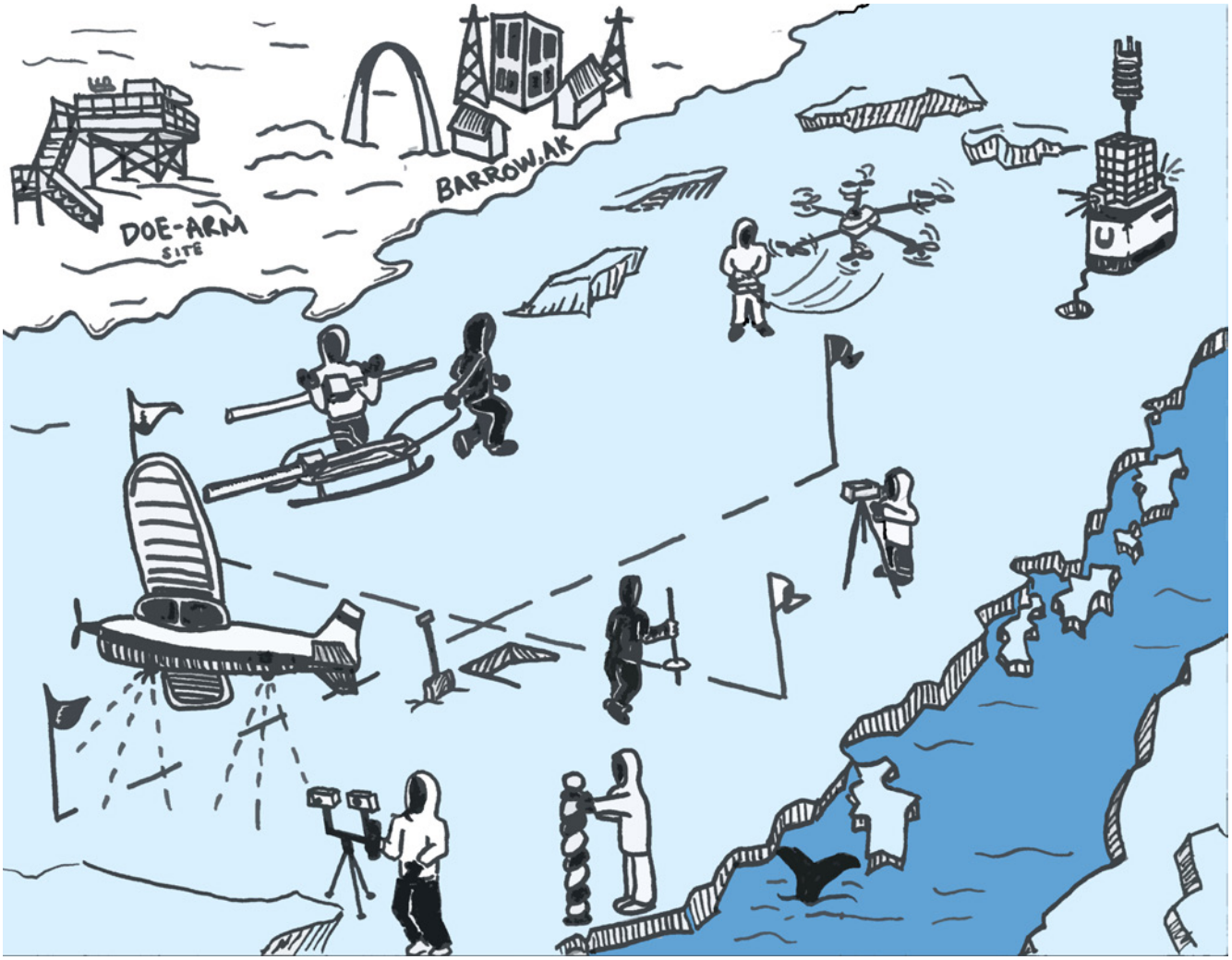

Figure 2. Schematic of the NAICEX Field Site. Highlighted activities are EM31, GIS Surveying, Sea Ice Drilling, Sea Ice Stereo Imaging, NRL Over-flights, and IceKid Arctic Observing Platform deployment. Image courtesy of Midshipman Haley Nowak.

The UD team was asked by USNA to organize the ice thickness survey, building from the successes of the USNA trip to Barrow the previous year. The primary educational goal was to establish a safe experience for undergraduate and graduate students. As first-year participants, UD's main contributions, included drill holes (see Figure 3), electromagnetic induction thickness retrievals, surveying and topography analysis, and stereo imagery. Thesis topics of UD students will focus on horizontal and vertical measurement accuracy by modifying traditional ice thickness methodologies. The UD activities were chosen to directly support airborne flights by NRL and NASA IceBridge programs as part of their MERLIN project (http://sites.udel.edu/merlinproject). Comparisons are underway between in-situ measurements and aerial instruments to improve our understanding of measurement uncertainties and changes in uncertainties from one scale to another.

Figure 3. Developing active-learning curriculum by collecting simple but effective measurements in the cold. Those engaged from right to left are Arnie from UMIAQ (red parka), Ph.D. Student Scott Sorensen (UD), USNA MIDN 1/C Dagmara Broniatowska (kneeling), Master's Student Renny Kane (UD), USNA LCDR John Woods (holding drill), Chris Linder (with camera), Cathy Geiger (UD) hunched over previous drill site, and CDR Angie Walker. Image courtesy of Tracy DeLiberty, UD.

The Polar Science Center team deployed the "Arctic Observing Experiment (AOX)" test site for the International Arctic Buoy Programme (IABP) (http://iabp.apl.washington.edu/). Site data will be used to reassess the accuracy of temperature, air pressure, GPS, and wind sensors typically used by the IABP. At the same time, a prototype "IceKid" was also deployed at the AOX site (see Figure 4), measuring temperature, air pressure, and winds using a new ultrasonic sensor. Observations from the AOX site will be collected for at least one year. Analysis of this data has already begun as a capstone project for a USNA senior oceanography major who is currently on a summer internship with PSC.

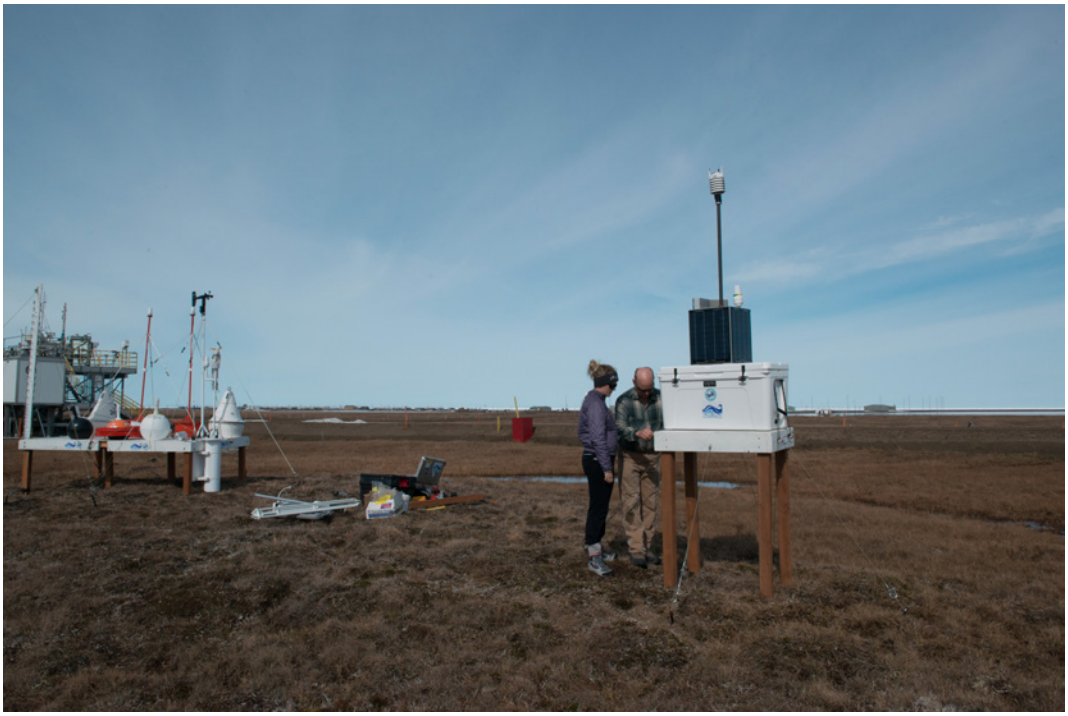

Figure 4. Midshipwoman Julia Zook, tightening the guy wires for the IceKid with Jim Johnson. The primary AOX test table is shown to the left, while on the horizon NARL can be seen to the left, and the old navy hangar can be seen to the right. Photo courtesy of Chris Linder.

In addition to the physical field exercises, there was an education and outreach component to NAICEX. Students worked side by side with local Inupiat on the ice, gaining knowledge and appreciation of those who call the North Slope home. They also participated as judges in the Barrow High School Science fair, and lead hands-on science, technology, engineering, and mathematics (STEM) activities such as building catapults and air gliders (Figure 5).

Figure 5. Midshipmen 1/C Molly Solmonson guiding Barrow High School students through STEM Activities during the annual Science Fair Expo. Photo courtesy of Chris Linder.

Successes and the Future of NAICEX

The NAICEX field exercises proved to be a great success for both students and collaborators alike. The participating midshipmen completed their research projects and presented initial results at the NSF-sponsored 9th Polar Technology Conference (http://polartech.datatransport.org/), and the USNA/ONR Research Poster Day. On graduation day, they were commissioned into the U.S. Navy and Marine Corps and may one day operate in similar harsh conditions. The field exercises provided valuable insight into the difficulties of performing tasks in arctic conditions, such as engineering failures due to cold and how mundane tasks become incredibly difficult when trying to perform them at 40˚F below zero. The students also gained an appreciation for the culture of communities that thrive on the North Slope. Data collected from the campaign can be accessed here (http://usna.edu/PSP/NAICEX_s13/NAICEX%20Real-time%20Data.php).

Future NAICEX programs are being planned in upcoming years with the purpose of exposing future Naval Officers to the rigors of fieldwork on the ice. The data sets collected will lead to more research projects, with a host of collaborators that will assist the scientific community in understanding the rapidly changing conditions. These future officers may one day find themselves operating on the Arctic Ocean, and this experience will benefit them through a better understanding of the challenges of this demanding environment.

NAICEX 2013 was supported by the Office of Naval Research (ONR) Polar and Global Prediction Program, the NSF Division of Polar Programs, the USNA Research Office, and the USNA STEM Office. UMIAQ (a subsidiary

of UIC) provided the field services support to the research team while on the ice.

For more information, see the NAICES website (http://www.usna.edu/PSP/NAICEX_s13/index.php) or contact LCDR John Woods, Polar Science Program, US Naval Academy (woods@usna.edu).

Lieutenant Commander John Woods is the coordinator for the United States Naval Academy (USNA) Polar Science Program (PSP). He is a Meteorology and Oceanography Officer (METOC) for the U.S. Navy and is currently assigned as a military instructor in the Oceanography Department. He completed tours as a Surface Warfare Officer on the USS Clevenland (LPD-7), Graduate studies at the Naval Postgraduate School, and was the Science Officer at the National Ice Center where he began to study changes in the Arctic and Antarctic sea ice. LCDR Woods participated in ICEX09 (Beaufort Sea), NASA ICEBRIDGE11 (Thule, Greenland) and NASA BROMEX12 (Barrow, AK) before leading NAICEX13.

Gina Henderson is an assistant professor in the Oceanography Department at the U.S. Naval Academy, and teaches courses in global climate change, physical geography, and atmospheric thermodynamics. As a climatologist, Henderson's primary research interests include understanding the role of snow cover in the hydrologic and global climate system. In particular she is interested in how snow influences atmospheric circulation and climate change through surface-atmosphere interaction using both climate data records and global climate models.

Cathy Geiger has been with the University of Delaware (UD) since 1998 where she currently works as a Research Associate Professor in the Geography Department at the College of Earth, Ocean, and Environment (CEOE). She coordinates an active research group through which several Master's and PhD students have developed expertise in sea ice, geography, and climatology. She is currently involved in editorship duties for the International Glaciological Society (IGS). Career highlights include participation in 12 high-latitude experiments in the Arctic and Antarctic and over 60 published works in sea ice and polar oceanography.

Ignatius Rigor, a climatologist from the University of Washington, studies Arctic and Antarctic sea ice, which is one of the primary indicators of global climate change. The ice waxes and wanes driven by variations in sunlight and temperature. Changes in wind also play an important role by redistributing the ice across the polar oceans creating areas of open water, and by compressing this ice into ridges. Making sense of the complex interplay between the air, ocean and sea ice is a challenging puzzle that motivates his research.

Tracy DeLiberty's interests are in the areas of physical and hydroclimatology, GIS, and remote sensing focusing on land surface interactions with climate (and vice versa) by investigating regional to global observations and remotely sensed datasets. She relies heavily on using GIS and image processing systems for visualization of the geographic data and for mapping and spatial analysis. Geographic areas investigated include the Southern Great Plains with her dissertation soil moisture work, the Amazon Basin, and more recently the polar areas examining sea ice thickness.

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Talking About Science

By: Lee McDavid, Arctic Program Manager, Dartmouth College, Dickey Center for International Understanding

A dozen teenagers from Greenland, Denmark, and the U.S. are twirling across the rolling tundra on the edge of the Greenland Ice Sheet laughing, looking as though they're just fooling around. But Dartmouth graduate students Julia Bradley-Cook and Ruth Heindel are leading them in a "carbon cycle dance" as a way to understand photosynthesis and other biological processes important to global warming.

Julia and Ruth are two of 24 Dartmouth doctoral students in earth sciences, ecology and evolutionary biology, and engineering who are fellows in the Integrated Graduate Education and Research Traineeship (IGERT) program, which is funded by the National Science Foundation.The Dartmouth IGERT, run by the Institute of Arctic Studies at the Dickey Center for International Understanding at Dartmouth, is a program in polar environmental change. While it is fundamentally an interdisciplinary curriculum in science, engineering, and the human dimensions of changing climate it also emphasizes science communication. What Julia and Ruth are doing with their students on the tundra may look silly, but their intent is serious—they are practicing one of the primary goals of the Dartmouth IGERT: to make science understandable, even fun, to yet another challenging audience.

"While dancing we talk about the added complexities of permafrost, a warming climate, and human consumption of fossil fuels," Ruth explains. "We also want to give the students a feeling for the work that we do each day in the field."

Ecology IGERT Julia Bradley-Cook talks to local middle school students during Science Day at Dartmouth. Photo courtesy of Lars Blackmore.

People often pick up science information from the media, not from the researchers who study the issues. But increasingly, scientists and engineers are being called upon to share their knowledge directly with policymakers and the public. Effective science communication is important to increasing the public's understanding of critical issues such as climate change, biodiversity, and energy policy.

For the past four years IGERT graduate students have been communicating with all sorts of unlikely audiences explaining properties of snow and ice, changes to the Greenland Ice Sheet, the composition of ice cores, the history of the earth's climate, threats to coastal communities from melting ice, and complex Arctic policy issues as well basic science concepts, in the hope that science, engineering, environmental change, and the research process will be more understandable.

Lauren Culler, who this summer completed a PhD in ecology and evolutionary biology, has become known as "The Mosquito Lady." In the course of her IGERT fellowship, she's talked to high school students, fly fishers, Greenland

Engineering IGERT Chris Polashenski talks to Greenland Radio host Henriette Rasmussen about his sea ice research. Photo courtesy of Dartmouth College IGERT program.

public radio, and landscape contractors, to name just a few. They even know her in Nunavut, where a local newspaper wrote a detailed article about her mosquito research and the consequences for Arctic communities of insect-borne diseases moving north. In Greenland she invited the community to share their local knowledge about climate variation and mosquito abundance to improve the research. Then she created a poster, translated into Kalaallisut, Danish, and English that diagrammed the life cycle of the mosquito and distributed it in Kangerlussuaq, Greenland. It became the talk of the town.

For the past two years, a group of IGERT students have tackled one of the most challenging audiences: excited four-year-olds at the Dartmouth Day Care Center. The kids tried on mukluk boots, held a whale's baleen and a musk ox pelt, and looked at maps of Greenland and diagrams of snow and ice. It's an educational show and tell.

"IGERT fellows learn to engage in different ways in order to improve their communication skills and to help increase the public's understanding of science," explains Ross Virginia, professor of environmental science and Principal Investigator (PI) of the Dartmouth IGERT.

For the past two years, students in the spring IGERT course have created short science videos for use in Greenlandic schools. "Greenlandic students want to understand why scientists come from around the world to study their ice sheet and the rapidly changing Arctic environment," explains Virginia, "so the IGERTs created videos to help explain climate change and introduce themselves as young people doing science. We hope they will inspire more Greenlandic students to study science."

Ecology IGERT Marcus Welker explains the aquatic life of the Arctic Ocean to four-year-olds at the Dartmouth Daycare Center. Photo courtesy of Lars Blackmore.

The graduate students have particularly enjoyed working with an NSF outreach initiative, the Joint Science Education Program (JSEP). JSEP brings together high school students from the U.S., Greenland, and Denmark to study science in Greenland. Dartmouth IGERT students have led field trips in Kangerlussuaq and at the NSF research facility, Summit Station, in Greenland so this international mix of students can study science as well as the process of scientific research and learn from one another.

IGERT students are not just thrown into a mosh pit with four-year-olds and climate skeptics. They receive training

in public speaking, video production, social media, and how to give a "30 second elevator speech" about their research to the public as well as government officials, community leaders, and experts in fields other than their own. The result has been dozens of presentations, a pub talk, a YouTube channel, radio and newspaper interviews, an Antarctic webcast, a lecture on an ice breaker, a photo in a roadside park display, and a bevy of enthusiastic followers of the IGERT student blog.

As part of a science outreach program sponsored by Dartmouth, Earth Sciences IGERT Laura Levy talks to a community group at the Salt Hill Pub in Lebanon, New Hampshire about past climate events. Photo courtesy of Lars Blackmore.

Over the past five years, the IGERT program graduated earth scientists, ecologists, and engineers who have communication skills that prepare them to face a world where the public's science literacy may hinge in part on the success of a carbon cycle dance.

For further information about the Dartmouth IGERT program, contact Lee McDavid (Lee.McDavid@dartmouth.edu).

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Arctic Forum 2013: Interagency Collaborations in Advancing Arctic Research

Brendan P. Kelly, on the far left, moderates the concluding discussion between panelists of the three Arctic Forum sessions. Photo Courtesy of Eddie Arrossi Photography and Video.

The 2013 Arctic Forum convened on 25 June in Washington D.C. with a focus on U.S. government interagency collaborations to advance Arctic research. The forum, sponsored by ARCUS with funding from NSF's Division of Polar Programs Arctic Sciences Section, was a featured section of the 2013 American Geophysical Union's (AGU) Science Policy Conference: Preparing for our Future (http://spc.agu.org/2013/).

Moderated by Brendan P. Kelly, Assistant Director, Polar Science, White House Office of Science and Technology Policy (OSTP), the Arctic Forum was organized into three panel sessions. Each panel discussion provided a different perspective on the opportunities and barriers to interagency collaboration in Arctic research, how research objectives are developed, and how the resulting information is shared with policymakers tasked with responding to rapid climate change.

The first session (http://spc.agu.org/2013/events/arctic-change-research-u-s-government-interagency-collaboration-i/) included panelists from the National Aeronautics and Space Administration (NASA) (http://www.nasa.gov/), Department of Energy (DOE) (http://energy.gov/), National Oceanic and Atmospheric Administration (NOAA) (http://www.noaa.gov/), and NSF (http://www.nsf.gov/)—four agency members of the Interagency Arctic Research Policy Committee (IARPC) (http://www.nsf.gov/geo/plr/arctic/iarpc/start.jsp). These panelists discussed the role of federal agency research within the context of carbon cycling and the Arctic marine ecosystem. The questions included what policy-makers should know about the carbon cycle, what resources their individual agency contributes to providing those answers, and how interagency collaboration facilitates those goals.

Some of the issues identified as key to policymakers included:

- Understanding the potential causes of abrupt climate change and feedbacks that might amplify the change.
- The basics of carbon sinks and storage.
- How the carbon balance might shift with changing climate.
- How changes interact on a system-wide level.
- The difficulty of developing policy to address these complex challenges.

Panelists observed that research objectives differed from agency to agency. For example, NOAA does both applied and basic research, DOE efforts are organized around carbon since it is the base for most energy, NASA's work focuses on earth system models and related data collection and interpretation systems, and NSF funds basic

research in a range of disciplines. Differences in research objectives and approaches, as well as organizational structures and cultures, create barriers to effective interagency communication and collaboration. However, there was general agreement that the effort to participate in IARPC activities is building a systems-based approach to research, helping to manage redundancies, and maximize efficient use of government research support.

During the second session (http://spc.agu.org/2013/events/arctic-change-research-u-s-government-interagency-collaboration-ii/) a different group of scientific program directors focused on the impacts of sea ice loss on infrastructure, human health, and marine and terrestrial environments. Panelists for this session included representatives from the U.S. Arctic Research Commission (USARC) (http://www.arctic.gov/), Office of Naval Research (ONR) (http://www.onr.navy.mil/), National Institutes of Health (NIH) (http://www.nih.gov/), and NSF's Division of Polar Programs (http://www.nsf.gov/div/index.jsp?div=PLR).

The information this panel identified as most critical to policymakers included:

- Understanding that sea ice observations (e.g., where the ice is, how fast it is moving, its condition) are a fundamental need for planning and assessing risks in both civil and research infrastructure.
- The need for improved predictions of when the Arctic will be ice-free in summer and what kinds of vessels will be required.
- An understanding of how climate change affects the lifestyles and associated health and mental health issues of northern communities.

Representatives from international and non-governmental organizations comprised the third session (http://spc.agu.org/2013/events/arctic-change-research-u-s-government-interagency-collaboration-iii/) panel. These panelists—from the University of Alberta (http://www.ualberta.ca/); the Aleutian/Pribilof Islands Association, Inc. (http://www.apiai.com/); the Smithsonian Institution (http://www.si.edu/); and the global research organization, Battelle (http://www.battelle.org/)-—provided perspectives on the government's role in Arctic research, additional opportunities for interagency collaborations, and potential research gaps. The panelists specifically highlighted several crucial needs and challenges:

- Economic, education, and public health issues rather than science and research generate the primary inputs for public policy.
- Further engagement of local indigenous communities in research activities.
- Understanding non-linear systems and feedback processes.
- Improved communication between agencies, which could facilitate the sort of opportunistic work that is seen in private-sector research.
- Including the costs of supporting collaboration in the initial funding structure.

There was substantial audience participation following each of the three sessions.

In addition to the series of panel discussions, Arctic Forum attendees presented posters during a networking session of the larger Science Policy Conference. An ARCUS poster on "Collaboration and the Science-Policy

Nexus in Arctic Research" shared best practices for building and sustaining research networks and for successful cross-disciplinary efforts. For more information about these best practices, please contact Helen Wiggins (helen@arcus.org).

For further information about the forum, including the agenda and speakers, please see the AGU Science Policy Conference website (http://spc.agu.org/2013/).

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Interagency Teams Formed to Implement Five-Year Arctic Research Plan

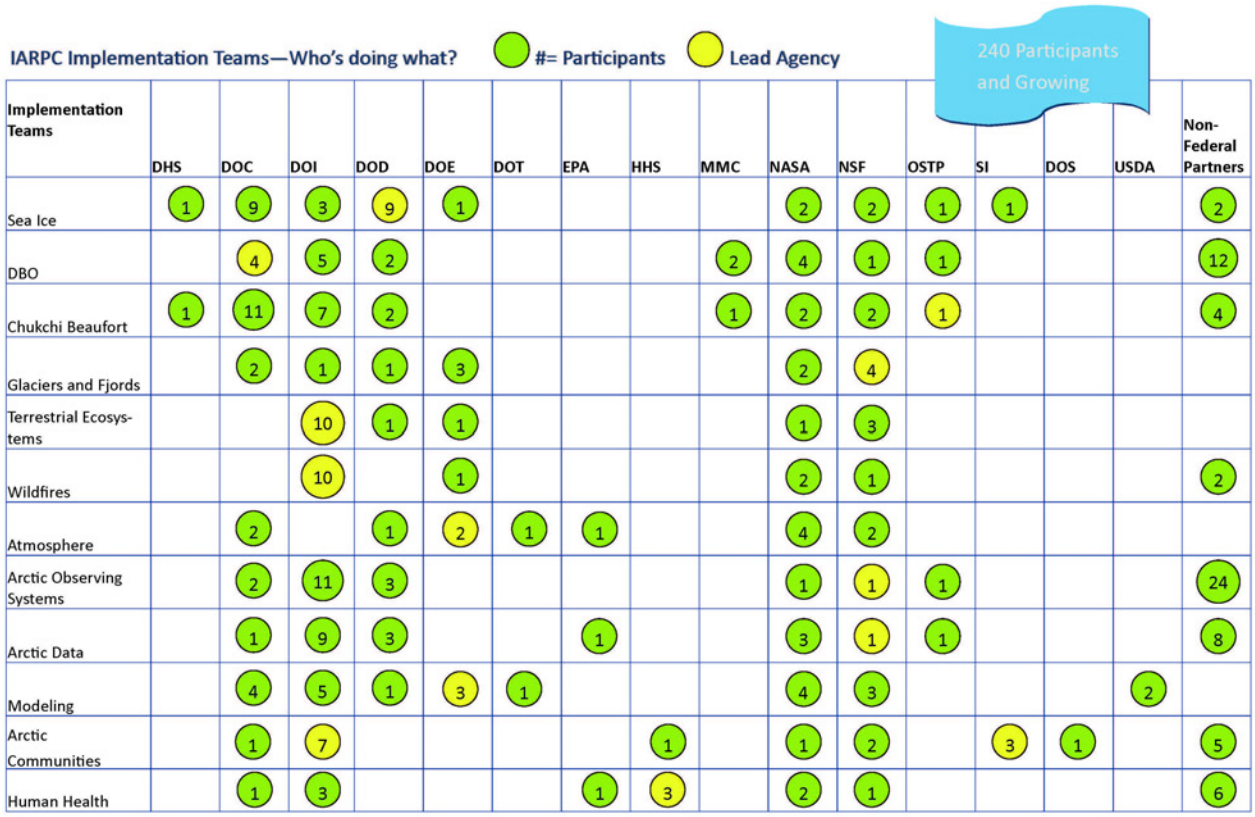
The Interagency Arctic Research Policy Committee (IARPC) has formed 14 interagency teams to implement the Administration's five-year *Arctic Research Plan: FY2013-2017* (http://www.whitehouse.gov/sites/default/files/microsites/ostp/2013_arctic_research_plan.pdf). The plan, released in February 2013, outlines key areas of study the federal government will undertake to better understand and predict environmental changes in the Arctic. The plan was developed by a team of experts (http://www.whitehouse.gov/blog/2010/08/23/nstc-coordinate-certain-arctic-research-policy-committee-activities) representing the 14 federal agencies that comprise IARPC and is based on input from collaborators including the Alaska Governor's Office, indigenous Arctic communities, local organizations, and universities. It highlights seven research areas that are both important to the development of national policies and well poised to benefit from interagency collaboration. Among the seven priority research areas are regional climate models, human health studies, and adaptation tools for communities.

The five-year *Arctic Research Plan* intentionally builds on the strong intellectual accomplishments and ideas of the research community at the federal, state, local, and tribal levels. It also includes ideas from the academic community, non-governmental organizations, and industry. The challenge is to continue to harness this scientific talent wherever it exists to address national Arctic research needs. Harnessing talent requires broad community participation and, therefore, the implementation teams will hold regular open meetings to coordinate domestic and international research in their focal areas.

The IARPC implementation teams, listed below, meet regularly to chart progress on meeting objectives outlined in the plan.

IARPC Implementation Teams, Chairs, and Agencies

Implementation Team	Chair(s), Agency
Sea Ice (SIIT)	Martin Jeffries, ARC; Tom Wagner, NASA
Distributed Biological Observatory (DBOIT)	Sue Moore, NOAA
Chukchi/Beaufort Ecosystems (CBIT)	Brendan Kelly, OSTP
Glaciers and Fjords (GFIT)	William Wiseman and Hedy Edmonds, NSF
Terrestrial Ecosystems (TEIT)	Carl Markon, DOI; John Payne, NSSI
Wildfires (WIT)	Kent Slaughter, DOI
Atmosphere (AIT)	Wanda Ferrell and Ashley Williamson, DOE
Arctic Observing Systems (AOSIT)	Erica Key, NSF
Arctic Data (ADIT)	Marco Tedesco, NSF
Modeling (MIT)	Mike Kuperberg, DOE
Human Health (HHIT)	Alan Parkinson, CDC
Arctic Communities, Local Priorities (ACIT-SG1)	Anna Kerttula, NSF
Arctic Communities, Scenarios and Food Security (ACIT-SG2)	Bill Fitzhugh, Smithsonian Institution
Arctic Communities, Language and Culture (ACIT-SG3)	Igor Krupnik, Smithsonian Institution



Implementation Teams	DHS	DOC	DOI	DOD	DOE	DOT	EPA	HHS	MMC	NASA	NSF	OSTP	SI	DOS	USDA	Non-Federal Partners
Sea Ice	1	9	3	9	1					2	2	1	1			2
DBO		4	5	2					2	4	1	1				12
Chukchi Beaufort	1	11	7	2					1	2	2	1				4
Glaciers and Fjords		2	1	1	3					2	4					
Terrestrial Ecosys-tems			10	1	1					1	3					
Wildfires			10		1					2	1					2
Atmosphere		2		1	2	1	1			4	2					
Arctic Observing Systems		2	11	3						1	1	1				24
Arctic Data		1	9	3			1			3	1	1				8
Modeling		4	5	1	3	1				4	3				2	
Arctic Communities		1	7					1		1	2		3	1		5
Human Health		1	3				1	3		2	1					6

Participation by federal agencies in IARPC implementation teams. The number and variety of non-federal partners is growing. Image courtesy of IARPC.

Some early accomplishments of IARPC teams include hosting a workshop to develop a conceptual model of the Chukchi and Beaufort Seas ecosystems, developing a mechanism for real-time data sharing within the Distributed Biological Observatory, developing tools for strategic querying of cross-cutting research investments, and contributing to the "Stewardship Line of Effort" of the *National Strategy for the Arctic Region* (http://www.whitehouse.gov/sites/default/files/docs/nat_arctic_strategy.pdf).

On 9 December 2013, IARPC and SEARCH (http://www.arcus.org/search) will co-host an Arctic Research Town Hall meeting at the American Geophysical Union Fall Meeting in San Francisco. In early 2014, IARPC will roll out a new website which will serve as a public forum for learning about Arctic research as well as provide a moderated workspace for the implementation teams.

For more information about IARPC, contact Sara Bowden (bowden@arcus.org).

Alaska's Rural Water and Sanitation Conundrum

By: Cheryl Rosa, DVM, PhD, Deputy Director/Alaska Director, U.S. Arctic Research Commission

The United States Arctic Research Commission is an independent U.S. federal agency tasked with advising Congress and the Office of the President on Arctic-related matters. The USARC develops national Arctic research policy, facilitates research cooperation, reviews federal Arctic research programs, and facilitates cooperation with Alaska and international partners. Its biennial "Goals Report" contains five research priorities for Arctic research. One of these five priorities is Arctic Human Health. The following article pertains to this priority. For more information, please see the USARC 2013-14 Goals Report (http://www.artic.gov/Goals_report).

Introduction: Water Security in Alaska: It's not just toilets we're talking about.

Water is needed for many purposes in daily life, including drinking, cooking, cleaning, and general hygiene. Much of the scientific discourse on water is focused on its quality but researchers have recently found that water quantity is also a factor critical to health in Alaska's rural villages.

Washing hands with clean water is something most people in the U.S. take for granted. Little thought is given to the importance of hand washing to remove bacteria, viruses, and other infectious particles that cause disease because it is an automatic act and the water is just there. However, for Alaska's rural residents, this is often not the case.

When people pay for water by the gallon, thought must be given to the quantity used. In many rural Alaskan communities, where jobs are scarce and household income is low, the cost of water is a significant economic issue that leads to household water rationing. With respect to hand washing, this type of water conservation often leads to the use of a communal washbasin, in which many people rinse their hands in the same water over the course of a day. These washbasins serve as transmission points for disease and, in some cases, have been measured to contain levels of microbial activity close to that of raw sewage by the time they are emptied. Recent Alaska-based research has shown that people who live in a place that has ample amounts of clean water for hand washing ("water secure") are likely to be healthier. Conversely, people who live in places that are not water secure have a significantly higher risk of certain "water-washed" diseases, such as pneumococcal disease (pneumonia, meningitis, etc.), respiratory syncytial virus (RSV) and a variety of skin diseases (including boils and infection with methicillin resistant S. aureus or MRSA).

Water holding tank and pump system typical of rural Alaskan homes. Photo courtesy of B. Lefferts.

Example of a village-based small vehicle waste haul system. Photo courtesy of B. Lefferts.

Over 5,000 rural homes in Alaska are considered "unserved[1] " at this time. More than 2,000 of these homes are considered "non-serviceable[2] " via traditional approaches (e.g., pipe or haul systems) because of concerns related to capital costs. Water and wastewater systems all over the state of Alaska are failing or out of regulatory compliance.

The need is increasing and funding is decreasing.

Conservatively, it would cost over $700 million to meet existing rural Alaskan water and sanitation needs and an additional $200 million for a growing number of minor needs and improvements. Operations and maintenance (O&M) costs are rarely included when funding is appropriated for a new water or sewer system. Many rural communities cannot afford to foot these O&M bills and, as a result, aging systems are failing due to lack of maintenance. Concurrently, as heating oil and gas prices rise, functioning systems are becoming unaffordable to use and maintain. Finally, climate change is adding a new layer to an already complex problem, stressing existing systems. Melting permafrost causing increased total solids in ground water (which typical filtration membranes cannot handle) and alterations in the timing of snowpack melt (resulting in a need for altered water storage strategies) are examples of these changes.

Example of a centralized disposal bunker and dumpster for village in-home 'honey bucket' waste. A honey bucket is a bucket that is used as a toilet in communities that lack a water-borne sewage system. Image courtesy of The Rural Alaska Water and Sanitation Working Group.

The bottom line: many existing water and sanitation systems in Alaska are unsustainable over the long-term. There is insufficient federal or state funding to serve the 5,000-plus unserved homes in Alaska or to make other essential improvements. Health problems are expected to increase with the decrease in hand washing and body hygiene that will follow service declines. Innovation is one way to address these issues.

So what can be done?

Money is short and need is high. Innovative technologies may be a partial solution to this problem. In this case it may not be new inventions that are needed, instead, the new application of tried-and-true technologies so that they function well in Arctic and sub-Arctic settings holds promise. An example of this is application of gray water[3] recycling technologies to in-home systems in rural Alaska. To flush a toilet with water previously used during showering or while washing clothes not only saves on the amount of delivered water used (and charged for) but also decreases the amount of wastewater that needs to be hauled away from the home. Low flow fixtures are another technology widely used in arid regions of the U.S., but not currently employed in Alaska. Investigation into their use and the behaviors surrounding their use is needed. Low flow fixtures must allow for adequate hand washing and the related improvement in health outcomes. The State of Alaska is currently promoting an effort to encourage this type of innovation. "The Alaska Water and Sewer Challenge" (http://dec.alaska.gov/water

/watersewerchallenge/index.html) is a request for proposals (RFP) intended to spur worldwide research to develop innovative and cost-effective water and sewer systems for homes in remote Alaska villages. This endeavor focuses on decentralized water and wastewater treatment, recycling, and water minimization. The ultimate goals are a decrease in capital and user costs of in-home running water and sewer in rural Alaska homes and improvements in health outcomes. The RFP opened on 15 August and will close 15 November 2013 at 1:30 pm.

Innovation can also mean applying management systems in new ways. During the 1990s the State of Alaska funded a proposal called the Local Utilities Matching Program (LUMP). While achieving what may be the #1 worst acronym in the field, it also made significant advances in rural water and sewer management. In the case of LUMP, a $480,000 state appropriation was used to match residential user fees dollar-for-dollar. It was capped at $10,000 per village, per quarter. This program encouraged communities to collect user fees, which increased during the program; promoted trained operator retention, which is a huge problem in rural areas; reduced non-compliance enforcement costs by upping compliance to a startling 100%; and facilitated preventative maintenance programs, a critical need and a great topic for future discussion. So what happened? LUMP worked but the money ran out. The Alaska Rural Water and Sanitation Workgroup is currently evaluating parts of this pilot program for potential revitalization.

There are a variety of entities in Alaska working towards improving health outcomes in rural Alaska by providing and improving water services in villages. The U.S. Arctic Research Commission (USARC) is coordinating these groups so that this work is maximally efficient and ideas can be shared between federal, state, Alaska Native (AN), and academic groups. Called the Alaska Rural Water and Sanitation Workgroup, their work is directly applicable to USARC's priority goal of Arctic Human Health. Especially important is the interface between health, engineering, and AN groups knowledgeable about socio-behavioral practices in their communities. The integration of these ideas allows research on subjects such as hand washing to be more successfully incorporated into planning for new water systems. The workgroup hopes that greater human health improvements can be made more rapidly through this partnering effort.

More information about the USARC Report on the Goals and Objectives for Arctic Research 2013-2014 and other USARC activities can be found on the USARC website (http://www.arctic.gov/) or contact Cheryl Rosa (crosa@arctic.gov).

End Notes

1. Unserved homes are homes without running water and wastewater service within the home. ↩

2. Non-serviceable homes are homes that do not have running water and wastewater service AND cannot be provided service even if available within the community for various reasons such as: the home is not structurally sound, does not have a thermostatically controlled heat source, is too far from the community center to feasibly serve, is too small or is not a year round occupied home. ↩

3. The relatively clean waste water from baths, sinks, washing machines, and other kitchen appliances. ↩

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Polar Research Board Study on Emerging Research Questions in the Arctic

By: Lauren M. Brown, Research Associate, National Academy of Sciences, Polar Research Board

Arctic research has gained substantial prominence during the last decade, as change in this region has been system-wide and has progressed at a rate exceeding expectations. Public attention has grown as well, a result of reductions in sea-ice, increased threats to homes from coastal erosion, loss of land ice and the implications for sea-level, thawing of permafrost and what that might mean for climate change and for Arctic and sub-Arctic infrastructure, and the exposure brought by the International Polar Year 2007-2008. Because of the unique challenges of conducting research in any polar environment, we often plan what research can be done rather than what might be done, allowing our vision to be constrained by practical limitations; but a big picture vision is valuable, even if not all can be made to happen, because it provides challenges and future directions.

The Committee on Emerging Research Questions in the Arctic (http://www8.nationalacademies.org/cp/projectview.aspx?key=49516) was convened under the auspices of the U.S. National Academy of Sciences (http://www.nasonline.org/) Polar Research Board (http://dels.nas.edu/prb) in early 2013. Sponsored by NSF (http://www.nsf.gov/), the National Aeronautics and Space Administration (NASA) (http://www.nasa.gov/), the National Oceanic and Atmospheric Administration (NOAA) (http://www.noaa.gov/), the Department of Energy (DOE) (http://energy.gov/), the Smithsonian Institution (http://www.si.edu/), and the U.S. Arctic Research Commission (USARC) (http://www.arctic.gov/), this activity is designed to provide guidance on future research questions in the Arctic over the next 10-20 years. The committee will identify the key scientific questions that are emerging in different realms of Arctic science, exploring both disciplinary realms (e.g., marine, terrestrial, atmosphere, cryosphere, and social sciences) and cross-cutting realms (e.g., integrated systems science and sustainability science). Based on the emerging research questions, the committee will also help identify research infrastructure needs (e.g., observation networks, computing and data management, ship requirements, and shore facilities) and collaboration opportunities. Attention will be given to assessing needs where there may be a mismatch between rates of change and the pace of scientific research. Although it is understood that there is no one answer, the committee is asked to explore how agency decision-makers might achieve balance in their research portfolios and associated investments (e.g., what are some of the challenges of trying to do both problem-driven research and curiosity-driven research?). The goal is to guide future directions in U.S. Arctic research so that research is targeted on critical scientific and societal questions and conducted as effectively as possible.

Committee members were selected through a careful process, and nominations were received from a wide range of academic, industry, and private sources. National Academies' committees are selected to ensure that they contain the full range of disciplinary perspectives, technical expertise, and diversity of views needed to address the statement of task in an independent and objective manner. This committee is co-chaired by Stephanie Pfirman and

Henry Huntington. A full list of the 17 committee members and the statement of task can be found on the National Academies' current projects website (http://www8.nationalacademies.org/cp/projectview.aspx?key=49516).

Over the course of the past eight months, the committee has held two meetings, including a community workshop in Anchorage, Alaska. The two-day workshop (7-9 May 2013) was designed to allow broad community input in identifying research priorities. The committee interacted with numerous invited speakers and also developed an online questionnaire to allow for additional community participation.

During the coming months, the committee will continue to seek input from the Arctic community including a third meeting in Ottawa, Canada, to be held in conjunction with a Canadian Polar Commission meeting. The committee will use this opportunity to explore Canadian and international priorities for future Arctic research. Report writing will continue during fall 2013.

The report will undergo the National Academies' careful outside peer review process to ensure that the document addresses the statement of task and that it is accurate and comprehensive. Following the peer review process, the report will be released publicly and made available as a free PDF on the National Academies Press website (http://www.nap.edu/). The report is expected to be publicly available in spring 2014. To sign up to receive a notification when the report is available, use the online form available here (http://dels.emerging-research-questions-in-the-arctic.sgizmo.com/s3/).

The Polar Research Board (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 can be found on their website (http://dels.nas.edu/prb/).

News from the Arctic Institute of North America, University of Calgary

By: Maribeth S. Murray, Executive Director, Arctic Institute of North America, University of Calgary

The Arctic Institute of North America (AINA) (http://www.arctic.ucalgary.ca/) is a non-profit membership organization and a multi-disciplinary research institute at the University of Calgary. The Institute was created in 1945 by an act of Canadian Parliament. It's mandate is to advance the study of the North American and circumpolar Arctic through the natural and social sciences and the arts and humanities, to preserve and disseminate information on the physical, environmental, and social conditions in the North. The Arctic Institute is home to the Kluane Lake Research Station in Yukon Territory and the Arctic Science and Technology Information System, and it publishes the interdisciplinary Arctic Journal (http://arctic.ucalgary.ca/publications/arctic-journal).

On 1 July 2013, the institute welcomed Maribeth Murray as new Executive Director. Murray came to AINA as the Executive Director of the International Study of Arctic Change (ISAC) and was a faculty member at the University of Alaska Fairbanks. Her research is focused on the linkages among human and natural system dynamics in the North, marine ecosystem sustainability, and historical human ecology. Murray holds a BA in archaeology from Wilfrid Laurier University in Waterloo, an MA in archaeology from Memorial University of Newfoundland, and a PhD in anthropology from McMaster University.

AINA is now entering a new phase of growth that includes expanding research activities, developing an education and outreach program, enhancing facilities at the Kluane Lake Research Station, and implementing an Arctic research and information-sharing platform. Of interest to the wider research community is the following project.

Feasibility Study – Implementation of Circumpolar Biodiversity Monitoring Program (CBMP) Terrestrial Biodiversity Monitoring Protocols at Northern Canadian Research Facilities

The goal of this implementation study (http://www.arctic.ucalgary.ca/news/aug-28-2013/feasibility-study-%E2%80%93-implementation-of-cbmp-protocols-at-northern-canadian-research-) is to engage station mangers, the research community, and agencies charged with monitoring terrestrial biodiversity and resource management, in a dialogue to:

1. Assess alignment between current station-based activities (research and monitoring) and proposed CBMP activities;
2. Determine opportunities for harmonization with the CBMP plan;
3. Identify necessary resources and capacity building requirements to improve monitoring of the Focal Ecosystem Components identified by CBMP;
4. Assess how implementation of CBMP recommendations might improve research (capacity and results), decision-making, and the exchange of data and information among Canadian stations, researchers, and agencies, and with the international terrestrial research and monitoring communities.

For further information about the study, to offer input, or participate in the upcoming survey, please contact: Sian Williams, Station Manager, KLRS, Arctic Institute of North America, University of Calgary (sian.williams@ucalgary.ca) or Maribeth S. Murray, Executive Director, Arctic Institute of North America, University of Calgary (murraym@ucalgary.ca).

For further information about the Arctic Institute of North America (AINA), see the AINA website (http://www.arctic.ucalgary.ca/).

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International Study of Arctic Change: Arctic Observing Summit Update

By: Maribeth S. Murray, Executive Director, Arctic Institute of North America, University of Calgary

Planning for the second Arctic Observing Summit, AOS 2014, is now underway. The AOS is led by the International Study of Arctic Change (ISAC). It is a task of the Sustaining Arctic Observing Networks (SAON) process. SOAN is led jointly by the Arctic Council and the International Arctic Science Committee (IASC). The AOS is part of the implementation of the 'observing change' component of the ISAC Science Plan, which also encompasses understanding and responding to Arctic change and which is an iterative international scientific program. AOS 2014 will be built on the strong foundation laid in 2013.

A draft report from the first Summit, AOS 2013, will be released in November 2013 and a final report will be available in early 2014. The AOS will continue to be a key platform to address the observation needs of Arctic stakeholders and to foster international communication and coordination of long-term observations for improving understanding and responding to system scale Arctic change. The AOS is planned as a biennial event with future AOS meetings to be held in conjunction with the Arctic Science Summit Week (ASSW). AOS 2014 will convene 9-11 April during the 5-11 April 2014 ASSW (http://www.igbp.net/events/event/arcticsciencesummitweekassw2014.5.19b40be31390c033ede80003908.html) in Helsinki, Finland.

A Note From the Board President

In the last issue of Witness the Arctic Vera Alexander quoted Bob Dylan's song "The Times They Are A-Changin'" in reference to the myriad environmental, cultural, and political changes we're witnessing in the Arctic. As Vera's successor I've thought a lot about that quote and also thought about how fast things change in one's lifetime. I want to personally thank Vera for sharing, over the years, her keen insights and vast experience in Arctic research. ARCUS and Arctic research will benefit from her strong and enduring commitment to developing a multidisciplinary Arctic research community, poised to take on the challenges that we are facing today.

In another major transition this fall Susan Fox, our Executive Director, announced that she would be leaving ARCUS in late October to take the position of Executive Director of the Acoustical Society of America. Susan was at the helm of ARCUS for four and a half years – that time seems to have passed so quickly. I vividly remember her interview visit during a cold, ice-foggy, early January in Fairbanks and wondering if we'd brought our candidate in the worst possible weather. Susan not only endured the visit, she quickly accepted the position and then immersed herself in learning about all aspects of Arctic research: the community, ongoing and planned initiatives, agencies, and stakeholders. I will always appreciate her positive attitude, her direct approach to problem solving, and her work, along with the ARCUS staff, to getting the job done well. I wish her well in her new position and thank her for all she has done for ARCUS and Arctic research.

Over the next few months the ARCUS Board of Directors will be working to recruit and hire a new Executive Director. In the meantime, the board has assembled a transition committee of board and staff members that will develop a short-term plan to ensure that ongoing and planned ARCUS activities continue during the interim period.

The board and staff are energized and looking forward to the challenges and opportunities that lie ahead. We welcome several new members who've recently joined the board: David Cairns, Texas A&M University; Howard Epstein, University of Virginia; and John Payne, North Slope Science Initiative. Please visit the ARCUS website for more information about our entire Board of Directors (http://www.arcus.org/arcus/board-of-directors). Earlier this year the ARCUS board and staff held several Task Force sessions to continue developing a Strategic Plan that clearly articulates and reaffirms our values, vision, mission, and goals. Arctic researchers are at the center of the ARCUS focus and a major goal for ARCUS is to be the place where Arctic scientists come to develop and manage interdisciplinary and collaborative projects.

A number of board and staff members will be attending the 2013 American Geophysical Union Fall Meeting the week of 9-13 December in San Francisco, California. We look forward to visiting with researchers from our member institutions and learning about your research ideas and concerns.

Mike Retelle
President, ARCUS Board of Directors

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Witness the Arctic is published periodically by ARCUS. Any opinions, findings, conclusions, or recommendations expressed in this publication do not necessarily reflect the views of NSF.

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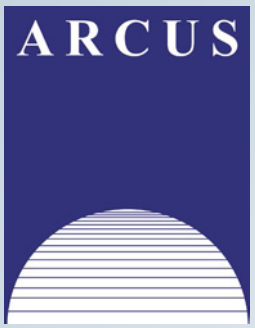

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