Witness The

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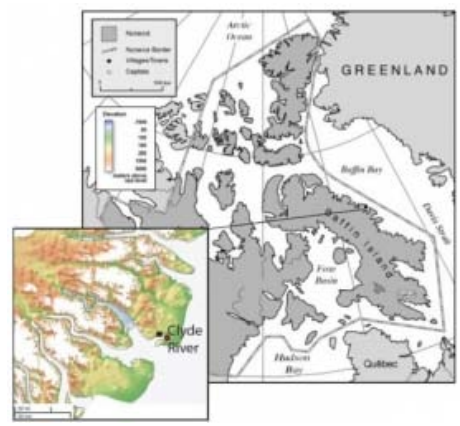
Linking Inuit Knowledge and Scientific Understanding of Environmental Change: A Case Study in Wind Observations

Introduction

Climate scientists and others investigating changes in the Arctic have increasingly incorporated indigenous knowledge and observations in their research. Valuable insights are gained by linking indigenous knowledge with scientific research; however, finding formal methods to connect culturally divergent observations can be a complicated task.

Dr. Shari Gearheard is a research scientist with the University of Colorado's National Snow and Ice Data Center. Unlike most of her scientific colleagues, she lives year-round in the small arctic town of Clyde River, an Inuit community of approximately 850 people located on the northeastern shore of Baffin Island in the Canadian territory of Nunavut. Gearheard has worked for over 15 years with Inuit hunters and Elders documenting their knowledge and observations of local changes in the climate and environment.



Map showing Clyde River on Baffin Island, Nunavut, Canada. Inset map shows location of Clyde River community. Image courtesy: Shari Gearheard

Case Study Introduction

During her studies, Gearheard has built connections with local people interested in working with scientists studying climate and environmental change in the Arctic. One product of these connections is a case study that analyzes the level of agreement between local weather station data and the observations of wind pattern changes made by local experts at Clyde River. The study revealed inconsistency between the two sets of observations. Clyde River Inuit report an increase of variability in wind speed and direction since the 1980s, but data from the local weather station did not consistently indicate the same changes in wind patterns over those years. For Gearheard, the differences in observations offer interesting lessons to be learned.

Inuit Observations of Wind Patterns

For many Inuit hunters in the Arctic, weather is the determining factor for daily activity. Of all weather variables, wind is the element that most concerns hunters. Travel and hunting activities are constrained by strong winds that reduce visibility with blowing snow and create hazardous conditions including whiteouts, large waves, and moving ice. Shifting wind directions can bring additional hazards such as fog, open water leads in the sea ice, and altered orientation of snow features. Gearheard has recorded over one hundred interviews with experienced, active hunters and Elders who have extensive knowledge of wind and weather processes.

Inuit travel long distances by snow machine and dog sled. Photo courtesy: Shari Gearheard

Uqalurait are tongue-shaped snowdrifts that form parallel to the prevailing wind direction and are used as navigational aids during poor visibility. Photo courtesy: Shari Gearheard

For Clyde River Elders, the most noticeable changes related to wind were a shift in the prevailing wind direction from northwest toward north, and an increase in variability of wind speeds and directions. Experienced hunters are able to keep track of wind direction and strength while traveling by observing surface snow forms, blowing snow, and clouds. The shift in prevailing seasonal wind direction affects snowdrifts that run parallel to prevailing wind and create directional navigation aids known as *uqulurait*. This can present dangerous circumstances for inexperienced travelers. Without expert skills in keeping track of the changes of shifting winds, they may follow the snowdrifts in the wrong direction and become lost. Observers also note that during the past 30 years winds may shift direction several times over the course of one to two days and pick up or die down suddenly, especially in the spring. This makes it difficult to predict conditions or know if it is safe to go out on the water or sea ice. Additionally, winter winds are now both stronger and longer lasting than in the past. These winds pack the snow so hard that it is difficult to build igloos for shelter in bad weather.

Clyde River observers make the point that although recent conditions have been mentioned in the past and weather has always been unpredictable, what is unprecedented is how quickly conditions are now changing and the persistence of this unpredictability over time.

Weather Station Records of Wind Patterns

Scientific observations of wind are made quite differently. Stationary instruments gather data individually and separately. In this study, statistical methods were used to interpret surface measurements made at the only available meteorological station for the area, maintained by Environment Canada at the Clyde River airport. Since 1977 this station has recorded hourly wind speed as a 2-minute average taken at the beginning of the hour. Time series data from 1980–2005 was analyzed on a monthly basis to allow comparison to the seasonal conditions reported by Clyde River Inuit. Both linear regression and a loess curve analyses were performed to identify overall trends in mean monthly wind speeds, wind direction, and wind variance.

Results indicated that on an annual basis, the proportion of winds exceeding 30 km/hr had not significantly changed, however, the proportion of wind less than 20km/hr had significantly decreased. The lower proportion of calm winds aligned with Inuit observations of generally windier conditions. In contrast, no consistent changes in the variability of wind speed and wind duration were apparent from statistical analyses of the data. Similar methods were used to examine the trends in mean wind direction and wind direction variance. No significant changes in wind direction were found, some increase in the mean range of wind directions was revealed, and there was no notable change in the prevalence of northwest winds according to station records.

Discussion of Divergent Observations

Overall there is limited agreement between Inuit observations and weather station data analyses of wind change at Clyde River. Gearheard and colleagues were particularly interested in what could be learned from the lack of agreement and suggest three possible explanations.

First, the weather station records are not representative of the areas where local hunters travel. The weather station is located near the sea in relatively flat terrain. Hunters often travel long distance in fjords that are bordered by high cliffs and mountains. Given the complex and varied topography of the area, a range of wind conditions is expected and the station may not be recording events that are of interest to local hunters. However, some correlation of general wind patterns could still be expected. Gearheard and colleagues suggest that future studies of wind variability should include data from additional weather stations (a new project by Gearheard and colleagues has since installed three new weather stations in the region). Gearheard's group also recommends that scientists collaborate more with local hunters to better understand the degree to which Inuit rely on information from the weather station, and learn more about their weather observing and forecasting techniques.

The second explanation considered is that because Inuit observations rely on personal recollections of events many years ago and on oral history records from older generations, they may be elastic. The importance of wind patterns may have changed over time. New technology and activity such as replacing dog teams with snowmobiles for hunting could have changed how weather was observed. Gearheard's research suggests that studies on long-term changes in hunter-wind interactions could clarify this possibility.

Thirdly, the study suggests that since Inuit and meteorological records do not observe the same phenomena, a comparison may be invalid. Inuit are more concerned with the sudden and unpredictable changes in wind patterns that affect safety in travel and hunting. Weather stations record events over different time scales, at a fixed location, and with no sensitivity to other environmental factors (such as blowing snow) that may increase perceived severity of wind at a given speed. Further study could account more precisely for the concerns and knowledge of Inuit in terms of various wind events and how those events might, or might not, be captured in weather station records.

Lessons for Designing Research Teams

Gearheard and colleagues suggest that future studies comparing observations and records of the same event might help understand the differences in perspective. For example, a sudden change in wind patterns reported by Inuit observers could be compared to records captured at the weather station for the same time. Comparison of complementary observations could reveal useful information about general wind patterns, frequency of events, and the difference between statistically and personally significant environmental changes.

Dr. Gearheard and other members of Sikulirijiit, Clyde River Nunavut sea ice experts working group edit maps for a publication. Photo courtesy: Shari Gearheard

Gearheard's continued work focuses on gathering additional data and coordinating projects that bring Inuit and scientists together to design and implement research. In a recent study of changes in weather persistence at Baker Lake, Nunavut, Canada, Inuit observations and understanding of weather variability was linked with results from prior meteorological studies to develop the research questions for the study. A current project entitled Siku-Inuit-Hila (Sea Ice-People-Weather) is a multidisciplinary and multicultural study of sea ice and sea use. In this innovative research model, project teams of indigenous experts from the communities of Barrow, Alaska; Clyde River, Nunavut, Canada; and Qaanaaq, Greenland work directly with sea ice scientists in all aspects of the study, including conceptualization, project design, field work, analysis, and reporting of results. Local community members monitor sea ice stations throughout the entire year, collecting sea ice thickness and temperature data and combining that information with their own qualitative observations. By bringing together Inuit knowledge, social science methods, and physical science, the team is able to examine the variability of sea ice characteristics on multiple scales through all seasons at three separate locations across the Arctic.

Gearheard notes that linking indigenous knowledge with climate change science requires recognition of the distinct differences between the two, and an understanding that neither is superior. Indigenous knowledge must be documented with care and in collaboration with indigenous partners to make sure that interpretation, analysis, and application of the information is correct.

For further information about Shari Gearheard's work, please see her website at the National Snow and Ice Data Center: **http://nsidc.org/research/bios/gearheard.html** or contact Dr. Gearheard at **shari.gearheard@nsidc.org**.

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SEARCH Updates

SEARCH Strategic Planning

The SEARCH Science Steering Committee (SSC) is continuing its strategic planning activities that began at the fall 2010 SSC meeting. As SEARCH is transitioning from a planning phase to an implementation phase, the SSC is developing a guiding vision, five-year goals, and an implementation plan to develop priorities and a clear path forward for SEARCH.

The SSC has developed a draft Vision and Mission statement focused on providing a scientific foundation to help society understand and respond to a rapidly changing Arctic. The SSC is finalizing the Vision and Mission with the SEARCH Interagency Program Management Committee and will distribute it in summer 2011.

The next stage of SEARCH strategic planning will be the development of five-year goals to provide specific priorities and to direct outcomes for the program. The SSC will meet in August to develop the 5-year goals, which will be finalized this fall.

Study of Environmental Arctic Change

Sea Ice Outlook and Sea Ice for Walrus Outlook

The Sea Ice Outlook 2011 season has been launched with a call for contributions for the first Outlook report, to be published in June. The SEARCH Sea Ice Outlook, supported by NSF, NOAA, and volunteer efforts, provides a synthesis of community projections of the September arctic sea ice minimum.

This year, the scientific synthesis of the pan-arctic outlooks will be led by Jim Overland (NOAA), and the synthesis of the regional outlooks will be led by Adrienne Tivy and Hajo Eicken (University of Alaska Fairbanks). Additions to this season's reports will include increased reporting of error estimates, further development of a data resources webpage, and information on sea ice thickness.

In March, ARCUS distributed a Sea Ice Outlook user survey, which was completed by 77 participants. The survey documented a wide variety of ways in which the Outlook is utilized: to evaluate modeling methods, as a classroom resource, as a tool for resource management, and others. A full report from the survey will be available this summer.

The Sea Ice for Walrus Outlook 2011 season has also been launched. The Sea Ice for Walrus Outlook provides weekly reports on sea ice and weather conditions as a resource for Alaska Native subsistence hunters, coastal communities, and others interested in sea ice and walrus. The weekly reports, which combine satellite imagery, forecasting, and local observations, began in early April and will continue through June.

Further information about the Sea Ice Outlook can be found at: **http://www.arcus.org/search/seaiceoutlook/**. For more information about the Sea Ice for Walrus Outlook, please go to: **http://www.arcus.org/search/siwo**.

SSC Welcomes New Members

Four new SSC members were recently appointed: Robert Bindschadler, Hydrospheric and Biospheric Sciences Laboratory, NASA Goddard Space Flight Center; Breck Bowden, Rubenstein School of Environment & Natural Resources, University of Vermont; Susan Crate, Department of Environmental Science and Policy, George Mason University; and Janet Intrieri, Earth System Research Laboratory, National Oceanic and Atmospheric Administration.

For more information about SEARCH activities, please go to: **http://www.arcus.org/search/** or contact Hajo Eicken, SEARCH SSC Chair, (**hajo.eicken@gi.alaska.edu**), or Helen Wiggins, SEARCH Project Office at ARCUS (**helen@arcus.org**).

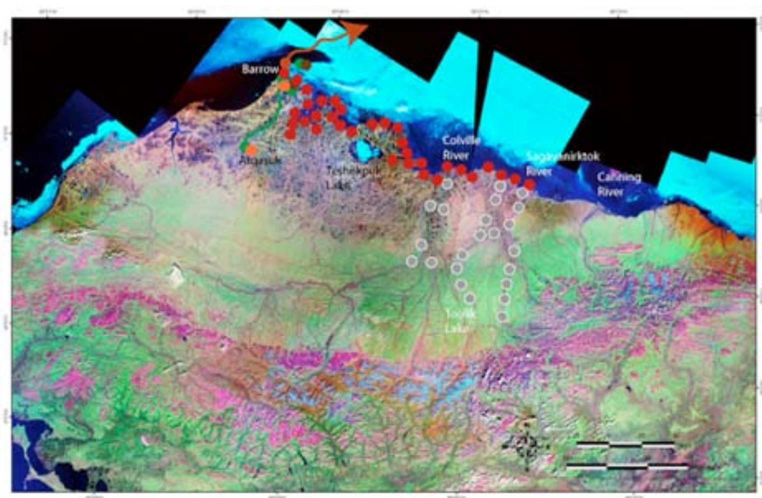
Study of the Northern Alaskan Coastal Systems (SNACS) Products Online

A compilation of products from the National Science Foundation-funded Study of the Northern Alaskan Coastal System (SNACS) research projects is now available online. SNACS projects focused on the arctic coastal zone of Alaska and addressed one or more aspects of two coupled themes:

- How vulnerable are the natural, human, and living systems of the coastal zone to current and future environmental changes in the Arctic?
- How do biogeochemical and biogeophysical feedbacks in the coastal zone amplify or dampen change locally and at the pan-arctic and global levels?

SNACS projects resulted in more than 60 journal publications, 88 conference presentations, and 25 other products.

For more information about SNACS and the list of products, see the SNACS website: **http://www.arcus.org/arcss/snacs/index.php**.



High-Resolution Permafrost Modeling and Planning Implications for Greenland and Alaska

Introduction and Project Objectives

Permafrost has received much attention recently because surface temperatures are rising in most permafrost areas of the earth, bringing permafrost to the edge of widespread thawing and degradation. The thawing of permafrost already occurring at the southern limits of the permafrost zone can generate dramatic changes in ecosystems and infrastructure.

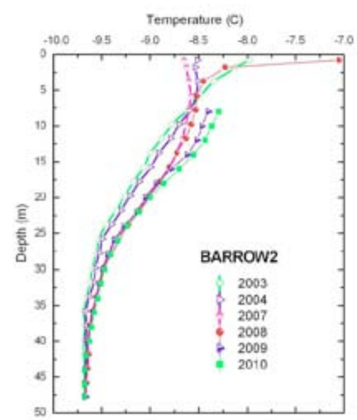
A project led by Vladimir Romanovsky, University of Alaska Fairbanks, and funded by the NSF Arctic Natural Sciences (ANS) Program, integrated climate change and permafrost modeling at a high-resolution, regional scale for western Greenland and Alaska. The project's objectives were to:

- Develop regional climate simulations for western Greenland (a coastal/maritime permafrost regime) and northern Alaska (a continental interior permafrost regime);
- Establish a series of monitoring sites representative of the range of permafrost types encountered in the two regions;
- Implement a state-of-the-art permafrost model to map present and future permafrost conditions; and
- Evaluate the implications for infrastructure planning in Greenland and Alaska.

Monitoring Results

For Alaska, air and ground temperature data were collected from four sites. Temperature data collected in 2006-2010 showed no significant changes except for Barrow, where mean annual soil temperatures have warmed continuously during the last several years. Mean annual temperature profiles down to 50 m depth obtained at the Barrow site show continuous warming at the depths below 10 m. This warming accelerated in 2009 and is in good agreement with accelerating warming at other coastal sites in Alaska and Russia.

In Greenland, permafrost was monitored in nine sites. The data revealed changes in ground temperature regime occurring along the west coast. The transect spanned sample areas of continuous permafrost with ground temperatures around -3°C; discontinuous permafrost where permafrost boreholes showed temperatures between -1 and 0°C; and sporadic permafrost where permafrost is unstable and actively thawing, indicated by the ground temperatures at 0°C.



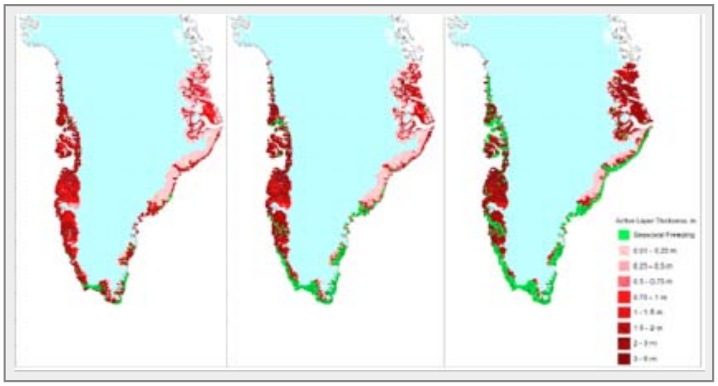
Changes in permafrost temperature at different depths at the Barrow, Alaska Permafrost Observatory, 2003–2010.

Modeling Results

A high-resolution regional climate model (HIRHAM model) was used to develop the permafrost simulations. Recent advances in computer power and model capabilities allowed the simulation of high spatial resolution on the order of a few kilometers.

Greenland

By the end of this century the bedrock mean annual temperature at 2 m below the surface will increase by an average of 1.56°C, and the mean annual temperature at 2 m in sediment will increase by 1.99°C. The active layer in sediment will increase by 0.44 m between current and future conditions; the greatest increases in the active layer depth will occur in the south.



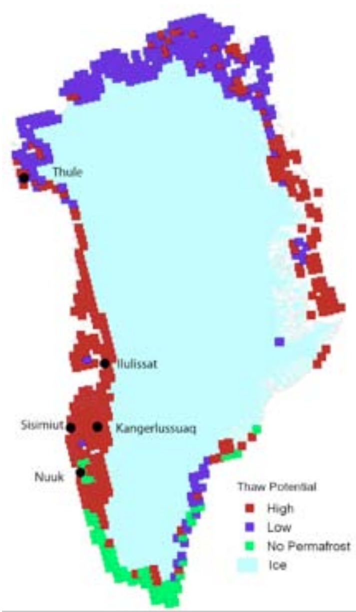
Active layer depth distributions averaged over the periods 1990-1999, 2046-2055, and 2090-2099, calculated using 5x5 km resolution climate forcing.

The project results show much stronger degradation of permafrost by the end of the century as compared to lower resolution model results. The degradation is much more pronounced in the coastal areas and decreases towards the ice sheet. Strikingly, the high-resolution model results indicate much more substantial degradation of permafrost along the west coast of Greenland, even in higher latitudes.

Alaska

Results for Alaska are less developed at this point, but indicate that the area of permafrost degradation in Alaska is projected to be more substantial than in Greenland. By the end of the 21st century, permafrost will be stable only in the Brooks Range and on the North Slope. By contrast, the models suggest that more than half of the present-day permafrost area in Greenland will still be stable, although active layer depths will increase.

Risk Assessment and Permafrost Thaw Potential: A Greenland Example



Permafrost Thaw Potential for Greenland. High thaw potential corresponds with a greater than 2.5 m potential active layer depth increase. The potential active layer depth increase was calculated by subtracting current sediment active layer depths from future bedrock active layer depths.

A new risk assessment method was developed by the project to determine the risk of permafrost degradation (or Permafrost Thaw Potential, PTP) on settlement infrastructure. Risk was classified in four categories: low, limited, medium, and high, based on environmental variables and a thermal criterion. The three main variables are sediment or rock type, presence and amount of ground ice, and the ground thermal conditions. The states of these variables are determined from field investigations or estimated based on background information such as geological maps and modeling output.

Most of the terrestrial portion of Greenland is at risk of permafrost degradation. The high-risk areas are mainly present in the southern part of the permafrost domain. In Sisimiut, the model forecasts a warming trend in the ground temperatures and present modeled permafrost temperatures as high as -1°C, so permafrost will soon be actively degrading in the area. For planning implications, this might mean that the cheapest solution to protect infrastructure is to remove perennially frozen soils and substitute them with non-frost-susceptible materials, or to use piles resting on bedrock.

Due to its present resolution (25 km grid), the applied PTP approach cannot be used as design criteria for individual projects. However, high-resolution PTP mapping may be used during site-specific permafrost analysis to determine the particular permafrost degradation risk for that site.

Future Research Directions

To maximize the usefulness of this approach, future research should be oriented to more specific regional and local applications. Site-specific permafrost dynamics models and risk assessment maps should be developed at a high resolution for the most vulnerable communities.

For more information, contact Vladimir Romanovsky, Department of Geology and Geophysics, University of Alaska Fairbanks (**veromanovsky@alaska.edu**).

ARCUS Board President Honored in R/V Sikuliaq Keel-Laying Ceremony

Vera Alexander, President of the ARCUS Board of Directors, participated in the keel-laying ceremony for Research Vessel (R/V) Sikuliaq, an icebreaker specifically designed for scientific research in arctic waters. On 11 April 2011 at the site of the ship's construction in Marinette, Wisconsin, Alexander initialed a steel plate that was then traced over by a welder. The plate, also initialed by cosponsor Bob Elsner, will be attached to the Sikuliaq's keel. Alexander and Elsner were both honored for their involvement in the long-term planning for the vessel, which started in 1973. A series of images and more information on the keel-laying ceremony and honorees are available at: **http://www.sfos.uaf.edu/arrv/keel-laying/**.

ARCUS President Vera Alexander stands with the plaque welder and cosponsor Bob Elsner at the keel-laying ceremony for R/V Sikuliaq. Photo courtesy: Mike Castellini

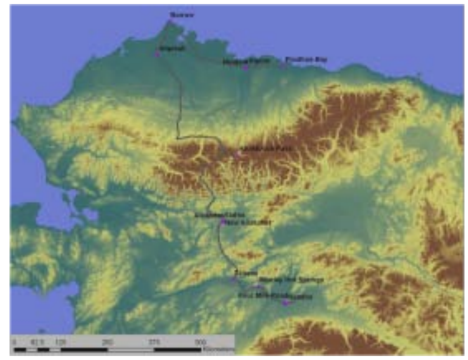
Designed by The Glosten Associates, R/V Sikuliaq will be owned by NSF, operated by the University of Alaska Fairbanks and based in Seward, Alaska. When complete, the vessel will be one of the most advanced university research vessels in the world and will allow scientists to conduct research in waters with ice up to 2.5 feet thick. The ship is designed to accommodate a wide range of research types with minimal environmental impact. The Sikuliaq will be launched in summer 2012 and undergo a series of trials before science operations aboard the ship begin in 2014.

For further information about R/V Sikuliaq, please see: **http://www.sfos.uaf.edu/arrv/**.

Snow Science Expedition: Traveling 2000 km on Snowmobiles for Outreach and Education

By: Matthew Sturm, Cold Regions Research and Engineering Laboratory (CRREL)

The four of us left Fairbanks, Alaska on 26 March 2010, headed for Barrow and Prudhoe Bay on four snowmobiles pulling eight sleds. Our route was historic; it retraced the 1924 U.S. Geological Survey expedition led by Philip Smith and J. B. Mertie, Jr. Theirs was the first scientific expedition to do geologic work north of the Brooks Range and south of the coastal plain. The route took us through the communities of Nenana, Manley, Tanana, Allakaket, Anaktuvuk Pass, Atqasuk, Barrow, and Nuiksut. Our plan was to trace the historic route as closely as possible and to work with students in each of the villages we passed through, using snow as a mechanism to show the kids that science was fun and that they lived in a fascinating place we had come miles to visit. Our path through the Brooks Range had even older historic significance: for thousands of years it has been a corridor of trade between the Inuit of the North Slope and the Koyukon people of the Koyukuk and Yukon rivers.



A map of the route covered by expedition members Matthew Sturm, Jon Holmgren, John Burch, and Henry Huntington. (Tom Douglas replaced Henry Huntington in Anaktuvuk Pass, as planned.) Image courtesy: C. Hiemstra.

Grammar school students in Anaktuvuk Pass look at snow crystals through stereo-microscopes. The blue blocks are foam insulation. Photo Courtesy: Matthew Sturm.

We spent the months prior to the trip making arrangements with the schools and adding to our repertoire of snow demonstrations. In particular, we tried to crack a problem that has long plagued us working with kids and snow—how to help them see snowflakes and snow crystals. The problem is that it takes a lot of time for the younger kids to get dressed to go outside, and then the environment is distracting. Looking through a microscope at snow crystals when you can run and jump in the snow is almost impossible. So we worked out a way to bring the crystals into the classroom without having them melt. We manufactured cold stages, which are surfaces capable of displaying frozen snow crystals. Some were made of smooth heavy stones, which have considerable thermal mass that is resistant to heat fluctuations. Others were plates we could cool by pumping salt brine through with a simple squeeze bulb. Foam boxes surrounded both models and they worked great. In each community we set up cold stages and the students used a high-quality microscope to get their first look at the hidden and beautiful world of snow crystals.

The second demonstration, on loan from Mike Taras of Alaska Department of Fish and Game, was a set of materials to illustrate animal tracks in the snow. The kit included casts of animal footprints and pictures of tracks. The huge cast of the brown bear track was the favorite. Most rural Alaskan children hunt and fish, so this connection between snow and game was particularly popular.

A student at Manley holds the cast of a grizzly bear print. Photo Courtesy: Matthew Sturm.

Finally, we added an avalanche demonstration that was developed by Bill Glude of Juneau. In the demonstration, a layered snow cover is simulated by sprinkling a board with flour, salt, potato flakes, and millet—representing fine-grained snow, coarse-grained snow, surface or depth hoar, and grauple (snow pellets), respectively. Miniature rocks, trees, and Playmobile snowmobiles are included on the board to add to the fun. The board is tipped up until the faux snow cover slides off. The demonstration does a nice job of simulating many features of avalanches. The students loved getting their hands into the bags of flour and salt. Even teenagers, for whom participating in science experiments can be "uncool," enjoyed this activity. We also went outside to dig snowpits and measure snow depths.

The impact of outreach is always hard to quantify, but the response from the students and teachers revealed that we were successful in reminding the students of the uniqueness and interest of their snowy environment, and we provided a welcome break from day-to-day classroom work. The novel way we arrived (novel in the sense that we have traveled farther by snowmobile than most of the people the students know) enhanced our reputation. Our arrival in a village required no advertising—everyone heard about us through the grapevine within a few hours of our arrival.

In the end, we safely arrived in Prudhoe Bay on 20 April, having traveled 2000 km and having reached about 600 students and teachers during our travels.

For more information about the expedition, contact Matthew Sturm (**msturm@crrel.usace.army.mil**).

High school students in Atqasuk sprinkle fake snow on an avalanche simulation board. Photo Courtesy: Matthew Sturm.

A Conversation with Dr. Brendan P. Kelly, Deputy Director of NSF's Arctic Sciences Division

Earlier this spring Witness the Arctic (WTA) had the opportunity to visit with Dr. Brendan P. Kelly (BPK). We asked a few questions about his new role as Deputy Director at NSF's Division of Arctic Sciences. Here are excerpts from that conversation.

Dr. Kelly has studied arctic marine mammals, their sea ice environment, and the cultural significance of this ecosystem to indigenous communities for over three decades. Prior to the NSF appointment, he was at NOAA's National Marine Mammal Laboratory and the University of Alaska where he led investigations regarding the impact of sea-loss on arctic seal populations. Photo courtesy: Melanie Duchin

WTA: The Deputy Director for the Division of Arctic Sciences is a new position charged to represent NSF as Executive Director of the Interagency Arctic Research Policy Committee (IARPC) and to develop a strategic vision for the Division of Arctic Sciences. As the Division's first Deputy Director, what do you see as the most interesting challenges and opportunities of this position?

BPK: The position attracted me for a number of reasons—chiefly because it came with mandates but didn't over-proscribe how to achieve them. Figuring that out is part of the job.

It's also important to understand the history here. In my view the staff and program directors have always been stretched thin in the Arctic Division. Program staff and directors work very long hours to keep the funding cycle going, and I know they suffer a fair amount of frustration from the insufficient time to devote to long range and big picture issues. So, the creation of this Deputy Director position is really a significant investment toward strategic planning within the NSF office as well as among all the federal agencies. Having somebody devoted to working on these issues can free everybody to take a step back and spend a little more time looking at the big picture. For me personally, it's a great opportunity to contribute to making the Arctic Sciences Division even more effective than it already is.

Managing intellectual talent is always an interesting challenge to me, which is magnified in the case of scientific research in the Arctic. The rapid pace of change in the biological, social, and physical environment we're observing—and the incredible need to forecast and respond to that change—challenges the pace of scientific research, which tends to proceed at a more measured pace.

Nationally and internationally we're blessed with tremendous scientific talents, and we have fabulous technologies. Realizing the full value of these technologies and intellectual talent requires cohesiveness in the community and a really high level of communication. That's difficult to achieve with changes coming along very very rapidly. We really need to figure out how we can accelerate not only the pace of investigation but also the dissemination of new findings. Those are huge challenges for all of us, and I appreciate the opportunity to contribute in my new position.

WTA: One of your duties will be to represent NSF as Executive Director of the Interagency Arctic Research Policy Committee (IARPC). What is your vision of a highly functioning IARPC?

BPK: To me, a highly functioning IARPC would be one in which every member is certain that time invested in IARPC meetings is more than compensated by the boost to their own agency objectives. In other words, IARPC would make them more effective in meeting the objectives of their particular agencies.

I think a huge part of getting people to look at IARPC as a positive tool in their kit is developing a shared vision of what the research community as a whole needs to accomplish. There have been several good efforts in the community to develop a shared vision, and a lot of progress has been made. I think to a certain extent, some of those efforts have suffered in that they've been cast in too much of an academic research light without simultaneously making it clear to the mission agencies how their work would be facilitated by the shared vision. Again, in a highly functioning IARPC, all the members and all the participants would see their own agency objective, and their own work, in the context of a shared vision. So, in continuing the efforts to forge that shared vision it's an issue of getting people to engage in the conversation and have faith that it's a worthwhile venture—not just another couple hours taken out of their busy lives.

WTA: Assuming your vision was realized, how would that impact arctic science?

BPK: I think we would see more rapid progress in gaining knowledge and understanding the Arctic simply because we'd have more effective leveraging of resources, whether they're human resources or ships or aircraft or technologies. A whole lot of what managing intellectual talent is about is connecting the right players at the right time, and you have to have someone who is there to make sure the pieces are being connected. IARPC needs to be playing that role by having members who are that engaged—who are aware of what is going on in their agencies and are able to figure out which connections need to be made between agencies. And this is huge, right? These are big agencies. But that's the culture we need to create. When we have people who can see and make the connections that are being missed I think we'll see some pretty big leaps in our scientific progress.

WTA: How would it affect the way the various agencies in IARPC work together?

BPK: What we need are strong relationships between the agencies that are characterized by individuals who are attuned to each other's communication styles and understand each other's motivation. That stuff happens over time with repeated interactions between people who really want to make things work. There is also a tension between the need to build these interpersonal relationships and the need to build a structure with institutional memory not strictly dependent on the personalities. You want to build a robust community that will survive the inevitable turnover of individuals.

That's the tension that we have to keep in everybody's mind; while it's good to be working well with somebody in another agency, it's important to find a way to diffuse what is learned back home within their own agency. This takes a lot of active work. So, within IARPC itself I'll start by asking members about their plans to make sure that people in their agency, at various levels and offices scattered around the country, are benefiting from these conversations.

WTA: What would be the implication for multi-agency programs such as the Study of Environmental Arctic Change (SEARCH) and the Arctic Observing Network (AON)?

BPK: Having IARPC functioning at a higher level would go a long way toward propelling any sort of multi-agency programs like SEARCH and AON, rather than those programs dragging IARPC along like an anchor.

WTA: In your remarks to the U.S. Arctic Research Commission (USARC) during their January meeting you mentioned that you were conducting a listening tour during the first weeks in your new position, asking community members about their concerns and hopes for IARPC. What did you hear from the community?

BPK: First, I'll say that the listening tour continues and I am still learning. But I will mention what's become clear already is the broad sense that IARPC has failed to realize its potential. At the same time, people seem to have a renewed hope that the combination of NSF dedicating a position to work on IARPC coupled with chartering IARPC as an interagency subcommittee under the National Science and Technology Council will help it realize its potential. So it's clear there's been disappointment in the past and that with these changes people seem quite hopeful.

More specifically, USARC has asked for an update to the five-year research plan and a budget that shows where money is being spent. Those are already under way within IARPC.

WTA: In response to climate change, do you see a shift in interagency attention toward strategic concerns in the Arctic such as national security, military preparedness, transportation needs, natural resource management, and energy security? How might a shift in concerns influence the coordination of arctic research?

BPK: Well, certainly there has been that shift. My sense is that this shift has elevated arctic science to be of much more than academic interest and has stimulated a much stronger interest across the mission agencies. And I'll just say that this is an opportunity that we dare not miss. There is a great deal of interest that we should harness—this is a time when it is really important that we function well across agencies.

WTA: How is the strategic vision for the Division of Arctic Sciences being developed?

BPK: It is just beginning to evolve; we are planning a retreat within the Division in early summer to bring out ideas and tap the knowledge of program officers and staff who have a tremendous history and perspective—that's a great potential. We'll also engage the Office Advisory Committee not only to inform the vision but also to inform the process of how to build that vision. Obviously it has to be an iterative process. We welcome ideas from anybody and everybody in the community on how to best proceed.

WTA: Will this strategic vision impact the way business is done in the Division of Arctic Sciences?

BPK: Yes, I think it very well could. I'm very encouraged by preliminary discussion within the Division. We recognize that the community is changing and we'd like to propel the enterprise. People are open to potentially very different ways of doing business. Earlier I talked about how the routine workload on program officers can hinder big picture thinking. People in the Division are stretched pretty thin. That's what I want to be addressed in the vision. Do we need to do something structurally different? Do we need to change the way the proposal and review enterprise works?

I hope we can think very wisely about the possibilities so that we can support the best possible science. I'm amazed by the amount of human resources that goes into every single proposal: starting with the PIs who generate the idea, write it up, interact with colleagues, and get the proposal reviewed within their institution. There is substantial investment before the project arrives in NSF's Fastlane. At the Foundation, there's a huge investment of resources: vetting the proposal to make sure it fits all the criteria, the ad hoc review panels, and tremendous attention from program officers. Then, after this huge investment of resources, the most likely outcome is that the project will not get funded.

Along the way we are burying everybody. During the 5-day review panel, really smart people are given 15 minutes to present their brilliant ideas—it's a daunting process for both the review panel and program officers. I worry that it's hard for them to step back and ask how each project fits into the overall vision. I want to be convinced that we're doing everything we can structurally to promote people at all levels of the process being able to keep their eyes on the big picture. I've got a real sense that people want to engage in these issues. My role is to allow a process to evolve for these discussions so that staff and program officers are energized by the potential.

WTA: Dr. Kelly, thank you for sharing your thoughts about the challenges and opportunities facing the arctic research community at this time.

BPK: It's been a pleasure; hopefully we'll see more of this kind of conversation in the near future.

For information about the April 2011 IARPC Principal Members meeting, see the **IARPC article in the Interagency News** section. For further information about IARPC, please see: **http://www.nsf.gov/od/opp/arctic/iarpc/start.jsp** or contact Brendan P. Kelly (**bkelly@nsf.gov**).

Interagency Arctic Research Policy Committee (IARPC) Meeting of Principal Members

IARPC Principal Members met 26 April 2011. This was their first meeting since IARPC became a subcommittee of the National Science and Technology Council (NSTC) in July 2010.

Key issues IARPC members were briefed on and discussed include:

- The significance of chartering IARPC as a subcommittee within the NSTC, which will bring a policy focus to its work. IARPC will need to incorporate into its work National Ocean Policy, the work of the Climate Change Adaptation Task Force, the Arctic Research Policy Act of 1984, and the National Security Presidential Directive 66 and Homeland Security Presidential Directive 25 Arctic Regional Policy (NSPD/HSPD-25) (see: **http://hspolitics.wordpress.com/2009/01/14/hspd-25-nspd-66-arctic-region...**);
- The new requirement and obligations associated a NSTC Charter for IARPC, as well as those derived from the Arctic Research Policy Act of 1984;
- Recommendations for IARPC communication with individuals outside the Federal Government;
- IARPC's role in the NSPD/HSPD-25 Arctic Regional Policy as well as commitments related to the Arctic Council's international Search and Rescue Agreement;
- Alaska's interests and involvement in arctic research;
- The National Ocean Policy's Changing Conditions in the Arctic Ocean Strategic Action Plan;
- Planning for the arctic research budget cross-cut and the directive for the Office of Science and Technology Policy and the Office of Management and Budget to coordinate budget requests from the agencies;
- Six interagency priority research themes for FY11 and FY12; and
- The outline for the IARPC 5-year research plan.

The next Principals meeting is scheduled for late summer 2011.

The full notes from the IARPC meeting are available below:

Download Meeting Notes (PDF - 80 KB)

Or at: **http://www.nsf.gov/od/opp/arctic/iarpc/iarpc_mtgs_public.jsp**.

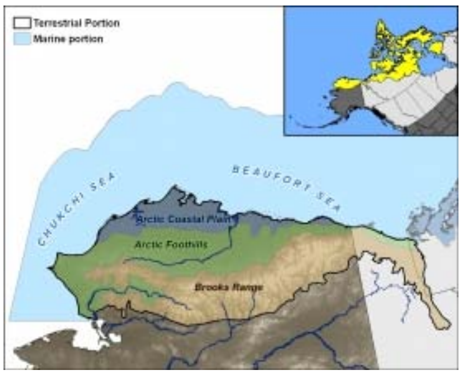
For further information about IARPC, please see: **http://www.nsf.gov/od/opp/arctic/iarpc/start.jsp** or contact Brendan P. Kelly (**bkelly@nsf.gov**), IARPC Executive Director.

The Arctic Landscape Conservation Cooperative: Leveraging Arctic Climate Science

About Landscape Conservation Cooperatives

Facilitated by the Department of the Interior, Landscape Conservation Cooperatives (LCCs) were established to provide a collaborative approach to conservation management. An initial federal investment of $25 million in 2010 funded the first nine LCCs of the 21 planned across North America. The LCCs will collectively form a network of resource managers, scientists, and public and private organizations with common interests in conservation. By leveraging existing resources and developing science-based tools, the network of LCCs will inform resource management decisions regarding the sustainability of natural systems and landscapes under stressors such as rapidly changing climatic conditions.

The Arctic Landscape Conservation Cooperative



Land ownership in the Alaska portion of the Arctic LCC, and geographic extent of the Arctic LCC. Image courtesy: U.S. Fish and Wildlife Service

The Arctic Landscape Conservation Cooperative (ALCC), one of the first LCCs formed, is a self-directed partnership that functions through a multi-tiered structure of at-large partners, a core staff, and a steering committee of cooperating agencies and organizations. Its geographic scope ranges across North America from Alaska to Labrador. The Alaska portion encompasses three eco-regions: the Brooks mountain range, the arctic foothills, and the arctic coastal plain. These areas provide critical breeding grounds and habitat for dozens of bird and mammal species.

The Arctic presents extraordinary challenges for resource managers who must anticipate the effects of climate-associated habitat change and incorporate that understanding into conservation planning. The rapidly warming climate is associated with significant changes already observed in arctic terrestrial landscapes, such as:

Eroding bluffs on Barter Island, Kaktovik, Alaska resulting from an increase in storm surges in August 2008. Photo courtesy: M. Osborne, U.S. Fish and Wildlife Service.

- Summer sea ice pulling away from the coast, exposing coastlines to increased rates of erosion and severity of storm surges while reducing habitat for ice-obligate species.
- An increasingly thick layer of the tundra actively thawing during each growing season, which influences both stream flow patterns and the probability that lakes will be tapped and drained into adjacent fluvial systems. These changes in surface hydrology, coupled with precipitation and evaporation-transpiration changes, affect the timing and severity of tundra drying. This affects the vegetation community composition and increases the probability of severe and extensive tundra fires.
- Arctic breeding birds that migrate based on the solar calendar may become decoupled from their invertebrate food sources, which emerge based on temperature. Emerging chicks hungry for insects may hatch too late to take advantage of the peak insect abundance that was once timed perfectly to suit their needs.
- Shrub cover is increasing in the Brooks Range and foothills, and warming is expected to favor increased shrub cover, at the expense of sedges and lichens.

In the face of such fundamental climate-driven changes, land managers remain uncertain of exactly how things will change on any given parcel of arctic landscape. In order to make crucial planning decisions, managers need improved scientific information and tools such as the development of vulnerability assessments for individual species, the compilation of widely scattered data sets, and access to those datasets. Working in collaboration with its partners, the Arctic LCC seeks to provide these tools.

The Anaktuvuk River tundra fire, August 2007. Photo courtesy: Arctic Long Term Ecological Research program.

The conservation goals of the Arctic LCC are to provide information on, and predict effects of, climate driven changes and other landscape stressors; determine how climate driven changes affect subsistence users; and provide improved data and information access to managers. During its initial stages the ALCC's science priorities were heavily influenced by previous assessments of arctic science needs including the **USFWS WildREACH report** and the **North Slope Science Initiative's Emerging Issues papers**.

Arctic LCC Science & Data Efforts

The Arctic LLC funded approximately $2 million in climate-related research and data synthesis efforts in 2010, with an equal amount of support leveraged in the form of in-kind contributions of labor and funding from other agencies and non-governmental organizations. One product of this initial cycle is the "Connecting Alaska Landscapes into the Future" report (**http://www.snap.uaf.edu/downloads/connecting-alaska-landscapes-future**). The project used a climate envelope modeling approach to assess how future climate scenarios match mean temperature and precipitation conditions of the years 2000 to 2009. Results suggest that approximately 60% of Alaska may experience a shift to a new climate biome during the twenty-first century.

Approximately $1.3 million of funding from the Arctic LCC and $1 million in leveraged work will support over two dozen distinct research and data synthesis projects during 2011. With a long-term science plan under development, the ALCC Steering Committee used an interim selection process to rank proposals based on responsiveness to ALCC goals, feasibility, degree of partnering, responsiveness to management concerns, and a number of other criteria. Currently, six technical working groups—permafrost, coastal processes, climate modeling, hydrology, arctic biology, and geospatial data—are providing input to the development of the Arctic LCC science plan, which will guide future project funding strategies. A draft of this plan will be available for comment in late 2011.

For more information, see the Arctic Landscape Conservation Cooperative website: **http://alaska.fws.gov/lcc/arctic.htm**, or contact Greg Balogh, Arctic LCC Coordinator (**Greg_balogh@fws.gov**).

Arctic Landscape Conservation Cooperative Steering Committee Member Agencies

National Park Service
Bureau of Land Management
U.S. Fish and Wildlife Service
U.S. Geological Survey
Bureau of Ocean Energy Management, Regulation and Enforcement
U.S. Arctic Research Commission
U.S. Army Corps of Engineers
National Oceanic and Atmospheric Administration
Alaska Department of Fish and Game

Arctic News from the Office of Naval Research

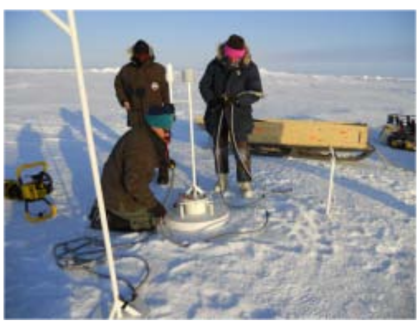
The Office of Naval Research (ONR) has launched a new program in the Ocean, Atmosphere, and Space Research Division of the Ocean Battlespace Sensing Department entitled "Arctic and Global Prediction." This program, a combination of new and realigned efforts, responds to the fifth focus area of the U.S. Navy Arctic Roadmap for "Environmental Assessment and Prediction." The objective of this focus area is to "provide Navy leadership and decision makers a comprehensive understanding of the current and predicted arctic physical environment on tactical, operational, and strategic scales in time and space." The U.S. Navy Arctic Roadmap, published in November 2009, was the first product of the U.S. Navy Task Force Climate Challenge.

The goals of the Arctic and Global Prediction program are:

1. Improve understanding of the physical environment and processes in the Arctic Ocean;
2. Develop integrated ocean-ice-wave-atmosphere earth system models for improved prediction on time scales of years; and
3. Investigate new technologies, e.g., sensors, platforms, communications, for sustained operation and observation in the challenging arctic environment.

One of the first actions of the Arctic and Global Prediction program was to announce, in February 2011, a five-year Department Research Initiative (DRI): *Emerging Dynamics of the Marginal Ice Zone*. The goal of the DRI is to improve the knowledge and understanding of the physics of the retreating summer ice edge and marginal ice zone (MIZ) in the Beaufort and Chukchi Seas. The approach will be to integrate data from *in situ* sensing platforms, remotely-sensed observations, and integrated process models to develop a comprehensive, quantitative picture of open-ocean, ice edge, and MIZ processes, interactions, and feedbacks as the ice retreats. The observational dataset that is generated will also be used to evaluate the skill of numerical models run by the Naval Research Laboratory (NRL) and academic researchers.

The announcement of the DRI included a call for planning letters, which were due on 1 April 2011, with a proposal submission deadline of 1 July 2011. ONR also accepts planning letters at any time for basic, curiosity-driven research that addresses the three Arctic and Global Prediction goals presented above.



Scientists installing an ice mass balance buoy (IMB) near the ICEX 2011 ice camp in the Beaufort Sea, Arctic Ocean, March 2011. Photo Courtesy Jacqueline Richter-Menge, CRREL (Cold Regions Research and Engineering Laboratory).

In March 2011 the Arctic and Global Prediction program supported a variety of research activities at the Arctic Submarine Laboratory Ice Exercise (ICEX) 2011 camp in the Beaufort Sea. A joint NRL/Cold Regions Research and Engineering Laboratory (CRREL) team coordinated a combined *in situ* and airborne ice thickness, snow depth, and surface topography measurement campaign. Below the ice, Navy submarines obtained upward-looking sonar (ULS) ice draft data. These data will be coupled with the on-ice and airborne data to evaluate the performance of the different sensors and develop a comprehensive picture of the ice thickness distribution. Another team, from the Naval Postgraduate School, investigated under-ice hydrodynamics, particularly in the vicinity of a pressure ridge keel. The study is expected to provide new insights into mixing and drag that can be applied in models of the combined air-ice-ocean system in the Arctic.

Ice draft data obtained by Navy submarines are a contribution to Scientific Ice Expeditions (SCICEX), the Arctic Submarine Science Program, which is a partnership among the U.S. Navy, other Federal agencies, and the arctic marine science community to use nuclear-powered submarines as platforms for scientific studies of the Arctic Ocean. In addition to measuring ice draft in spring 2011, the submarines obtained underway conductivity, temperature, depth, bathymetry, and navigation data for SCICEX. There were also two SCICEX projects that tested expendable conductivity temperature depth profilers and tested procedures and calibrated equipment for routine, underway ocean biogeochemistry measurements.

USS Connecticut (SSN 22) at the surface of the frozen Beaufort Sea, Arctic Ocean, with a USCG HC-130 aircraft overhead, March 2011. Photo Courtesy Dan Eleuterio, U.S. Navy/Office of Naval Research.

To read the 2009 U.S. Navy Arctic Roadmap, please see: **http://greenfleet.dodlive.mil/files/2010/08/US-Navy-Arctic-Roadmap-11-10...**.

For more information about Task Force Climate Change and the Arctic Roadmap, please contact Bob Freeman (**robert.freeman@navy.mil**).

Further information about the ONR Arctic and Global Prediction Program and submission of planning letters can be found at: **http://www.onr.navy.mil/Science-Technology/Departments/Code-32/All-Progr...** or contact Martin Jeffries (**martin.jeffries@navy.mil**), or Scott Harper (**scott.l.harper@navy.mil**).

NOAA Releases Final Arctic Vision and Strategy

In February, NOAA released its final Arctic Vision and Strategy, which provides a high-level framework and strategic goals to address NOAA's highest priorities in the Arctic.

According to the vision document, NOAA will focus its efforts on the following six priority goals:

1. Forecast Sea Ice
2. Strengthen Foundational Science to Understand and Detect Arctic Climate and Ecosystem Changes
3. Improve Weather and Water Forecasts and Warnings
4. Enhance International and National Partnerships
5. Improve Stewardship and Management of Ocean and Coastal Resources in the Arctic
6. Advance Resilient and Healthy Arctic Communities and Economies

Arctic Vision and Strategy

In support of this vision and in order to fulfill NOAA's missions and responsibilities that are critical for other agencies to succeed in fulfilling their responsibilities, NOAA intends to undertake four steps.

First, in the next five years, implement, through a NOAA five-year Arctic Action Plan, actions to achieve the six primary goals that are identified and described in this document in support of the arctic vision.

Second, in order to accomplish these goals, coordination across all NOAA Line and Staff Offices and collaboration with local, regional, federal, academic, and non-governmental organizational partnerships will be required.

Third, develop an engagement strategy to reach internal and external employees, partners, and stakeholders. As a starting point, establish a single point of contact within NOAA Senior Executive Leadership that is accountable for implementation of this strategy.

Fourth, include the formalization of a detailed budget strategy as part of the NOAA Arctic Action Plan. NOAA anticipates initial investment of $10 million towards the implementation of this strategic plan, recognizing that additional funds will be needed to achieve these goals.

The Vision and Strategy can be downloaded at: **http://www.arctic.noaa.gov/**.

Fran Ulmer Appointed Chair of the U.S. Arctic Research Commission


Fran Ulmer Appointed Chair of the U.S. Arctic Research Commission

President Barack Obama appointed Fran Ulmer to a four-year term as the Chair of the U.S. Arctic Research Commission (USARC) on 10 March 2011. Ulmer is Chancellor of the University of Alaska Anchorage.

As the Chair of USARC, Chancellor Ulmer will advance federal arctic research in coordination with the state of Alaska and international partners. The Arctic Research Commission's current goals for the U.S. Arctic Research Program include: expanding a federal emphasis on Arctic Ocean and climate research; improving efforts to prevent and respond to oil spills in ice-covered waters; and strengthening research in arctic human health and indigenous languages and cultures.

Ms. Ulmer has served as a member of the Aspen Institute's Commission on Arctic Climate Change and held Board of Directors positions with the Alaska Nature Conservancy, the National Parks Conservation Association, the Union of Concerned Scientists, the Alaska Commonwealth North Board, and several other state and community organizations. In 2010 President Obama appointed her to serve as a member of the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Oil Drilling.

Prior to her academic appointments, including Director of the Institute of Social and Economic Research at the University of Alaska Anchorage, Ms. Ulmer served as Mayor of Juneau, Representative in the Alaska State Legislature, and Lieutenant Governor of Alaska. Ms. Ulmer earned a Doctor of Law cum laude from the University of Wisconsin Law School, and has been a Fellow at the Institute of Politics at the Kennedy School of Government.

For more information, see: **http://www.arctic.gov/ulmer.html**.

Workshop on International Collaboration and Cooperation in Arctic Science

The International Study of Arctic Change (ISAC) convened a workshop on international cooperation in the Arctic 30 May–1 June in Fairbanks, Alaska. About 30 participants representing international arctic programs attended the workshop from countries including Japan, China, Korea, Norway, Denmark, Canada, Russia, and the United States.

The goal of the workshop was to develop a strategy for international cooperation and collaboration, and joint planning of arctic environmental change science programs and related observing activities. The workshop addressed three objectives:

1. Improve international cooperation in arctic science;
2. Advance planning for an Arctic Observing Summit in 2012; and
3. Advance planning for a Responding to Change workshop.

International Study of Arctic Change (ISAC)

The outcomes will include a workshop report and a plan of action with specific and concrete coordination activities.

For further information about ISAC, please go to: **http://www.arcticchange.org** or contact Maribeth Murray, ISAC Executive Director (**murray@arcticchange.org**).