Witness the ARCTIC

Chronicles of the NSF Division of Arctic Sciences Spring 2012, Volume 16 Number 2

In this Issue

Published by the Arctic Research Consortium of the United States • 3535 College Road - Suite 101 • Fairbanks, AK 99709 • info@arcus.org

Community Input Into SEARCH 5-Year Goals and Objectives

In April, the SEARCH Science Steering Committee (SSC) (http://www.arcus.org/search/sciencecoordination/ssccommittee.php) released a set of draft 5-year goals and objectives for review by the broader arctic science community. The goals and objectives will direct the SEARCH program in the next five years. They are not intended to represent all of the science questions important for SEARCH, but have been selected as shorter-term priorities that are ready for implementation.

Study of Environmental Arctic Change

The draft SEARCH goals focus on four areas: ice-diminished Arctic Ocean, warming permafrost, land ice and sea level, and societal and policy implications. Together, the goals will provide significant insight into arctic system change as a whole.

The SEARCH SSC has reviewed the community input and is currently revising the goals, which will be released in their revised form via ArcticInfo and through the SEARCH website. The SEARCH SSC will then be working closely with agency representatives on a plan to implement the goals through research opportunities and community activities.

For more information on the draft goals and additional background information, go to: http://www.arcus.org/search/goals or contact Helen Wiggins, ARCUS, at helen@arcus.org.

Published by the Arctic Research Consortium of the United States • 3535 College Road - Suite 101 • Fairbanks, AK 99709 • info@arcus.org

SEARCH Encourages Proposals to the Arctic Science, Engineering, and Education for Sustainability (ArcSEES) Opportunity

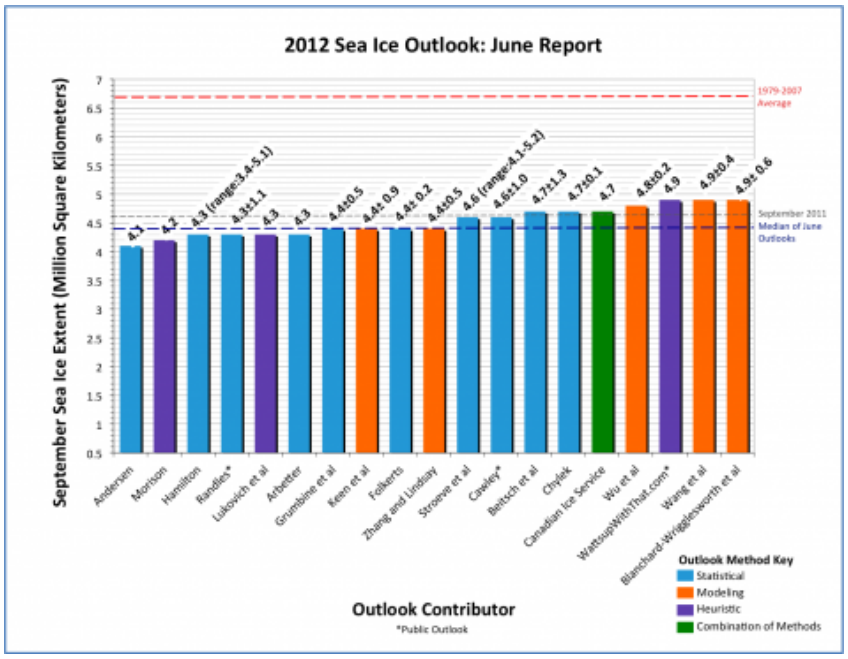
The SEARCH and International Study of Arctic Change (ISAC) (http://www.arcticchange.org/) steering groups released a "Dear Colleague" letter to encourage SEARCH and ISAC-relevant proposals to the recent NSF solicitation on Arctic Science, Engineering, and Education for Sustainability (ArcSEES (http://www.nsf.gov/pubs/2012/nsf12553/nsf12553.htm), see funding article (http://www.arcus.org/witness-the-arctic/2012/2/article/19147) in this issue of *Witness*). The Dear Colleague letter highlights three reports that may be useful in linking proposal topics to identified priorities from the science community. The NSF ArcSEES solicitation presents an excellent opportunity to propose projects that implement ideas developed by the broad SEARCH and ISAC communities that are relevant to sustainability issues in the Arctic.

The Dear Colleague letter and relevant reports are available at:
http://www.arcus.org/search/searchscience/arcsees.

2012 Sea Ice Outlook and Sea Ice for Walrus Outlook Launched

The first Sea Ice Outlook reports for 2012 have been released. The SEARCH Sea Ice Outlook (http://www.arcus.org/search/seaiceoutlook/index.php) produces monthly reports throughout the summer that synthesize projections of the expected sea ice minimum at both pan-arctic and regional scales. The June Pan-Arctic Summary, Pan-Arctic Full Outlook, and Regional Outlook are available at: http://www.arcus.org/search/seaiceoutlook/2012/june.

With 19 responses for the Pan-Arctic Outlook, the June Sea Ice Outlook projects a September 2012 arctic sea extent median value of 4.4 million square kilometers, with quartiles of 4.3 and 4.7 million square kilometers. This compares to observed September values of 4.6 in 2011, 4.9 in 2010, and 5.4 in 2009. Both the 2012 quartile values and the range (4.1–4.9) are quite narrow. The 2012 June Outlook differs from all previous Outlooks in that there are no projections of extent greater than 5.0. It is always important to note for context that all 2012 estimates are well below the 1979-2007 September mean of 6.7 million square kilometers.



Distribution of individual Pan-Arctic Outlook values (June Report) for September 2012 sea ice extent.

Individual responses are based on a range of methods: statistical, numerical models, comparison with previous rates of sea ice loss, composites of several approaches, estimates based on various non-sea ice datasets and trends, and subjective information. The consensus is for a continued downward trend of September sea ice. It seems that the time may have come to declare that the arctic sea ice has in fact reached a "New Normal." The physical justification for this statement is based primarily on the loss of old, thick sea ice and the increased mobility of sea ice. An expanded discussion of sea ice age and thickness is included in this month's full report, which includes new sea ice thickness data from NASA IceBridge (http://www.nasa.gov/mission_pages/icebridge/index.html) aircraft flights in March-April 2012.

In addition to the Pan-Arctic Outlooks, there were six contributions to the June Regional Outlook report. The regional outlooks shed light on the uncertainties associated with the estimates in the Pan-Arctic Outlook by providing more detail at the regional scale, including: the Northwest Passage and Hudson Bay/Hudson Strait shipping routes, Beaufort/Chukchi Seas, the Canadian Archipelago/Nares Strait, and Barents/Greenland Seas.

The 2012 Sea Ice for Walrus Outlook (SIWO) (http://www.arcus.org/search/siwo) was launched in early April and provides online reports for use by Alaska Native subsistence hunters, coastal communities, and others interested in sea ice

and walrus. The weekly SIWO reports integrate local observations, satellite imagery, and sea ice and weather forecasts.

SIWO is supported by the National Oceanic and Atmospheric Administration (NOAA) (http://www.noaa.gov/) and NSF and organized by NOAA's National Weather Service (http://weather.gov/), the University of Alaska (http://www.gi.alaska.edu/), ARCUS, and the Eskimo Walrus Commission (http://www.kawerak.org/servicedivisions/nrd/ewc/index.html), with significant contributions from Alaska Native sea ice and walrus experts.

Plans are underway to expand both the Sea Ice Outlook and Sea Ice for Walrus for 2013; please contact Helen Wiggins, ARCUS (helen@arcus.org), with any ideas for future improvements for either project.

For more information about the Sea Ice Outlook and to see the June reports, go to: http://www.arcus.org/search/seaiceoutlook/index.php.

For more information about the Sea Ice for Walrus Outlook and to see the latest weekly report, go to: http://www.arcus.org/search/siwo.

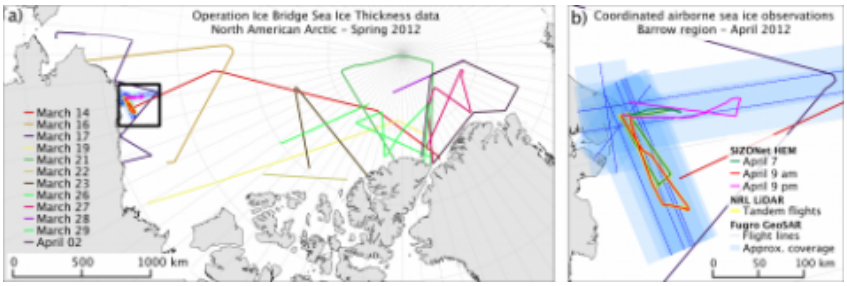
Published by the Arctic Research Consortium of the United States • 3535 College Road - Suite 101 • Fairbanks, AK 99709 • info@arcus.org

Early-Release Data on Ice Thickness, Snow Depth, and Ice Characteristics

A new webpage developed through SEARCH provides access to early-release datasets on ice thickness, snow depth, and ice characteristics collected in March/April of 2012 in the North American Arctic. The webpage is available at: http://www.arcus.org/search/seaiceoutlook/ice-thickness-data.

Data were obtained by different projects, centering around the National Aeronautics and Space Administration's (NASA) Operation IceBridge (http://www.nasa.gov/mission_pages/icebridge/index.html) survey flights, with key contributions from NSF-funded activities of the interagency Arctic Observing Network (AON). The goal of this early release of preliminary data is to provide timely information to the international sea-ice prediction community for initialization of seasonal ice predictions, including those for the SEARCH Sea Ice Outlook (http://www.arcus.org/search/seaiceoutlook/index.php).

The data release includes contributions from different U.S. federal agency, private industry, and international partners to provide timely sea-ice data of broader relevance in the North American Arctic. The data acquisition reflects collaboration with local government and co-management boards to avoid interfering with subsistence hunting activities and provide information of relevance to coastal communities.



Map showing approximate location of flight lines and data sets. Image courtesy of SEARCH.

Datasets available through this webpage include:

1. NASA Operation IceBridge Quicklook Data
2. Seasonal Ice Zone Observing Network (SIZONet) Airborne Electromagnetic Induction Ice Thickness Surveys Quicklook Data
3. Fugro Earth Data, Inc. Airborne P-band Synthetic Aperture Radar (SAR) Survey Quicklook Data
4. Naval Research Laboratory Tandem Flight Airborne LiDAR and Radar Altimeter Surveys
5. SIZONet Surface-based EM Survey Data (Barrow Landfast Ice Region and Drifting Multiyear Ice Site)
6. Cold Regions Research and Engineering Laboratory (CRREL)-Arctic Observing Network Ice Mass-balance Buoy Data
7. SIZONet Snow and Ice Property Measurements

The full webpage, including contact information, is available at: http://www.arcus.org/search/seaiceoutlook/ice-thickness-data.

U.S. Arctic Observing Coordination Workshop Held in March

A U.S. Arctic Observing Coordination Workshop (http://www.arcus.org/search/meetings/2012/coordination-workshop) was held in March in Anchorage, Alaska, to coordinate U.S. activities to observe and monitor the Arctic. The workshop brought together 104 participants, including arctic scientists; local, state, and federal agency representatives; decision makers; data managers; and other stakeholders.

The workshop was funded by the NSF Division of Arctic Sciences (http://www.nsf.gov/div/index.jsp?div=ARC), the Office of Naval Research (http://www.onr.navy.mil/), the Arctic Landscape Conservation Cooperative (http://arcticlcc.org/), the North Slope Science Initiative (http://www.northslope.org/), the North Pacific Research Board (http://www.nprb.org/), and the Alaska Ocean Observing System (http://www.nprb.org/).

After an introductory plenary session on a vision of an arctic observing network and underpinning science needs, workshop participants divided into breakout groups to develop ideas for *showcase projects*—activities to highlight effective approaches of coordination in the context of the interagency Arctic Observing Network (AON).

A workshop report to be released this fall will summarize the results of the discussions, including presentation of several showcase projects spanning ocean-, land-, and data-focused activities. The results of this workshop will set the stage for an international Arctic Observing Summit in 2013.

More information about the workshop, including the agenda, plenary presentations, attendee list, and background materials, is available at:
http://www.arcus.org/search/meetings/2012/coordination-workshop.

Arctic Observing Network Design and Implementation Workshop Planned

The AON Design and Implementation (ADI) Task Force (http://www.arcus.org/search/aon/adi) provides guidance to NSF, the scientific community, and others on how to achieve a well-designed and effective interagency Arctic Observing Network.

The Task Force will meet in July in Boulder, Colorado to develop a final Task Force report with recommendations for optimizing components of an international arctic environmental observing system, with emphasis on the U.S. AON. The report, which will be released this fall, will:

- Evaluate the implementation status of the Arctic Observing Network in relation to key science questions identified by the arctic research community;
- Evaluate promising methods to improve design and adaptation of observing system components through simulation experiments and other approaches; and
- Synthesize information on existing observing system components and design studies.

More information about the ADI effort is available at: http://www.arcus.org/search/aon/adi.

Alaskan North Slope Snow LiDAR Campaign: SnowSTAR-2012

During mid-April 2012 an interagency team completed a 13-day campaign as the first phase of an innovative field project, entitled SnowSTAR 2012, to measure the snow cover of the North Slope of Alaska. The 16-member team, funded in part by NSF's Arctic Sciences Division, included scientists from the U.S. Army Cold Region Research and Engineering Laboratory (CRREL), the University of Alaska, Colorado State University, the U.S. Forest Service, the National Snow and Ice Data Center, and Ultimate Thule Lodge. Working near Toolik Lake, just north of the Brooks Range, the team measured the snow characteristics using a variety of techniques including snow pits, GPS-enabled snow depth probes, snow cores for snow water equivalent (SWE); and also indirectly measured the snow using both airborne and ground-based LiDAR (Light Detection And Ranging) equipment. The goal of the project is to develop a more effective way of measuring snow depth in variable conditions and over large areas.

Snow cover in northern Alaska lasts eight months of the year. Understanding the characteristics of the snow cover is important for several reasons. First, it is a significant source of the fresh water in the region—an estimated 50-80% of the run-off in the rivers in this part of Alaska comes from snowmelt alone. Second, snow is an effective insulator. Without the snow permafrost in this region might be thicker and colder, the summer thawing active layer thinner, and the plant life less verdant. Third, the snow has a high albedo, reflecting about 85% of incoming solar energy. The fine balance between the insulation effect and the solar reflecting effect of snow plays a critical role in the climate of the Arctic with implications for the entire planet. Accurate snow depth measurements also provide important information for land use management. For example, it can inform the State of Alaska and the U.S. Government, which manage thousands of square kilometers of land on the north slope of Alaska, in deciding where and when to allow oil, gas, and mining companies to transit over the tundra.

Snow depth across the North Slope of Alaska can be extremely variable. Wind constantly moves the snow creating drifts and scour zones. In the space of 100 meters, snow depths can range from 10 to 500 centimeters (cm). Previous methods of measuring snow depth have yielded some successes, but efficient operational level methods that work for all types of snow have not emerged. The problem has been especially acute for snow that tends to be thin (<100 cm) like the snow on the north slope of Alaska. A key goal of SnowSTAR 2012 was to develop better operational measuring methods.

SnowSTAR 2012 Field Campaign

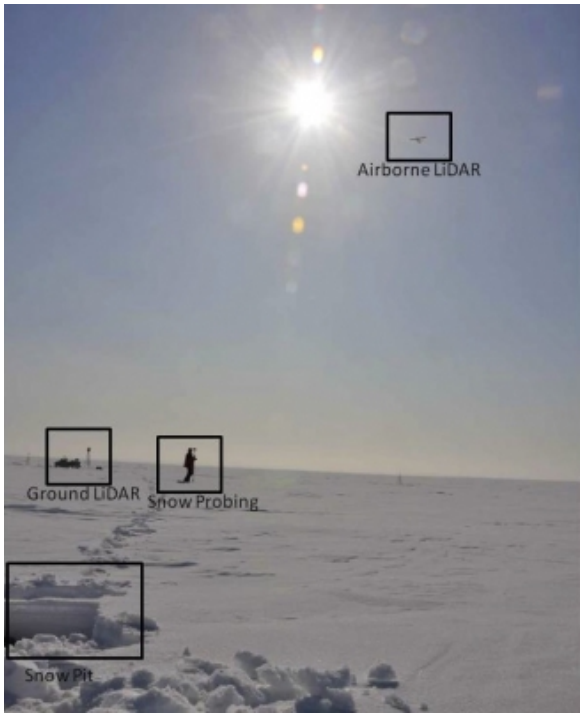
The ground campaign was designed to characterize snow properties so that these measurements could be compared to results collected using ground-based and airborne LiDAR.

The ground-based campaign therefore focused on accomplishing three tasks:

1. Setting up a precise GPS control network, including high-order base stations, to allow the aircraft to navigate with 10 cm positioning precision;
2. Operating ground-based LiDAR to produce small and specific targets where the snow surface topography was measured to centimeter accuracy; and
3. Measuring snow depth and snow water equivalent (SWE) along the planned flight path—with minimum snow disturbance—before the aircraft flies.

One of the unique aspects of the ground snow measurements involved digging snow pits. These pits are dug with vertical walls and square corners; they allow researchers to look at the snow layers, which provide a stratigraphic record of the winter's wind, snowfall, and thaw events. The arctic snow pack has a high percentage of depth hoar frost and frequent surface hoar frost formation due to severe cold and strong temperature gradients. The snow surface can be -30°C while the base of the snow will be -10°C, driving heat and moisture from the warm base to the cold surface of the snow. Due to this metamorphic process, very little of the snow layer texture is due to the nature of the initial snowfall.

Measuring snow depth also included use of the "MagnaProbe," a device invented by CRREL, which measures snow depth and a GPS position at the same time (see http://www.snowhydro.com).



Schematic depicting the various facets of SnowSTAR fieldwork. Photo courtesy of Chris Polashenski.

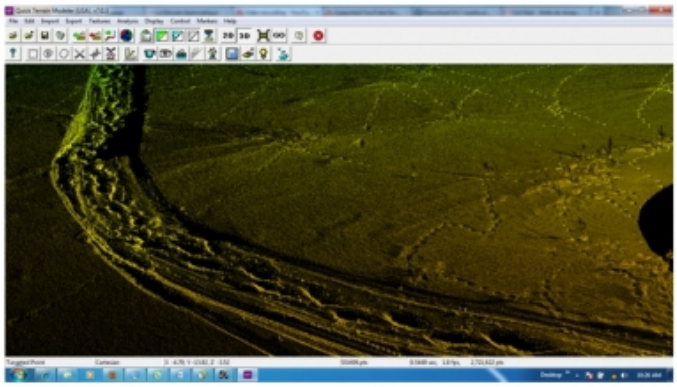
Dr. Sveta Stuefer collects snow depth measurements with a MagnaProbe. Photo courtesy of Sveta Stuefer.

LiDAR Campaign

After eight days of preparation work the aircraft arrived to do airborne LiDAR while the ground crew collected ground-based LiDAR data for comparison. Scanning LiDAR equipment uses a laser rangefinder to measure surfaces. LiDAR works by hitting the surface with laser pulses and can only scan along a line of sight. For ground-based LiDAR anything out of the line of site - such as the backside of small hills within the scan area - is missed in the scans. To fill these gaps the team established multiple LiDAR station positions around an area of interest, making scans first of one side of hills, then of the other, and overlaying the scans to build a full surface. In order to overlay the scans accurately targets were set around the site and located by the scanner for each position. Data collected at each site was then rotated and

shifted until the targets lined up. This allowed the team to very precisely tie the scans collected from different viewpoints together into a single surface map.

Ground-based scanning LiDAR collects 11,000 points in less than half a second averaging between 20 and 30 million points at each site. This enables the ground-based LiDAR team to produce 3D surface maps with very high resolution (a few hundred points per square meter) and very high accuracy (approximately ±0.5 cm vertical resolution).



A screenshot of LiDAR data collected during SnowSTAR 2012. Note the snowmobile track and footprints across the bottom of the image and the ptarmigan tracks wandering around the snow surface. Image courtesy of Simon Filhol.

Airborne LiDAR is mounted on an aircraft, pointing down. It runs continuously as the plane flies and collects 10-100 times more data than ground-based LiDAR. However, airborne LiDAR has lower accuracy than the ground-based system (approximately 10 cm vertical resolution).

To calculate the snow depth the team will return after snowmelt and collect LiDAR data at the same locations to create a second surface. With the use of Differential Global Positioning Systems (DGPS), a precise co-registration of the two maps is possible. Subtracting the ground surface from the snow surface will yield a map of the snow depth with high accuracy. Using the snow cores, team members will develop a simple regression equation to convert snow depths into snow water equivalents and produce maps of snow pack across the study region.

Results

The airborne LiDAR team makes a pass in their DeHavilland DHC-3 Otter airplane. Photo courtesy of Matthew Sturm.

SnowSTAR 2012 succeeded in collecting a very large dataset of snow measurements over the same areas using a number of different techniques. The team took more than 100,000 ground-based snow depths spread across a 200 kilometer swath of northern Alaska, dug 20 detailed snow pits, obtained 286 snow cores that were weighed for snow water equivalent (average density was 283 kg/m^3), produced 19 ground-based LiDAR maps, and collected more than one hundred square kilometers of airborne LiDAR mapping along a swath about 200 meters wide.

The ground data are currently being uploaded into ACADIS. The airborne and ground LiDAR will require more processing before they can be archived.

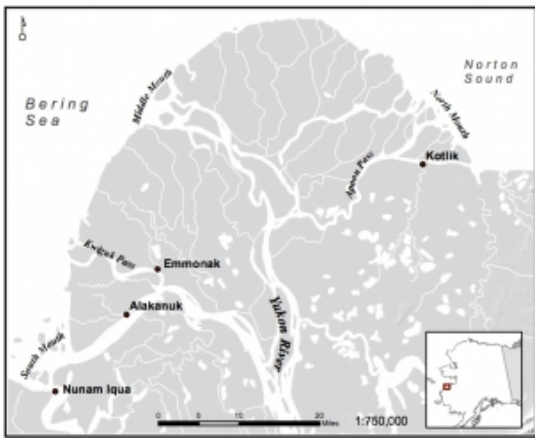
For further information about the SnowSTAR 2012 project, please see the five dispatches produced during the field campaign and posted on the Scientific American website (http://blogs.scientificamerican.com/expeditions/tag/alaskan-north-slope) or contact Matthew Sturm (Matthew.Sturm@erdc.dren.mil).

The Value of Ethnography in Times of Change: The Story of Emmonak

Introduction

Since 1976, social anthropologist and ethnographer Ann Fienup-Riordan has worked in southwest Alaska documenting traditional Yup'ik knowledge of communities in the Bering Sea coastal area and delta system of the lower Yukon and Kuskokwim rivers. Her recent work aims to conceptualize the Bering Sea ecosystem in Alaska Native terms and is part of the Integrated Bering Sea Project (http://bsierp.nprb.org/focal/index.html) (see *Witness*, Fall 2010 (http://www.arcus.org/witness-the-arctic/2010/1/article/884)).

The use of ethnography for her work in the village of Emmonak provides a framework for investigating Yup'ik concerns about the changes in climate and ecology occurring along the Bering Sea coast.



The village of Emmonak is located near the Bering Sea coast in the delta system of the Yukon and Kuskokwim rivers. Image courtesy of Nicole Braem, Alaska Department of Fish and Game, Subsistence Division.

Ethnography is a qualitative research method of gathering and synthesizing empirical data on human societies and cultures. Data collection often combines participant observation, field notes, interviews, questionnaires, and archival research. Instead of viewing a community's response to environmental and economic changes as a function of fixed cultural norms, the ethnographic perspective helps researchers understand how people continually reshape their lives in the course of everyday experiences.

Working in coordination with the staff of a regional non-profit organization, the Calista Elders Council, including Yup'ik language translator Alice Rearden, Fienup-Riordan's recent work pioneered a topic-specific format for documenting traditional knowledge. Small groups of elder experts, accompanied by younger community members, are gathered to address a specific set of questions. These sessions last two to three days and always take place in the Yup'ik language. Similar to academic symposia, this format encourages elders to speak among peers as topic experts. These topic-specific gatherings create a context for cultural transmission in which elders share the qanruyutet (words of wisdom) that guide their interactions with the environment.

Fienup-Riordan's ethnography of the village of Emmonak draws on observations from topic-specific gatherings on the Yukon delta during 2011, results of previous survey and interview work, and historical information. Her work illuminates the social and economic conditions facing many coastal Alaska communities today and provides perspective for understanding the ways in which marine ecosystems matter to these communities.

Dogs pulling a house across the ice in spring 1964 to found the village of Toksook Bay. Although Emmonak and other villages may look fixed with frame houses and elaborate infrastructure, populations remain incredibly fluid, moving great distances for a wide range of harvesting activities. Photo courtesy of Jesuit Oregon Province Archives, Spokane, Washington.

The Ethnographic Story of Emmonak

The village of Emmonak, with a population of 750, faces significant challenges today. These are exemplified by the harsh conditions of 2009 in which the foundation of the local economy, commercial king salmon fishing, crashed; severe cold weather prevented fuel delivery; and subsequent escalating fuel costs for heat and transportation created economic crises for many households. Unfortunately, these hardships are not uncommon.

The community's history helps provide context for current conditions. Starting in the late 1800s contact with non-native people had significant impact on communities along the lower Yukon River. Barged supplies for new settlements were landed at St. Michael to be shipped up the Yukon and non-natives moved to the Yukon delta to exploit the salmon fishery, building canneries and stores at central locations. With a cash economy and easier access to western goods, contact also brought epidemic diseases. During both the 1900 and 1918 influenza pandemics whole villages were wiped out. Orphans gathered at the Catholic Mission just south of present day Emmonak. At the mission children learned English, which in adulthood they spoke to their own children, breaking the strength of the Yup'ik language. Even with these changes, families continued to live scattered in hundreds of seasonal camps, comprised of one to a dozen households. In the early 1960s, however, the Bureau of Indian Affairs built schools at central locations like Emmonak. The law required parents to send their children to school and people abandoned their winter camps and moved into town.

People did not, however, abandon use of subsistence resources. Emmonak residents are heavily dependent on local harvests, annually averaging 510 pounds per person compared to 23 pounds per person for urban Alaska, according to a 2008 survey done by the Alaska Department of Fish and Game. While salmon have declined, The Yukon delta wetlands support whitefish in abundance, and moose numbers have risen dramatically in the past 20 years. While these populations are rising, however, king salmon numbers have declined.

Salmon harvesting on the lower Yukon illustrates the challenges facing Emmonak today. Elders describe nonstop fishing from 1 June through 15 July in the 1950s. The average annual take was 1,200 king salmon, which sold for 50 cents each. A man could bring in $600.00 in a season, which was enough to see him through the winter. By the late 1990s these commercial harvests had dropped significantly, and they have been non-existent since 2008.

Summer fish camps provide time for elders to share stories. Photo courtesy of Ann Fienup-Riordan.

The decline of the commercial fishing economy has a broader social impact on the Emmonak community. Commercial fishing income helps support subsistence activities such as residence at summer fish camps. These camps have been a central activity involving family members of all ages for up to four months a year. In addition to harvesting fish, time spent at these seasonal camps is necessary for other subsistence activities and for educating young people in traditionally proper ways to live. The loss of commercial fishing has contributed to a slow decline in summer fish camp residence.

Social Challenges

The social consequences of the commercial fishery crash are especially troubling. Southwest Alaska has some of the highest rates of suicide and domestic violence in the nation, and Yukon communities have the highest rates in Southwest Alaska. Residents have repeatedly attributed recent suicides to the changes in social and economic conditions. They say that although individuals are responsible for their own actions, they cannot be expected to act appropriately if they are not in control of their land, language, and life. Economic recessions past and present make the situation worse. Lower Yukon residents are using their traditions to solve current social problems. An innovative program of suicide prevention, led by village elders, is making use of traditional practices to rid their communities of suicide. One resident recalled how in the past ritual acts were done in fours, and in 2008 he and other elders worked with students, having them stomp on the ground four times to take away death, then brush it away in four directions. He said, "Since that time, they haven't [committed suicide] up to this day. It was really bad during that time, and I was constantly afraid something would happen to my children."

Deon Aketachunak, Joallyn Johnson, and Juan Akaran explore the lower Yukon near their home in Kotlik, July 2011. Photo courtesy of Ann Fienup-Riordan.

Yup'ik Cultural Perspective

During the topic-specific gatherings conducted in 2011 elders often repeated the Yup'ik adage, "The world is changing following its people." Yup'ik people see environmental change related to not only human actions, such as overfishing or burning fossil fuels, but also to human interactions. Elders encourage young people to learn traditional rules and proper behavior to act with compassion and restraint in order to reverse negative impacts on their world. They educate young people on the practical skills needed to survive the responsive nature of the world in which they live.

Social and economic conditions, as well as distinctly Yup'ik cultural perspectives, shape the ways Emmonak residents respond to environmental changes. Local knowledge holders want to work with scientists to better understand their past and present and to inform their future. They do this for the sake of the younger generation and to gain respect for their ways of being in the world, which they view as still having value. The Emmonak residents view their work with the CEC staff as part of an active solution to the challenges of change.

For further information, please contact Ann Fienup-Riordan (riordan@alaska.net).

References

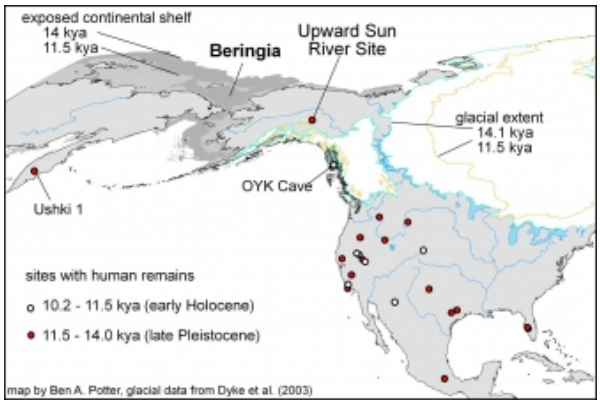
Fienup-Riordan, Ann, and Alice Rearden. 2012. Ellavut/Our Yup'ik World and Weather: Continuity and Change on the Bering Sea Coast. Seattle: University of Washington Press.

Rearden, Alice, and Ann Fienup-Riordan. 2011. Qaluyaarmiuni Nunamtenek Qanemciput/Our Nelson Island Stories. Seattle: University of Washington Press.

Fienup-Riordan, Ann. 2005. Wise Words of the Yup'ik People: We Talk to You Because We Love You. Lincoln: University of Nebraska Press.

Ice Age Child: Earliest Human Remains and Residential Structure in Northern North America

Researchers at the University of Alaska Fairbanks recently recovered Pleistocene - or Ice Age - human remains and an associated residential structure at the Upward Sun River site located along the upper Tanana River in central Alaska. These discoveries are significant first finds for the eastern Beringia region, which encompasses Alaska and the Yukon Territory. Residential structures and human burials from the late Pleistocene and early Holocene are rare. None are previously known for the North American Subarctic and Arctic. The remains of a child who was cremated and buried, and the nearby residential artifacts, at the Upward Sun River site provide new cultural information regarding early Beringians.



Map of excavation site of early human remains in North America. Image courtesy of Ben A. Potter.

A team led by Ben A. Potter of the University Alaska Fairbanks and funded by the National Science Foundation discovered the burial and house during a 2010 excavation. The excavation was designed to explore the earliest of several late Pleistocene occupations previously identified at the Upward Sun River site, also known as 'Xaasaa Na.' While excavating older materials, approximately 13,300 years old, the team found the cremated remains of a child within a pit-hearth. The child was approximately 3 years old at death. After consultation with local and regional Native groups, the team returned to the site in 2011 and found that the hearth was the central cooking hearth of a residential structure which was about 4 meters diameter. Several hundred fragments from stone-working were found in direct association with the residential features. These lithic fragments included several bifacial tools, which were probably used as knives. Radiocarbon dates place the find at 11,500 years old, making the Upward Sun River site one of very few Paleoindian structures in North or South America and the earliest in northwestern North America.

The Upward Sun River site provides data for a number of important problems regarding colonization of the New World and human adaptations at the Pleistocene – Holocene transition.

Excavating the burial pit (L-R): Joshua D. Reuther, Ben A. Potter, and Joel D. Irish. Image courtesy of Ben A. Potter.

The residential structure is relatively small, suggesting small co-residing populations. The faunal remains indicate a wide diet breadth, including salmon, ground squirrel, hare, and birds. This can be contrasted with the Gerstle River site, a nearby early Holocene site dominated by weapons technology, including microblades and composite points, and faunal remains of exclusively large ungulates such as wapiti and bison.

Both the Upward Sun River and Gerstle River sites are technologically part of the Denali Complex. The new data suggests more realistic complexity in prehistoric settlement systems, technology, and subsistence economies than previously known. These discoveries indicated that facets of forager behavior were a condition of social context. Specifically the logistically organized hunting group(s), as

represented at the Gerstle River site, were distinct and separate from a local foraging group, which included females and children, as represented at the Upward Sun River site. Interestingly, the site provides a glimpse of human activities in an area where relatively little is known about prehistoric adaptations. Combined with other inter-site evidence, the emerging patterns suggest complex adaptive strategies, where people adopted conservative yet flexible and resilient technological and settlement systems enabling them to cope with major climatic changes, including the cold and arid Younger Dryas and the subsequent Holocene Thermal Maximum.

Total station work in the evening. Image courtesy of Ben A. Potter.

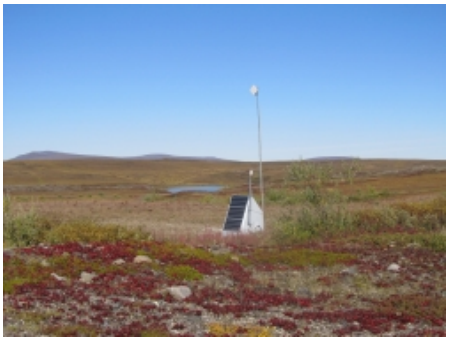
For further information about these discoveries, please see: http://www.sciencemag.org/content/331/6020/1058.short or contact Ben Potter (bapotter@alaska.edu).

Published by the Arctic Research Consortium of the United States • 3535 College Road - Suite 101 • Fairbanks, AK 99709 • info@arcus.org

EarthScope's Transportable Array Plans Deployment in Alaska Beginning Late 2013

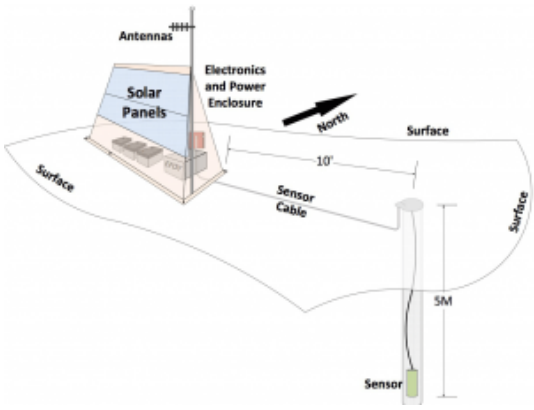
EarthScope (http://www.earthscope.org/), a multidisciplinary earth sciences research program funded by the NSF, is developing plans to deploy its Transportable Array across Alaska beginning in late 2013. The Transportable Array is a suite of 400 broadband seismic stations, which are deployed across a large-scale grid. The observatory stations are placed in a wide variety of settings and operate for two years to record continuous high-quality seismic data with precision timing. As planning continues for deployment in Alaska, the broader scientific community is encouraged to consider possible collaboration opportunities with this infrastructure to create multi-disciplinary observing stations. Collaborations might include modest additions to the sensor suite, such as a meteorological package, sample collection of soils, and thermal soil profiling on multiannual timescales.

A test station is currently operating at the University of Alaska Toolik Lake Research Station.



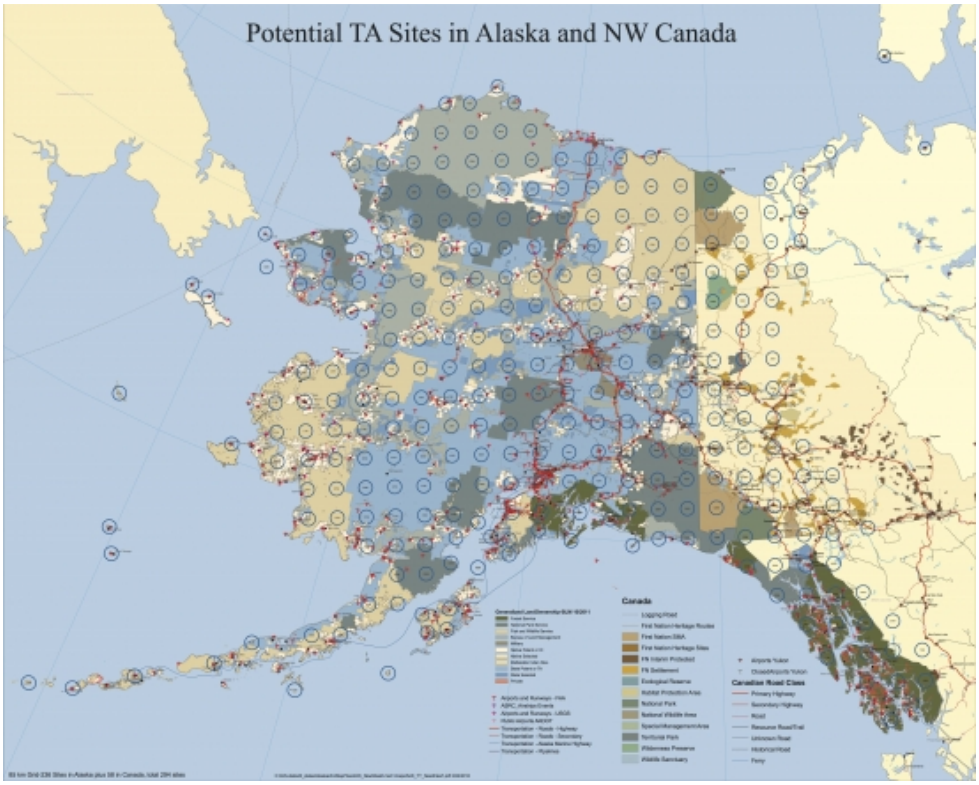
Transportable Array Station TOLK at the Toolik Lake Research Station. Image courtesy of IRIS.

Since 2004, EarthScope has occupied some 1,400 individual station sites with geophysical instruments, including seismometers, GPS systems, and strain meters, to better understand the structure and evolution of the North American continent and the origins of earthquakes and volcanoes. Funded by the NSF, EarthScope's three observatories -- USArray, the Plate Boundary Observatory, and the San Andreas Fault Observatory at Depth -- have recorded more than 32 terabytes of seismic data used to produce high-resolution images of the Earth's interior.



Design schematic of Transportable Array Station TOLK. Image courtesy of IRIS.

Current plans, subject to review and approval by NSF, call for deploying Transportable Array stations in Alaska beginning in late 2013. Transportable Array stations in Alaska would be arranged in a grid-like pattern with 85-km spacing and are planned to cover all of interior Alaska and westernmost Canada, including parts of the Yukon, Northwest Territories, and British Columbia. Installation of about 300 sites is projected to begin in late 2013 and the deployment phase would take over two years to complete. The stations would then operate for two to three years. Many of the proposed locations would supplement or enhance existing seismic stations in coordination with the Alaska Regional Network, the Alaska Volcano Observatory, and the Alaska Tsunami Warning Seismic System. When possible, Transportable Array stations would be co-located with existing GPS stations constructed by EarthScope's Plate Boundary Observatory. Removal of the stations would commence in 2018. To discuss possible collaborations, please contact Robert Woodward, USArray Director, 202-682-2220 extx 206 or Robert Busby, Transportable Array Manager, 1-800-504-0357 at the Incorporated Research Institutions for Seismology (IRIS).



Planned Transportable Array deployment with past and present station coverage. Blue circles indicate general locations of proposed stations. Image courtesy of IRIS.

For further information about plans to deploy the Transportable Array in Alaska, please visit: http://www.usarray.org /Alaska or the IRIS Consortium (http://www.iris.edu/) or download Transportable Seismic Network: Alaska (http://www.usarray.org/files/docs/pubs/AK_Host-a-Station_Oct2011-final.pdf), Opportunities for EarthScope Science in Alaska in Anticipation of USArray Final Report (http://www.iris.edu/hq/Alaska_Workshop_2011/media /docs/ES_Alaska_report_final.pdf), Autonomous Polar Observing Systems Workshop Report (http://www.iris.edu/hq/files /publications/other_workshops/docs/APOS_FINAL.pdf), and USArray: The First Five Years (http://www.usarray.org/files /docs/pubs/usarray_5_years-final-lores.pdf).

Published by the Arctic Research Consortium of the United States • 3535 College Road - Suite 101 • Fairbanks, AK 99709 • info@arcus.org

Advanced Cooperative Arctic Data and Information Service (ACADIS) Update

Advanced Cooperative Arctic Data and Information Service

Advanced Cooperative Arctic Data and Information Service (ACADIS (http://www.aoncadis.org/home.htm)), the NSF Data Management program for arctic sciences (see: NSF's New Data Management System for Arctic Research Programs (http://www.arcus.org/witness-the-arctic/2011/3/article/1774)), is approaching its first anniversary of providing services for the arctic research community. This is a collaborative project between the National Snow and Ice Data Center (NSIDC (http://nsidc.org/)), the University Corporation for Atmospheric Research (UCAR (http://www2.ucar.edu/)) and the National Center for Atmospheric Research (NCAR (http://ncar.ucar.edu/home)). ACADIS data experts have spent the year expanding existing data archive infrastructure and services to support all investigators funded through the Office of Polar Programs (OPP) Division of Arctic Sciences (ARC).

Accomplishments include:

- Ongoing support for all OPP/ARC investigators to meet their data management requirements through the availability of a Data Management Plan Template for researchers to use when completing NSF proposal documentation;
- Customized support to scientists preparing an effective data management strategy in their NSF proposals for field projects or individual investigations;
- Expansion of the ACADIS data repository to serve the diverse data from all ARC projects and individual investigators;
- Development and implementation of a data search and discovery portal for finding and accessing AON data;
- Provision of support for all NSF arctic investigators to submit their metadata and datasets to ACADIS;
- Formation of an ACADIS Data Advisory Committee (ADAC) made up of community investigators to provide guidance and oversight of ACADIS activities; and
- Implementation of an ADAC recommendation to define and develop a 'Showcase' project to harmonize arctic soil temperature and permafrost data as a demonstration of the value of attention to data formats and metadata standards as well as the value of ACADIS services.

Looking forward to Year 2, focus will shift to expanding system functionality to accommodate greater data diversity, offering Digital Object Identifier (DOI)-based data citations for data submitted to ACADIS, establishing interoperability with other arctic data archives, and incorporating an on-the-fly Excel to NetCDF data format conversion tool. ACADIS search and discovery capabilities in Year 2 will be expanded to include data from all NSF arctic projects and beyond to other selected archive sites housing complementary datasets. ACADIS will continue its strong support to the community for bringing NSF/ARC data and metadata into ACADIS and assisting with other data management support needs.

For further information about ACADIS, please go to: http://www.aoncadis.org or contact Mark Serreze (serreze@nsidc.org) or Jim Moore (jmoore@ucar.edu).

Arctic Visiting Speakers Program

Arctic Visiting Speakers

The Arctic Visiting Speakers Program (http://www.arcus.org/arctic-visiting-speakers) (AVS), funded by NSF's Division of Arctic Sciences and developed and managed by the Arctic Research Consortium of the U.S. (ARCUS), provides small grants to arctic experts to share their knowledge in communities where they might not otherwise connect. Speakers cover a wide range of topics and address a variety of audiences including communities and the general public, university audiences, K-12 students, and under-served populations.

In the first half of 2012, AVS supported five tours on topics including oral traditions in northern cultures, research on Weddell seals, award-winning films exploring pressures on northern populations of both people and wildlife, and rural Alaska issues. These five tours directly connected with over 1,100 people, with thousands more reached through media coverage.

Applications are currently being accepted by potential host organizations for 2012 tours. Successful host applications will provide a schedule of events that includes a wide variety of speaking engagements to a diverse set of audiences. Rural and under-served areas are especially encouraged to apply.

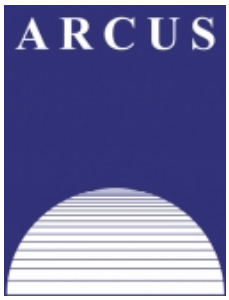
For more information about AVS, past and upcoming tours, and the application process, please visit: http://www.arcus.org/arctic-visiting-speakers or contact Judy Fahnestock (judy@arcus.org).

Alex Eilers and Dr. Jennifer Burns discussing Weddell seals with students at St. John Catholic School in Memphis, Tennessee. Photo courtesy of Alex Eilers and the Pink Palace Museum.

"Regardless of all the communication technologies we currently have at our fingertips, person-to-person contact is indispensable and by far the most powerful and lasting mode of communication. Thank you for honoring and facilitating it." K. Heuer, AVS speaker.

Arctic Forum 2012

The Arctic Forum 2012 convened on 1 May in Washington DC, bringing together a diverse group of scientists, decision makers, and stakeholders to advance dialogue on several key arctic science issues. The forum was sponsored by ARCUS, with funding from the NSF's Arctic Science Division (for scientific speakers) and the U.S. Arctic Research Commission, and was part of the American Geophysical Union's (AGU) Science Policy Conference 2012 (http://sites.agu.org/spconference).



ARCUS

The AGU Science Policy Conference focused on science that helps inform decision making related to natural hazards, natural resources, oceans, and the Arctic. The conference's opening plenary session featured an arctic focus with talks on the historical context of U.S. Arctic Science Policy from ARCUS Board President, Vera Alexander; a perspective on how scientific research can help improve decision making related to oil and gas resources in the Arctic from Fran Ulmer, Chair of the U.S. Arctic Research Commission; and a discussion of how applied science informs resource management decisions in a changing Arctic by Alan Thornhill, Chief Environmental Officer, Bureau of Ocean Energy Management, U.S. Department of the Interior. After the plenary session, the conference convened concurrent tracks, one of which was the Arctic Forum.

The Arctic Forum was organized into three sessions, each of which included presentations from a panel of topic experts followed by discussion with the audience. The first session was titled "Changing Arctic Ecosystems" and highlights of the discussion included:

- Recent data indicates that warming in the Arctic is not homogenous. Novel ecosystems have emerged in the Eurasian Arctic, in which tundra shrub communities have transformed to stands of trees within the past 30 years.
- Discussion of the impacts of environmental change on the Alaskan community of Newtok, where severe coastal erosion has decimated infrastructure, forcing residents to abandon its current location and move the village to a new site.

The second session of the Arctic Forum was "Energy Development in the Arctic" and focused on national and international issues related to oil, natural gas, coal, and methane hydrate in the Arctic. Panelists discussed how climate change and transformations in the economic and cultural fabric of arctic communities have created new challenges for developing public policy. Discussion also touched on the international geopolitics of arctic resource development in countries such as China.

In session three, titled "Governance and Security in the Arctic," panelists discussed military, geopolitical, and legal implications of international interest in the Arctic, which has increased as a result of climate change. The panel presentations covered topics such as:

- The consequences of declining sea ice cover, including increasing impacts from storm surges;
- International policy issues raised by the opening of the arctic seaways;
- Russia's coastal security strategy and its implications for other arctic nations;
- Emerging international security issues facing arctic nations;
- The impact of U.S. ratification of the United Nations Convention on the Law of the Sea treaty; and

- The need for international relations to be based on finding common interests.

Governance and Security in the Arctic Panel (from left): Bob Corell, Global Environment and Technology Foundations; Heather Conley, Center for Strategic and International Studies; Caitlyn Antrim, Rule of Law Committee for the Oceans; Rear Admiral David Titley, Oceanographer and Navigator of the Navy; and Rob Hubert, University of Calgary. Photo courtesy of ARCUS.

The success of the Arctic Forum 2012 was reflected in the depth of audience participation following each of the three sessions, with active discussion among resource managers, the press, legislators and their staff, and members of the public.

For further information about the Arctic Forum 2012, including a list of panel speakers and web links to abbreviated biographies, please see the Science Policy Conference 2012 Program Agenda (http://sites.agu.org/spconference/agenda).

New Funding Opportunity Released: Arctic Science, Engineering, and Education for Sustainability (ArcSEES)

A new funding opportunity entitled Arctic Science, Engineering, and Education for Sustainability (ArcSEES) has been released to support investigations focused on understanding resiliency and sustainability in the high north. This solicitation is released under the joint auspices of the National Science Foundation (NSF), Bureau of Ocean Energy Management (http://www.boemre.gov/), Environmental Protection Agency (http://www.epa.gov/), U.S. Fish and Wildlife Service (http://www.fws.gov/), U.S. Geological Survey (http://www.usgs.gov/), and the Centre National de la Recherche Scientifique (http://www.cnrs.fr/) in France.

ArcSEES is an interagency and international program encompassing a wide array of disciplines including physical, natural, social, computational, and mathematical sciences; and will draw upon the expertise of engineers, managers, and conservationists. The partnership between basic research, management, and foreign agencies allows for a pan-arctic perspective on the rapidly changing arctic system that also bridges the gap between basic research and applied sciences.

In this joint solicitation the agencies welcome research proposals that focus on understanding the complex and often inter-dependent changes in the areas of:

- The living and natural environment - with focus on in-depth understanding of the nonlinear biophysical platform and human-environmental interchanges within the Arctic, and between the Arctic and the rest of the globe;
- The built environment - including housing and transportation structures, energy and communication technologies, climate-resilient materials, and sustainable observing designs;
- Natural resource development - comprising both the potential positive regional-to-global impacts of arctic resource development and related hazards; and
- Governance - addressing the interactions between political, economic, scientific, and cultural organizations that govern arctic futures from the tribal to multi-national scale.

Proposals that are developed in collaboration with communities and make use of the breadth of disciplinary and traditional knowledge available to address one or more of these four thematic areas are encouraged.

All proposals will be submitted in English through the NSF Fastlane system or grants.gov no later than 14 September 2012. To read the full solicitation, please see: http://www.nsf.gov/pubs/2012/nsf12553/nsf12553.htm. For more information, including a link to the solicitation, please see: http://www.nsf.gov/sees. For specific questions, please send an email to arcsees@nsf.gov.

Interagency Arctic Research Policy Committee (IARPC) Releases Draft Arctic Research Plan for Review and Comment

The Interagency Arctic Research Policy Committee (IARPC) has released the draft Arctic Research Plan for public review and comment. The plan is available in PDF format and can be downloaded from the National Science Foundation's IARPC website (http://www.nsf.gov/od/opp/arctic/iarpc/arc_res_plan_index.jsp). Comments on the plan may be submitted through Friday, 22 June 2012. For complete instructions on how to submit comments, please see the bottom of this article.

IARPC consists of principals from 13 agencies, departments, and offices across the federal government and is charged with developing five-year plans for federally sponsored research in the region (see *Witness*, Spring 2011 (http://www.arcus.org/witness-the-arctic/2011/2/article/1662)). The IARPC Arctic Research Plan focuses on research expected to benefit from interagency collaboration. For the years 2013 to 2017, the IARPC identified the consequences of rapid environmental change on ecosystems and societies as the most pressing and overarching scientific questions in the Arctic. Diminishing sea-ice cover is expected to have consequences for global climate; diminishing ice sheets and glaciers will raise sea level; and thawing permafrost will impact infrastructure and increase greenhouse gases in the atmosphere. Thus, the plan comprises seven initiatives for arctic research:

1. Sea ice and marine ecosystem studies
2. Terrestrial ecosystem studies
3. Atmospheric studies of surface heat, energy, and mass balances
4. Observing systems
5. Regional climate models
6. Adaptation tools for sustaining communities
7. Human health studies

The research aims to prompt solutions based on sound research discovered and implemented by collaborative efforts.This plan does not include all research conducted by Federal agencies. Many important priority investigations are and will continue to be conducted within individual agencies or other interagency collaborations.

Brendan P. Kelly, Assistant Director for Polar Science at the Office of Science and Technology Policy, Executive Office of the President, presented the Arctic Research Plan during an informational webinar on 12 June 2012. That presentation is available for download in PDF format on the NSF website (http://www.nsf.gov/od/opp/arctic/iarpc/start.jsp).

Comments on the plan may be submitted through Friday, 22 June 2012, 11:59 EST. All submissions must be in English and must include name, return address, and email address, if applicable. Submissions should be clearly labeled as "IARPC FIVE-YEAR PLAN COMMENT" in any of the following methods:

Email:

agraefe@arctic.gov; include "IARPC FIVE-YEAR PLAN COMMENT" in the subject line of the message.

Mail:

Interagency Arctic Research Policy Committee (IARPC)
c/o Arctic Sciences Division

National Science Foundation
Suite 755S
4201 Wilson Blvd, Arlington, VA 22230
Attention: "Linda Izzard, IARPC FIVE-YEAR PLAN COMMENT"

FAX:

703-292-9082
Attention: "Linda Izzard, IARPC FIVE-YEAR PLAN COMMENT."

Please note that submissions may be subject to public release "as is" under applicable law. Classified, personally identifying information (such as social security numbers), copyrighted material, or business confidential information should not be included with submissions.

For further information, please see NSF's IARPC website (http://www.nsf.gov/od/opp/arctic/iarpc/start.jsp) or contact Brendan P. Kelly (Brendan_P_Kelly@ostp.eop.gov).

U.S. and Canadian Arctic Commissions Establish Collaborative Path Forward

The U.S. Arctic Research Commission (USARC (http://www.arctic.gov/)) and Canadian Polar Commission (CPC (http://www.polarcom.gc.ca/)) met in Montreal on 27 April 2012 at the conclusion of the International Polar Year (IPY) 2012 conference, "From Knowledge to Action (http://www.ipy2012montreal.ca/)." This was the first joint meeting of the two commissions in over a decade. The primary goals of the meeting were to explore common issues between the commissions and to identify opportunities for enhanced cooperation and coordination.

CPC Chairman Bernard Funston and USARC Chair Fran Ulmer provided introductory remarks outlining the mandates and responsibilities of their respective commissions. USARC Commissioners and CPC Board Members then discussed common interests in arctic human health research, Canada's ArcticNet (http://www.arcticnet.ulaval.ca/) initiative, and research associated with water and sanitation issues in the North. The Chairs of each organization expressed strong interest in working together more closely.

The two organizations discussed their mandates, and identified common ground within the broader context of Canadian and U.S. national arctic policy and strategy. The commissions reached consensus on the need for the following actions:

- Encourage closer collaboration among current scientific research and environmental assessment efforts across the Beaufort Sea region;
- Support activities conducted by Canada and the U.S., which will serve as the back-to-back chairs of the Arctic Council from 2013 to 2017;
- Support for arctic observing networks and, particularly, for sustainable funding, given the importance of long-endurance records; and
- Support for increased and easier scientific access to the arctic region.

The meeting included presentations from four invited participants: Lt. Governor of Alaska, Mead Treadwell, spoke about the upcoming sequential chairmanship of the Arctic Council and underscored the importance of the Sustaining Arctic Observing Networks (SAON (http://www.arcticobserving.org/)) initiative; Robert Corell, Principal, Global Environment and Technology Foundation, spoke on "Adaptation Action for a Changing Arctic," an activity being considered for endorsement by the Arctic Council; Kate Moran, Director of NEPTUNE (http://www.neptunecanada.ca/) Canada, discussed an initiative for small-scale cabled marine observatories in the Arctic; and Matt Morrison, Executive Director of the Pacific Northwest Economic Region (PNWER (http://www.pnwer.org/)), introduced his organization and identified links with the USARC and CPC.

The Canadian Polar Commission, created by an Act of Parliament in 1991, is Canada's national institution for furthering polar knowledge and awareness. The CPC supports the sharing of information about the polar regions through enhanced connections among northerners, research communities, governments, and the general public, and provides analysis of current and emerging polar issues. For more information about the Canadian Polar Commission, please see: http://www.polarcom.gc.ca.

The Arctic Research and Policy Act of 1984 established the USARC. Its principal duties are to develop and recommend an integrated national arctic research policy and to assist in establishing a national arctic research program plan to implement

U.S. Arctic Research Commission members in Montreal 2012. From left: Warren Zapol, Charles Vörösmarty, Mary Pete, and Fran Ulmer, Chair. Photo courtesy of Cheryl Rosa.

the policy. Commissioners also facilitate cooperation between the federal government, state and local governments, and other nations with respect to basic and applied arctic research. For more information about USARC, please see: http://www.arctic.gov.

Published by the Arctic Research Consortium of the United States • 3535 College Road - Suite 101 • Fairbanks, AK 99709 • info@arcus.org

Polar Research Board Releases Report on Lessons and Legacies of International Polar Year 2007-2008

In April 2012, the Polar Research Board (PRB (http://dels.nas.edu/prb)) of the U.S. National Academy of Sciences released a report on the Lessons and Legacies of International Polar Year 2007-2008. It reports that the International Polar Year (IPY) was an intense, coordinated field campaign of observations, research, and analysis that led to numerous scientific advances and discoveries. IPY engaged the public to communicate the relevance of polar research to the entire planet, strengthened connections with the Indigenous people of the Arctic, and established new observational networks. The report explains how activities at both poles led to scientific discoveries that provided a step change in scientific understanding and helped translate scientific knowledge into policy-relevant information. At a time when the polar regions are undergoing a transformation from an icy wilderness to a new zone for human affairs, these insights are both timely and relevant.

The report is structured to reflect the important facets of IPY: the human element, scientific advances and discoveries, scientific tools and infrastructure, knowledge to action, and reflections.

The Human Element

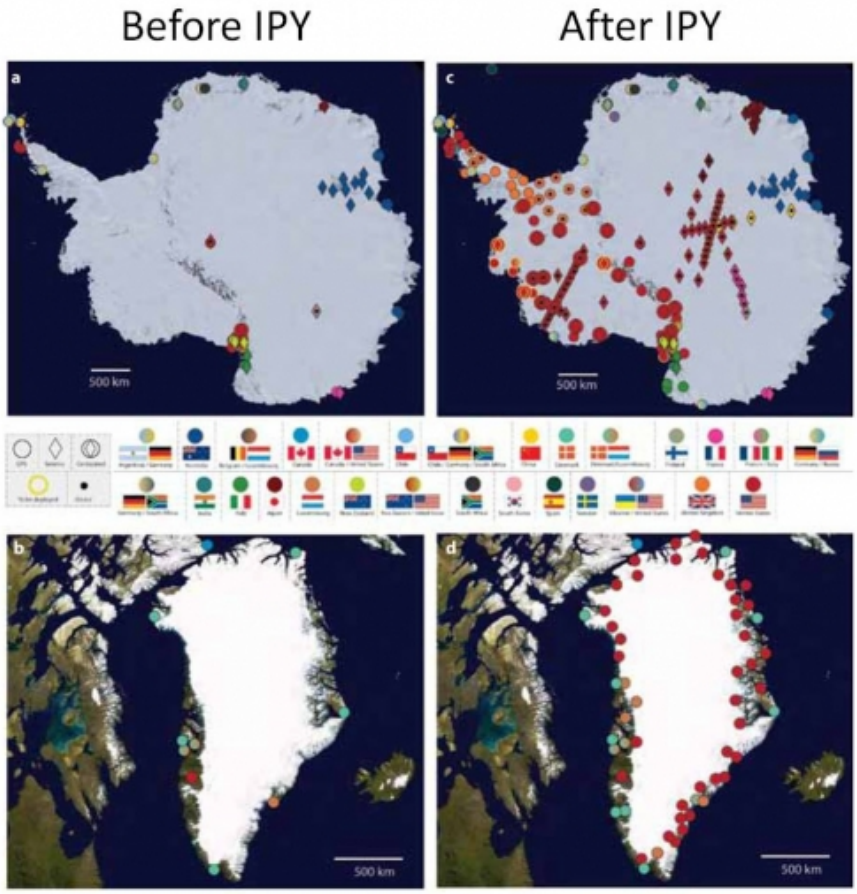
People were the engine that powered IPY. Notably, IPY projects encouraged international collaboration that allowed the polar science community to become more connected and that leveraged infrastructure and intellectual assets from multiple nations to make numerous research projects more efficient. A major objective of IPY was to create new connections between science and the public to increase understanding of the role of the poles in global systems through a broad spectrum of education and outreach activities. One example is Polar Palooza (http://passporttoknowledge.com/polar-palooza/pp01.php), which engaged audiences with big-screen video presentations, music, and opportunities to interact face-to-face with dynamic polar researchers and arctic residents with powerful stories to tell.

Scientific Advances and Discoveries

IPY helped develop new collaborations that enhanced scientists' observational capacity in many of the poles' most remote areas. For example, the Gamburtsev mountain range under the Antarctic ice sheet was discovered during the International Geophysical Year in 1957-58, but its extreme inaccessibility meant that it remained uninvestigated until this IPY. Seven countries collaborated on the Antarctic Gamburtsev Province (AGAP) (http://www.ldeo.columbia.edu/res/pi/gambit/) project, which used cutting-edge airborne radar to investigate the subglacial mountains that are thought to be the initial originating site of the East Antarctic ice sheet millions of years ago.

Scientific Tools and Infrastructure

IPY saw not only the use of existing tools in new places, but also the deployment of new tools that will remain in place long after IPY. A number of observing networks established during IPY combined or extended data collection capabilities beyond what single countries or projects could install or sustain. The Polar Earth Observing Network (POLENET (http://www.polenet.org/)) is an example of a land-based observational network for geodesy and seismology established at both poles during IPY. Data from these stations will contribute important insights into internal processes of ice and rates of ice loss at both poles.



POLENET networks before (left) and after (right) IPY. Image courtesy of POLENET; maps drafted by M. Berg and S. Konfal.

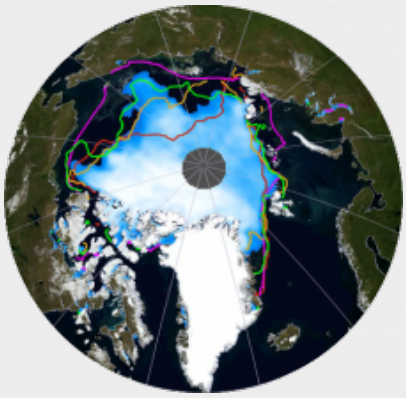
Knowledge to Action

IPY activities, particularly in human health, community vulnerability, and local observations of change, sought to convert scientific data into societally relevant information to be shared with polar communities, local agencies, and grassroots organizations in the Arctic. One example comes from the IPY Sea Ice for Walrus Outlook (SIWO (http://www.arcus.org/search/siwo)), a web-based monitoring and data-sharing network in the Bering Strait region. Developed by ice scientists in partnership with the Eskimo Walrus Commission and several local village monitors, SIWO uses high resolution satellite images, analysis of weather and ice patterns, and observations from local scientists and Indigenous experts to provide forecasts for the spring ice breakup relevant to walrus migration in the northern Bering Sea region.

Reflections

Coming at a time of rapid polar and global change, IPY investments enabled the scientific community to observe and benchmark the state of the polar system. The inclusiveness of IPY helped ensure that the polar research community grew in number, skill, and knowledge, and researchers have forged new collaborations to carry out ambitious projects far beyond the capability of any single nation. Although not everything worked perfectly during IPY, evidence shows that IPY was an overwhelming success.

Investigating Arctic Sea Ice



Minimum extent of Arctic Sea Ice, September 2007 (in red) and September 2008 (in orange). Image courtesy of Stroeve et. al., 2011.

Image courtesy of Winton Weyapuk, Jr., 21 May 2007, Krupnik and Weyapuk 2010, p. 341.

With a 2007 minimum sea ice extent 27 percent lower than the previous record low in 2005, IPY provided an unprecedented opportunity to study the Arctic in a time of rapid change. Several projects investigated sea ice thickness and the mechanisms behind melting. In this satellite image (left), the red line marks the September 2007 sea ice extent, the orange line the extent for September 2008, the green line the September 2009 extent, and the pink line the climatological monthly mean for September 1979-2000. To broaden perspectives and gain more historical information on sea ice, IPY projects matched Indigenous knowledge of sea ice with scientific data. For example, Indigenous terms (right) can distinguish between numerous types of ice and related phenomena in a small area, easily describing the various ice formations shown in the image on the right, such as large floes (puktaat), vertical blocks of ice (puikaanit), pieces of dirt ice (taaglut), and small floating pieces of ice (sangalait).

From outreach activities that engaged the general public to projects that brought researchers from multiple disciplines and several nations together, the legacies of IPY extend far beyond the scientific results achieved, and valuable lessons learned from the process will guide future endeavors of similar magnitude. The world will continue to change, and processes of polar amplification will continue the rapid transformation of the high latitudes in coming decades. The legacy of IPY will help society to understand these changes and put knowledge into action, forging new frontiers in the understanding and management of the planet's resources at all latitudes.

The Lessons and Legacies of International Polar Year 2007-2008 report is available as a free PDF download: at http://www.nap.edu/catalog.php?record_id=13321 and paper copies are available for purchase through the National Academies Press at 888-624-8373.

The PRB is a unit within the National Academies and is responsible for studies related to the Arctic and Antarctic, and cold regions in general. For more information about the PRB and to sign up for the e-newsletter, please visit their website: http://dels.nas.edu/prb/.

Published by the Arctic Research Consortium of the United States • 3535 College Road - Suite 101 • Fairbanks, AK 99709 • info@arcus.org

International Polar Foundation Symposium Identifies Key Needs for the Arctic

The International Polar Foundation (http://www.polarfoundation.org/) has released a final report from the Arctic Futures Symposium 2011 (http://www.polarfoundation.org/documents/arctic_futures_symposium_2011_final_report/) held in Brussels, Belgium. Arctic Futures is an annual event that brings together European Union (EU) and foreign policymakers, scientists, industry representatives, indigenous peoples, and academics to discuss key issues facing those living and working in the arctic region. Speakers at the 2011 symposium shared perspectives from Arctic Council nations and gave presentations on science and cooperation in the Arctic, predicting climate impacts on the Arctic, natural resource exploitation in the Arctic, the economy of the North and indigenous perspectives.

Key concerns identified in the final report are the need for enhanced search and rescue capabilities and environmental protection measures in the Arctic. Proceedings of the annual conference, released in March, also report the desire of arctic states to proceed using currently established mechanisms and forums for arctic governance without additional treaties, and that the EU plans to continue in a constructive and dynamic role for the region. Other needs highlighted in the report include the need for continued cooperation and dialogue among arctic states, indigenous inhabitants, and other stakeholders in the region, and the importance of supporting long-term multidisciplinary scientific research projects, including Earth observation and remote sensing.

Dr. Sebastian Gerland (left) Sea Ice Research scientist at the Norwegian Polar Institute (NPI) and Jean-Pascale van Ypersele, Vice-Chair of the Intergovernmental Panel on Climate Change (IPCC) and Professor of Climatology and Environmental Sciences at the Univesrité catholique de Louvain (UCL) address the Arctic Futures Symposium 2011. Photo courtesy: Joseph Cheek, International Polar Foundation.

The Arctic Futures Symposium is an initiative of the International Polar Foundation in partnership with the Prince Albert II of Monaco Foundation to provide a platform for dialogue amongst stakeholders in the region. Speakers in 2011 included HSH Prince Albert II of Monaco, Icelandic President Olafur Ragnar Grimsson, and senior officials of the EU and Arctic Council. The Arctic Futures Symposium 2012 is scheduled for 4-5 October and will again be held in Brussels

The full report from the Arctic Futures 2011 proceedings can be downloaded from the International Polar Foundation's website:
http://www.polarfoundation.org/documents/arctic_futures_symposium_2011_f....

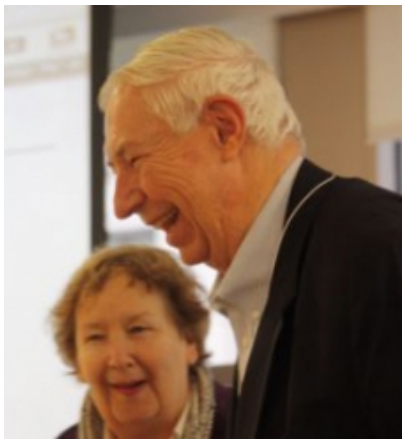
For more information about the International Polar Foundation and Arctic Futures Symposium 2012, please see: http://www.polarfoundation.org/ or contact Joseph Cheek (joseph.cheek@polarfoundation.org).

ARCUS Update

Board President Vera Alexander thanks Bruce Forbes for 8 years of service on the ARCUS Board. Photo courtesy of John Tichotsky.

2012 represents a signal year for ARCUS. After a three-year hiatus, the organization successfully partnered with the American Geophysical Union (AGU) to present the Arctic Forum as part of the inaugural Science Policy Conference. The Forum brought together polar scientists, policymakers, and stakeholders to discuss gaps and priority needs for arctic scientific information. Over 350 people attended the two-day conference that included a science communication workshop, a reception on Capitol Hill, and an opening plenary presentation by ARCUS President Vera Alexander.

The ARCUS annual membership meeting took place the following day at the Pew Conference Center. Here, President Alexander recognized outgoing Board members Bruce Forbes, Andi Lloyd, Rune Storvold, and Bernie Zak for their service.



Board President Vera Alexander thanks Bernie Zak for 19 years of service on the ARCUS Board. Photo courtesy of John Tichotsky.

The Board also welcomed newly elected members Mark Ivey, Site Manager, DOE/SANDIA Atmospheric Radiation Measurement (ARM) site on the North Slope of Alaska; Timo Koivurova, Research Professor, Northern Institute for Environmental and Minority Law (NIEM), University of Lapland; Mark Nuttall, Professor, Department of Anthropology, University of Alberta; and Barry Zellen, Center for Contemporary Conflict, Naval Postgraduate School. Marianne Douglas, Director of the Canadian Circumpolar Institute and a professor in the Department of Earth and Atmospheric Sciences at the University of Alberta, was elected to serve another term.

The ARCUS board also engaged in a two-day visioning retreat facilitated by Cate Bower, Cygnet Strategy, LLC. With much forward momentum provided by the revitalized Arctic Forum, the board discussed ARCUS vision, mission, and purpose in an increasingly crowded arctic arena. The discussions from the retreat will form the basis of a strategic plan that will guide the organization through the next three to five years.

— Susan E. Fox
Executive Director, ARCUS

The Age of the Arctic

Last month, ARCUS held its annual membership meeting in Washington DC, along with a face-to-face Board meeting and retreat, all in conjunction with the American Geophysical Union (AGU) Science Policy Conference 2012 (http://sites.agu.org/spconference). AGU very generously encouraged us to include the Arctic Forum in that venue, with an emphasis on emerging arctic policy. Our interest and involvement in policy recognizes the changing Arctic, which produces multiple needs and challenges. Since our members for the most part are academic institutions, our focus is primarily on the scientific information needed to inform strategy and policy.

Increasing activity, plans for oil and mineral extraction, increased marine transportation, and the emergence of an ever-growing international arena are all factors raising multiple issues of safety, sovereignty, and impacts on coastal communities. Only one aspect, military presence in the support of U.S. arctic research, has decreased since I started looking at arctic policy in the 1980s. In the present environment it is critical that policy decisions be made using the best possible scientific information; this creates an expanded need for research and effective communication of the results. Furthermore, this information must be available freely with no restrictions. This is not only needed for decisions on various issues, but is needed for the scientific work itself. Science is an iterative process. It builds on the existing state of knowledge and increases and refines it as new information emerges. Therefore, access and discussion is absolutely essential to scientific progress. ARCUS, as an academic research-based organization, has a large role and responsibility in this regard.

— Vera Alexander
President, ARCUS Board of Directors

Published by the Arctic Research Consortium of the United States • 3535 College Road - Suite 101 • Fairbanks, AK 99709 • info@arcus.org