Witness the ARCTIC

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In this Issue

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ARCUS Member Highlight: The Smithsonian Institution

Note: "Witness the Arctic" regularly features the research and related programs of ARCUS member institutions. This article spotlights the Smithsonian's Arctic Studies Center (http://www.mnh.si.edu/arctic/html/about.html), which is part of the Department of Anthropology (http://anthropology.si.edu/) in the National Museum of Natural History, a section of the Smithsonian Institution.

The Arctic Studies Center was established in 1988 with a mandate from Congress to study northern cultures, peoples and environments, and promote interest in the north—with a special focus on northern cultural research and education. During the past 27 years the Center has developed a wide range of programs, including anthropological studies of circumpolar cultures from ancient times to the modern day; collections and preservations of artifacts, photographs, and art; distribution of information through publications, exhibitions and electronic media; and training of northern peoples in anthropology and museum studies.

Originally directed at Alaska, where the Smithsonian research and collecting began in the 1860s, and in Labrador, where the Smithsonian has been active since 1970, Arctic Studies Center programs are now conducted throughout the circumpolar and northern regions from Siberia to Scandinavia, Alaska, and Newfoundland. The Center seeks to bring Arctic Studies Center researchers together with community scholars in the collaborative exploration of the cultural heritage represented in the Smithsonian's anthropology collections (http://anthropology.si.edu/cm/) from Arctic and sub-Arctic regions.

Over the years, the Arctic Studies Center's resources and partnerships have resulted in many innovative programs and projects. Community-based archaeology and history, collaborative exhibit development, knowledge repatriation, and indigenous interpretation of museum collections all form part of an integrated approach to shared discovery and learning. The Arctic Studies Center is currently involved in producing numerous publication and media projects, including the launch of its own publication series titled Contributions to Circumpolar

Anthropology. The Arctic Studies Center also participates in several education programs, seminars, conferences, and symposiums with the public and native communities. Thanks to these efforts, the Arctic Studies Center is bringing the Smithsonian's collections and research out of "the nation's attic" and introducing them to audiences around the globe.

Recent Events, Research, Exhibits, and Resources

- The Smithsonian's National Museum of Natural History hosted the Arctic Spring Festival celebrating Arctic peoples, cultures, and sciences from 8-10 May 2015 to mark the United States' 2015–2017 chairmanship of the Arctic Council. The museum encouraged visitors to learn more about the Arctic through a variety of activities including demonstrations from Arctic nations, research agencies and organizations; workshops; games; and musical and dance performances.

Arctic Studies Center featured research project "Arctic Crashes" is a collaborative study of polar animal fluctuations. Image courtesy of the Arctic Studies Center.

- The Arctic Crashes research program is a collaboration with Arctic anthropologists, biologists, and indigenous experts to explore the roles of human agency, climate, and habitat change in historical collapses ('crashes') of marine and terrestrial animal populations. The Arctic makes a compelling case for assessing the role of multiple players in biological resource sustainability, particularly during the Anthropocene era. The Yakutat Seal Camps Project (http://www.mnh.si.edu/arctic/html/Yakutat-seal-camps/), sponsored by the National Science Foundation, is multi-disciplinary study of 900 years of interaction between people, seals, and glaciers at Yakutat Bay Alaska. It addresses the ancient, historical, and contemporary harvest of harbor

seals at ice-floe pupping grounds near Hubbard Glacier in the context of Holocene climate change.

Yakutat Seal Camps Project community researchers, the Ramos-Abraham family, at Yakutat Bay, Alaska. Photograph by Brandon McElroy, image courtesy of the Arctic Studies Center.

- The Arctic Studies Center's Living Our Cultures (https://www.anchoragemuseum.org/exhibits-events/permanent-exhibits/alaska-native-cultures/) exhibition at the Anchorage Museum features the Smithsonian's extensive collection of Alaska Native objects combined with interactive media to present masterworks in the context of the peoples' lives today. The associated Sharing Knowledge Alaska website (http://www.mnh.si.edu/arctic/html/sharing-knowledge-alaska/Index.html) and Living Our Cultures (https://www.youtube.com/playlist?list=PL33278BF298794573) playlist on YouTube present some of the many programs conducted by the Arctic Studies Center Alaska to highlight contemporary indigenous arts, cultures, and languages.

The art, ceremony, and spiritual beliefs associated with whaling traditions are explored in the online exhibit "Sharing Knowledge." Image courtesy of the Arctic Studies Center.

- The Center's website (http://www.mnh.si.edu/arctic/html/about.html) features links to a wide range of web-based exhibitions (http://www.mnh.si.edu/arctic/html/exhibitions.html), ongoing research, publications, and resources available to the public.

The Arctic Studies Center has its main office in the National Museum of Natural History in Washington, D.C. and cooperates closely with the Smithsonian's National Museum of the American Indian. The Alaska Office of the Arctic Studies Center is located at the Anchorage Museum of History and Art (https://www.anchoragemuseum.org/), with whom they have a longstanding cooperative agreement.

For more information about the Arctic Studies Center, please visit the Center's website (http://www.mnh.si.edu/arctic/html/about.html).

Or, contact the Director of the Arctic Studies Center, William Fitzhugh (Fitzhugh@si.edu) or Aron Crowell in the Alaska office (crowella@si.edu).

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Study of Environmental Artic Change (SEARCH) Update

Several SEARCH activities have been underway since the last SEARCH update (http://www.arcus.org/witness-the-arctic/2015/1/article/22948):

Final Arctic Observing Position Paper

This SEARCH position paper, released in its final form in April, focused on issues related to the design and implementation of an integrated Arctic Observing Network. The drafting of the paper was led by Craig Lee, chair of the SEARCH Observing Change Panel (OCP) (http://www.arcus.org/search-program/sciencecoordination/observing), with input from the OCP, SEARCH SSC (http://www.arcus.org/search-program/sciencecoordination/ssc-committee), and via a call for input from the broader community. The paper represents a synthesis of discussions within SEARCH over the last year and builds on past SEARCH-AON community events and workshops. Key issues addressed in the paper include governance, network integration, and sustained funding. The final paper and a matrix showing responses to comments from the open input period are available here (http://www.arcus.org/search-program/aon).

Arctic Observing Open Science Meeting 2015

The Arctic Observing Open Science Meeting will be held 17-19 November 2015 in Seattle, Washington. The goals of the Arctic Observing Open Science Meeting are to:

- Present and discuss scientific findings and advances resulting from Arctic observing projects funded by U.S. agencies and organizations;
- Review operational and technological achievements of observing programs funded through local, state, and federal agencies and private and non-profit organizations;
- Explore how well new scientific achievements meet science and mission objectives; and
- Further define and strengthen collaborations.

Core funding for the meeting has been awarded by NSF's Arctic Observing Network program (https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503222). Co-sponsorship opportunities are available for support of web-streaming, meeting product development, a poster session, student/early career travel support, and other targeted activities.

More information on the meeting and registration will be posted as it becomes available here (http://www.arcus.org/search-program/meetings/2015/aoosm).

Sea Ice for Walrus Outlook

The Sea Ice for Walrus Outlook (SIWO) season started in April and is now concluding. SIWO is a resource for Alaska Native subsistence hunters, coastal communities, and others interested in sea ice and walrus. The SIWO provides weekly reports from April through June with information on sea ice conditions relevant to walrus in the Northern Bering Sea and southern Chukchi Sea regions of Alaska. Last week's report was the last full report of the season, as there is very little sea ice left in the regions of interest. The SIWO project is a collaboration including weather and ice forecasters, climate scientists and sea-ice researchers at NOAA; the National Weather Service; the University of Alaska Fairbanks; ARCUS; Alaska Native sea ice experts; and the Eskimo Walrus Commission. More information and the weekly reports can be found here (http://www.arcus.org/search-program/siwo).

New SEARCH Governance Structure

SEARCH has made continued progress on key governance and structure issues. An announcement of personnel for new SEARCH positions, including a SEARCH Executive Director and rotations in the Science Steering Committee (SSC), are expected this summer, along with a new Terms of Reference and an annual plan.

Sea Ice Prediction Network

The Sea Ice Prediction Network (SIPN) (http://www.arcus.org/sipn) Leadership Team organized several activities this spring, including initiating the 2015 Sea Ice Outlook Initial Condition Experiment and convening the associated 2015 Sea Ice Modeling Action Team (http://www.arcus.org/sipn/action-teams/2015-modeling), the first two in a series of SIPN webinars (http://www.arcus.org/sipn/meetings/webinars) aimed to provide the sea ice research community with useful and timely information on topics like the characteristics and processes critical for the radiation budget and observations of Arctic snow and sea ice thickness from satellite and airborne surveys. At the start of the 2015 Sea Ice Outlook (SIO) season, SIPN solicited a new call for Informal Contributions (http://www.arcus.org/sipn/sea-ice-outlook/2015/informal-contributions) for sharing information on sea ice parameters other than extent and/or for other time periods than what is included in the regular monthly reports. The regular June call for Sea Ice Outlook Contributions (http://www.arcus.org/sipn/sea-ice-outlook/2015/june/call) was solicited in early June with contributions due on 12 June. The June SIO report will be released on Monday, 22 June.

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Tracking Public Knowledge and Perceptions About the Arctic

By: Lawrence C. Hamilton, Carsey School of Public Policy, University of New Hampshire

The U.S. public knows that *something* is happening in the Arctic. It involves melting ice, because that has been mentioned in so many news accounts and scientific reports. But where exactly is that ice? Is it still melting? What might that mean for people who live far away? On such points public awareness becomes fuzzy, with some people's perceptions shaped by their ideology instead of geographic or scientific knowledge. These findings emerge from research that has been asking Arctic knowledge questions alongside the usual public opinion or political items on national or statewide surveys.

The first research of this type involved the General Social Survey (GSS) (http://www3.norc.org/GSS+Website/), a flagship nationwide instrument supported by the U.S. National Science Foundation. In 2006 and again in 2010, the GSS carried a "polar module" of questions assessing levels of public knowledge about polar regions, and concern about polar climate change. Analysis of those surveys found that knowledge improved slightly from 2006 to 2010, while levels of concern stayed about the same—and were strongly divided in terms of ideology (Hamilton 2008; Hamilton, Cutler and Schaefer 2012a). Ideological divisions prove to be so strong they actually reverse the effects of objectively tested science literacy. Concern about polar climate change tends to increase as science literacy rises among people who self-identify as liberal or moderate. Among the most conservative, however, concern about polar climate change tends to decrease as science literacy rises (Hamilton, Cutler and Schaefer 2012b).

The GSS results inspired a second generation of polar survey research asking more specific questions. In this note we look at one example about Arctic ice:

Which of the following three statements do you think is more accurate? Over the past few years, the ice on the Arctic Ocean in late summer...

- *Covers less area than it did 30 years ago.*
- *Declined but then recovered to about the same area it had 30 years ago.*
- *Covers more area than it did 30 years ago.*
- *Don't know/no answer.*

Sixty-eight percent of those responding to a 2011 national version of the Community and Environment in Rural America survey (NCERA) knew or guessed the correct answer—ice area has declined. In fact, since 2007 the

extent of Arctic sea-ice in September remains over a million square kilometers lower than it was 30 years before. Public recognition of this striking change, however, varies with political orientation and with beliefs about climate change. For example, 80 percent of the NCERA respondents who personally agree with the scientific consensus that climate change is happening now, caused mainly by human activities, answered the sea ice question correctly. On the other hand, only 32 percent of those who think climate change is not happening answered this question correctly. On this and other factual questions, it seems likely that many people chose answers derived from their more general beliefs about climate change (Hamilton 2012).

Figure 1 graphs average Arctic sea ice area, calculated from satellite observations for each September from 1979 to 2014. In 2012, the year after the NCERA survey, ice area reached an historic low point almost three million square kilometers below 1980s levels. The following year, 2013, it recovered somewhat but still remained far below earlier decades.

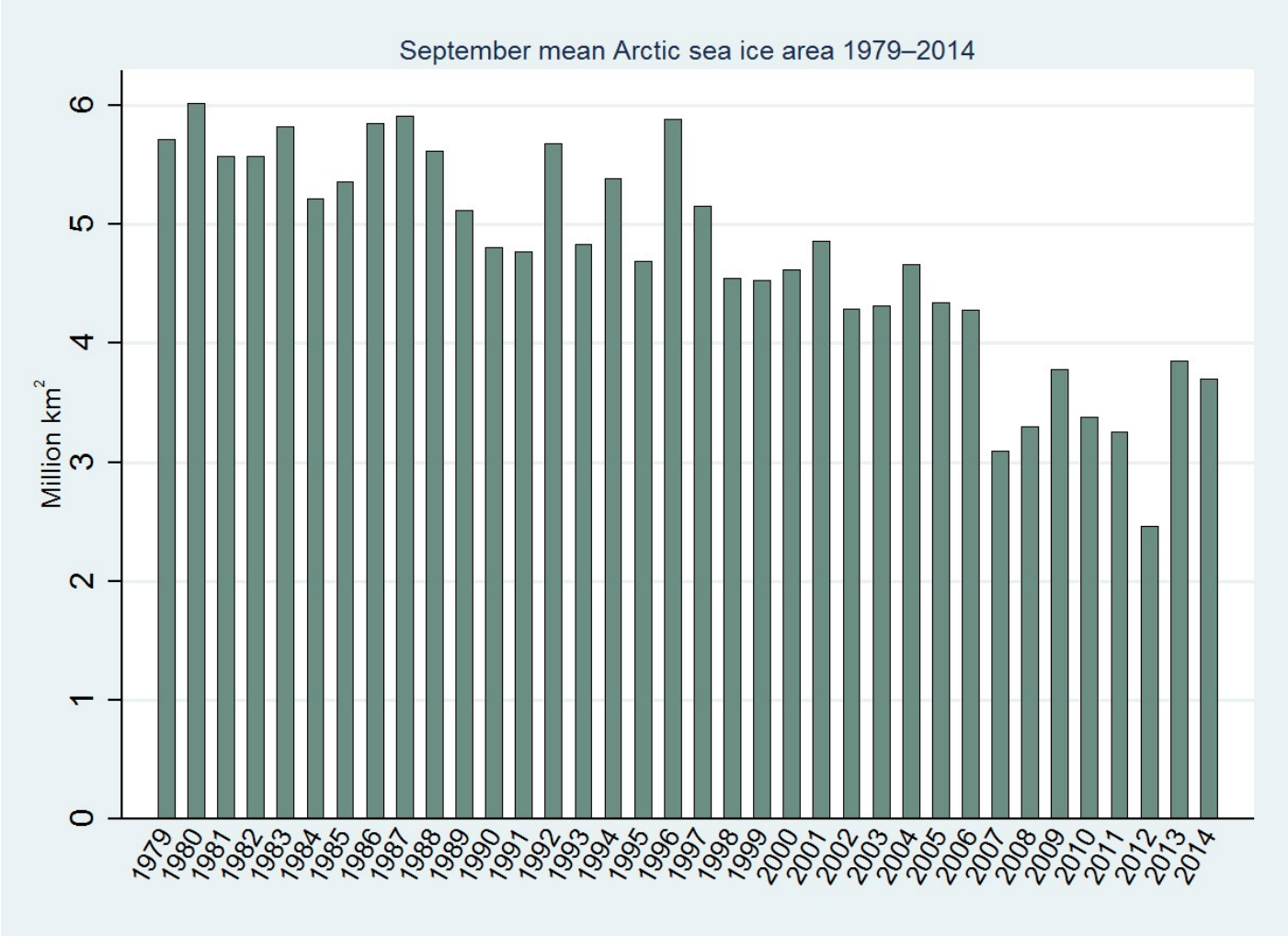

Figure 1: Mean Arctic sea ice area in September 1979 to 2014 (Cryosphere Today data; graph adapted from Hamilton 2015a). Image courtesy of L. Hamilton.

Would physical events such as the record low ice extent in 2012, or its partial rebound in 2013, affect public perceptions on surveys? What about future Arctic change, which could be even larger? Or possible impacts from other news, and improved science communication? In order to track perceptions over time, in 2011 we started including the same sea ice question on a regular series of statewide New Hampshire surveys. Sixty-eight percent of the respondents on our nationwide NCERA survey had answered this question correctly in 2011; so did 71 percent of those on our statewide New Hampshire survey that year. This follows a pattern seen with later survey comparisons as well: New Hampshire provides an imperfect but not unreasonable proxy for U.S. views. Figure 2A tracks the percent of New Hampshire respondents choosing "ice declined" on six surveys from June 2011 to May 2015 (Hamilton 2015b). There is no trend, although we see an abrupt 8-point drop between August and October 2013. That drop followed news that the September 2013 sea ice area was substantially above its record low point from the previous year. This was confusingly described as a sea ice "recovery" in some media and blogs, even though actual ice area in 2013 was still far below what it had been 30 years before so an "ice declined" response to our question remained unambiguously correct (see Figure 1). By fall 2014, while September sea ice area remained similar to what had been in 2013, survey responses went back to more typical levels with 72 percent selecting "ice declined." All of these fluctuations are within the range of survey sampling uncertainty (shown by vertical bars).

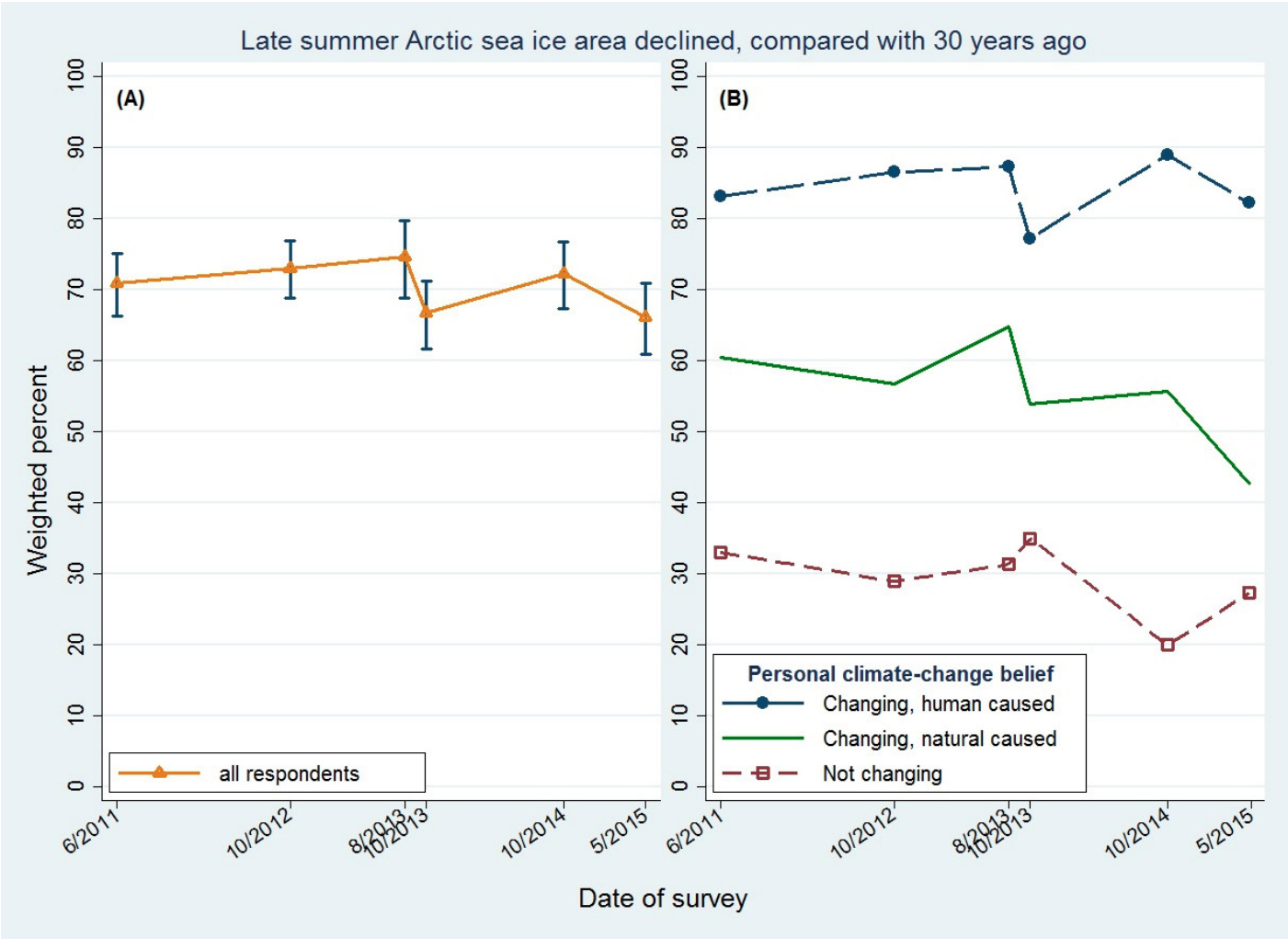

Figure 2: New Hampshire surveys from 2011 to 2015 tracking public awareness of Arctic sea ice area decline: (A) all respondents, and (B) separated by beliefs about climate change. Image courtesy of L. Hamilton.

A standard climate-change question on our surveys reads as follows:

Which of the following three statements do you personally believe?

- *Climate change is happening now, caused mainly by human activities.*
- *Climate change is happening now, but caused mainly by natural forces.*
- *Climate change is NOT happening now.*
- *Don't know/no answer.*

About 52 percent of NCERA respondents, and 55 percent of New Hampshire respondents, agree with the consensus among scientists that climate change is happening now, caused mainly by human activities—again following the pattern of New Hampshire responses a few points warmer than national (Hamilton 2012). Thirty-nine percent nationally and 34 percent in New Hampshire chose the climate changing, natural cause option. Relatively few people on either survey believed that the climate is not changing (5 percent nationally, 6 percent in New

Hampshire).

Figure 2B tracks accuracy on the sea-ice question among people who personally believe that climate change is happening now, caused mainly by human activities; happening now, but caused mainly by natural forces; or not happening now. There is a 55-point gap in beliefs about the area of sea ice, comparing those who accept the scientific consensus on climate change with those who believe that the climate is not changing. Indeed the not-changing group performs much worse on the sea ice question than people who say they don't know or express no opinion on climate change: 29 percent accuracy among those who think climate is not changing, vs. 59 percent among those with no opinion about climate change (not graphed in Figure 2).

So what is happening, to produce the strong pattern in Figure 2B? According to the *information deficit* model of science communication, people express low concern about scientifically-identified problems because they lack information that scientists could provide (Burgess et al. 1998). This model implies that some people do not accept the scientific consensus on anthropogenic climate change because they do not have information, such as Arctic sea ice decline, that scientists know but they don't. An information-deficit explanation might account for the correlation between sea ice and climate beliefs in Figure 2B, but it does not fit other data and is clearly too simple. For one thing, those who express no opinion about climate change are *twice as likely* to get the sea ice question correct, compared with the climate-not-changing group; and despite admitting ignorance the no-opinion folks are just as accurate about sea ice as the climate-changing-for-natural-reasons group. This and other evidence suggests causality in the opposite direction: people doubt that sea ice has declined because they reject anthropogenic climate change, rather than the other way around.

An alternative to the information deficit model, called *biased assimilation*, suggests that people tend to seek and retain information that reinforces their prejudices, and reject information that contradicts them (Borick and Rabe 2010; Corner et al. 2011; McCright and Dunlap 2011). Although the reality of anthropogenic climate change is uncontroversial among the great majority of scientists (Doran and Zimmerman 2009; Cook et al. 2013), among the U.S. public it has become a polarized topic (McCright and Dunlap 2011) that correlates more strongly with political identity than almost any other survey question (Hamilton 2014). Another concept helps to understand this polarization: *solution aversion*, in which people doubt the seriousness of a scientifically-identified problem because they object to its possible solutions (Campbell and Kay 2014). Anthropogenic climate change provides an archetype for solution aversion: its reality is often rejected by people who ideologically oppose governmental solutions. So climate-change beliefs come from more general convictions that filter what scientific information about Arctic change individuals will believe.

What people believe about polar regions, *who* believes *what*, and how those beliefs take shape are topics of ongoing research, as we continue tracking results from surveys conducted several times each year. In addition to the sea ice question discussed here, we have other time series on beliefs about whether future Arctic warming will affect weather where you live (Hamilton and Lemcke-Stampone 2014) and whether melting of Arctic sea ice or of the Greenland and Antarctic ice sheets could potentially do more to raise sea level. A new experimental question tests whether people even know that the North Pole is on sea ice (Hamilton 2015b). Results from this research are providing insights on the challenges facing science communication.

Further information about the NCERA survey results is available here (http://scholars.unh.edu/carsey/154/). Further information is available here (http://thepolarhub.org/tags/Survey), or for questions contact Lawrence Hamilton (Lawrence.Hamilton@unh.edu).

Acknowledgments

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The U.S. Arctic GEOTRACES expedition set to embark in 2015

By: David Kadko, 2015 Expedition Chief Scientist

A team of 50 scientists, students, and technicians will embark on the U.S. Arctic GEOTRACES expedition this year, 9 August -15 October 2015, aboard the *U.S. Coast Guard Cutter Healy*. Established by the U.S. GEOTRACES Science Steering Committee, the U.S. Arctic GEOTRACES initiative will be part of an international, multiple icebreaker effort—provided by the United States, Canada and Germany—and will include scientists from several nations who will conduct geochemical sampling of the Arctic Ocean.

GEOTRACES (http://www.geotraces.org/) is an international research program focused on the marine biogeochemical cycles of trace elements and isotopes (TEIs) (Henderson et al., 2007). Study of TEIs in the context of ongoing changes in Arctic systems is well justified since trace elements can play dual roles as essential micronutrients, including Iron (Fe), Zinc (Zn), and Cobalt (Co) (Martin et al., 1990 Saito et al., 2002; Coale et al., 2003) and as toxicants such as Arsenic (As) and Copper (Cu) (Sunda and Guillard, 1976; Sanders and Vermersch, 1982), and therefore affect biological productivity and carbon cycling. These and other elements and isotopic tools can trace and determine rates of many geochemical, biogeochemical, and physical processes in the ocean. The GEOTRACES mission is: "To identify processes and quantify fluxes that control the distributions of key trace elements and isotopes in the ocean, and to establish the sensitivity of these distributions to changing environmental conditions." This is highly relevant to the Arctic, where rapid climate change and accompanying biogeochemical responses are occurring. For this reason there has been strong interest in carrying out studies in the Arctic Ocean since the inception of GEOTRACES.

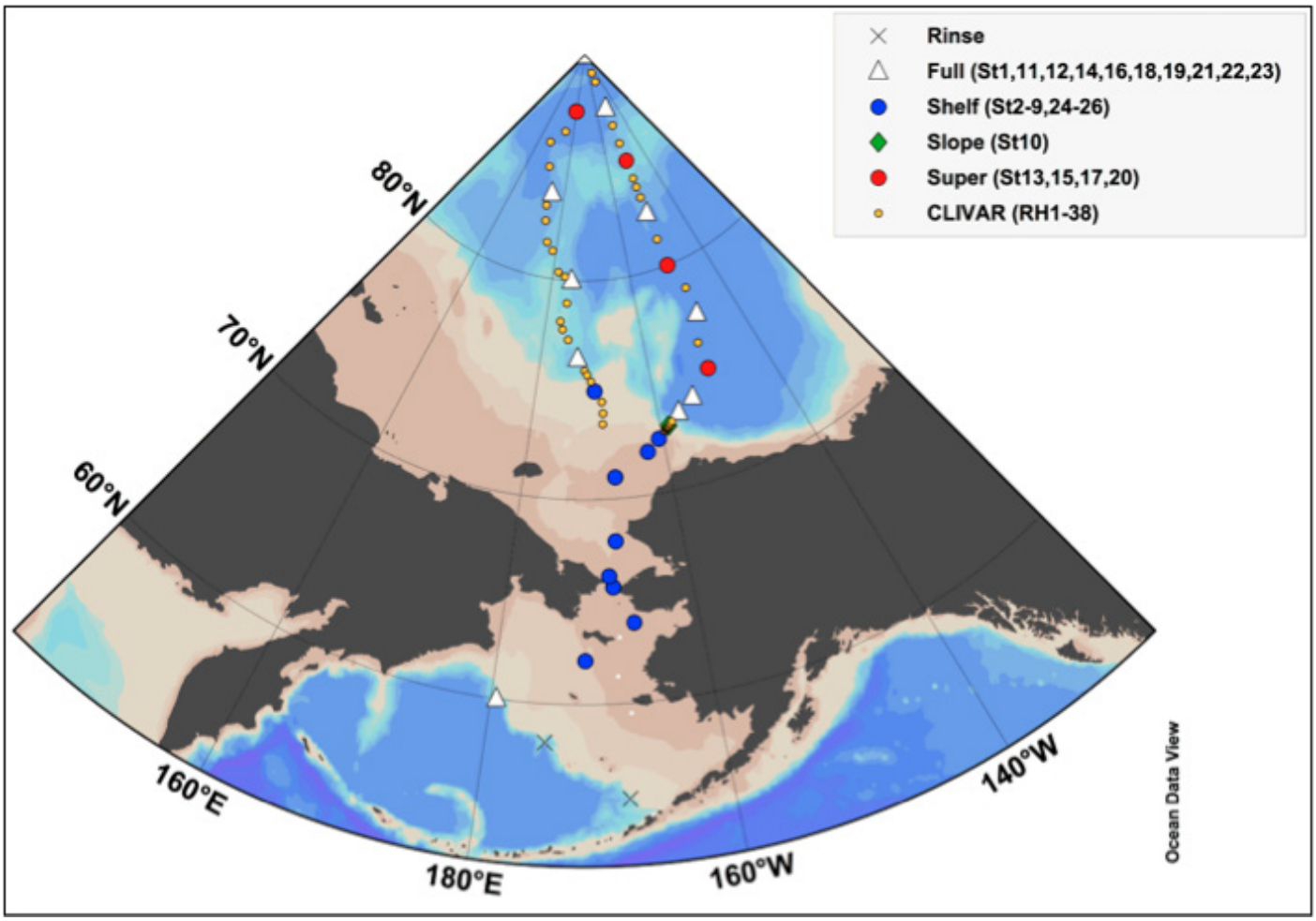

Figure 1: The U.S. Arctic GEOTRACES cruise track. Image courtesy of GEOTRACES.

A small ocean with large global impact, the Arctic Ocean offers a unique opportunity to study TEI biogeochemistry in a regime dominated by two ocean sources (Pacific and Atlantic), with major influences from river supply, shelf-basin exchanges, and sea ice. The U.S. GEOTRACES' transect in the western Arctic (see Figure 1) will be augmented by the CLIVAR (http://www.clivar.org/) program, and be done in collaboration with pan-Arctic efforts from a large international community. These expeditions involve the deployment of ice-capable research ships from three nations (the U.S., Canada, and Germany) across different regions of the Arctic Ocean in 2015 (see Figure 2), and application of state of the art geochemical tracers to unravel the complex biogeochemical dynamics of the Arctic Ocean and its continental shelves. As part of the international collaboration, crossover stations will be occupied by more than one country to assist data quality control and better assure inter-laboratory calibration. Scientists from countries without icebreaker capability will also participate in this endeavor. Heretofore, there have been few comprehensive studies of the marine biogeochemical cycles of TEIs in the Arctic Ocean. The combined international program this year will be unprecedented in regional scope and scientific breadth.

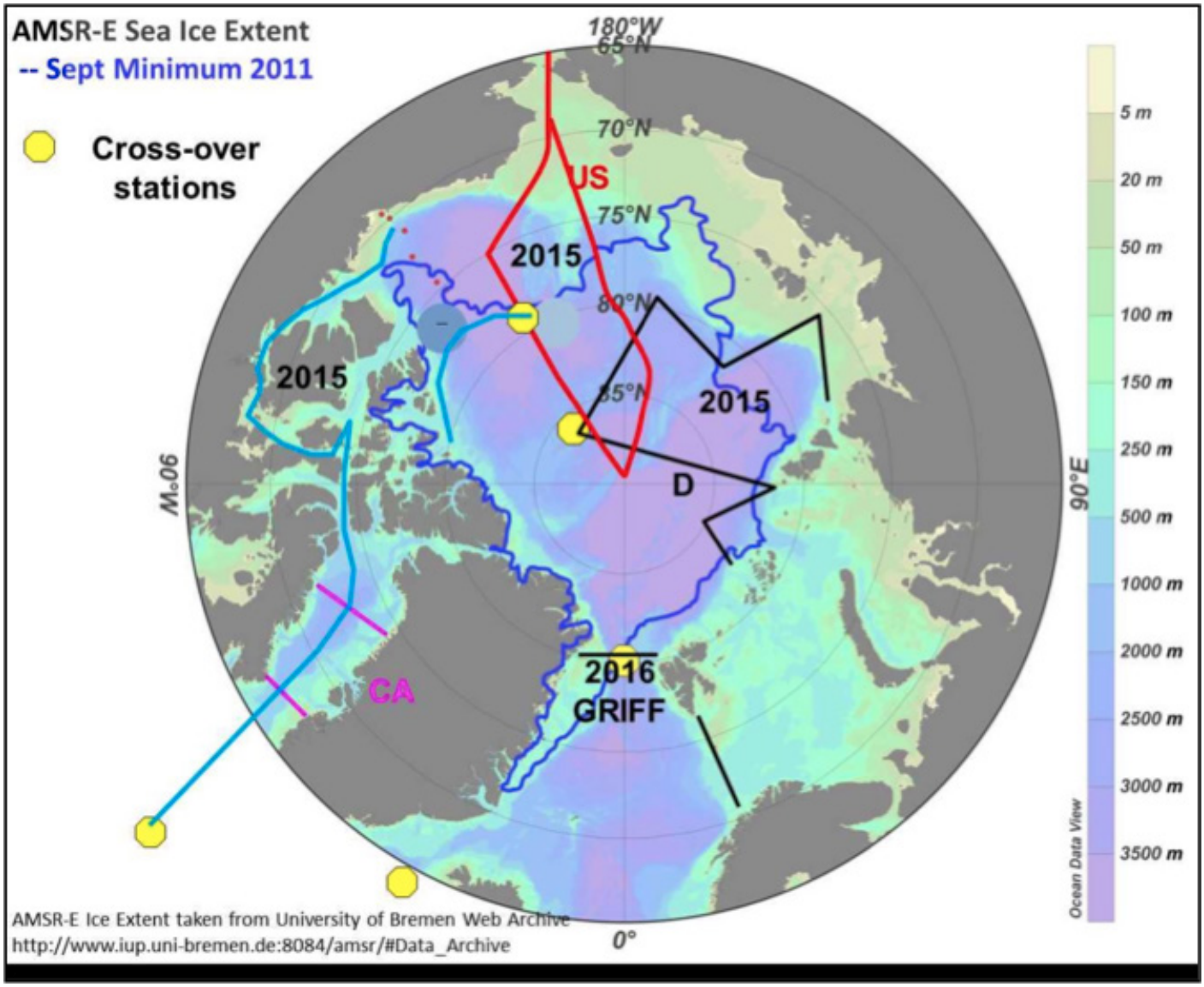

Figure 2: The international Arctic GEOTRACES effort. The U.S. (red), German (black), and Canadian (blue) tracks are shown. Image courtesy of GEOTRACES.

The overall sampling program explores the Pacific inflow through the Bering Strait (U.S.), the Arctic outflow to the Atlantic through the Canadian Arctic Archipelago (Canada), exchange between the Arctic and the Atlantic through Fram Strait and the Nordic Seas (Germany), and a comprehensive coverage of the deep Canada and Eurasian basins (U.S., Sweden, Germany, and Canada).

Overarching goals that motivate the GEOTRACES Arctic initiative include:

1. Quantify the fluxes of TEIs into and out of the Arctic Ocean through choke points (for example, the Bering Strait);
2. Identify the processes that regulate shelf-basin exchange of TEIs and quantify their rates;
3. Characterize the sources and transport of TEIs in the Arctic Ocean via aerosols, sea ice, rivers, and sediments;

4. Identify processes removing TEIs from the water column and quantify their rates;
5. Establish current levels of essential micronutrients and of potentially toxic TEIs as a reference for future change;
6. Describe and quantify the time-varying change in the TEI chemistry of deep water as it mixes westward from the Atlantic Ocean into the Canadian Basin; and
7. Better define the relationship of TEIs to the hydrographic, carbon, and tracer distributions, which form the core of our present knowledge of Arctic waters and circulation.

This mission is part of the greater GEOTRACES mission described above. This program is being carried out in every global ocean basin by the United States and international partners. To date, the U.S. has conducted missions in the North Atlantic and the Eastern Equatorial Pacific.

For further information contact Dr. David Kadko, chief scientist (dkadko@fiu.edu).

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ACADIS Data Management Continues At Your Service

By: James Moore, ACADIS Lead Principal Investigator and Karen Andersen, UCAR

The Advanced Cooperative Arctic Data and Information Service (ACADIS) (http://www.aoncadis.org/) team continues to support data management needs of projects funded by NSF's Division of Polar Programs (PLR) Arctic Sciences Section (ARC) with data submission, preservation, search and sharing services. After discussions with the NSF/PLR/ARC Program Officers, our support to the community through current ACADIS grants to the University Corporation for Atmospheric Research UCAR (http://www2.ucar.edu/)/ the National Center for Atmospheric Research (NCAR) (http://ncar.ucar.edu/) and the National Snow and Ice Data Center (NSIDC) (http://nsidc.org/) will be extended until 15 January 2016 in anticipation of a new support agreement for ACADIS being in place late this year. This means uninterrupted ACADIS support will be provided to the NSF/PLR/ARC community. Proposals for the next phase of ACADIS were due at NSF on 18 May and will be evaluated over the coming months.

Our highest priority is to keep the ACADIS archive open and fully operational for the input, access, and archival of all datasets produced by NSF/PLR/ARC funded investigators until a new arrangement for the continuation of NSF/PLR/ARC data management support is put in place. You will also have ongoing access to ACADIS support staff to address data management support questions.

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

ACADIS team members are ready to help you meet NSF proposal requirements. Feel free to email us and request a review of your Data Management Plan (DMP). Our DMP template is also freely available for download and use here (http://bit.ly/datamgmtplan).

Below is a summary of Arctic dataset holdings and ACADIS usage as of May 2015. This represents over 170 NSF awards from more than 250 Principal Investigators. The current ACADIS data archive contains more than 4.2TB of data, metadata, imagery, and model output.

- 3,377 Arctic Datasets
- 250 Contributing PIs
- 170 NSF Grant Awards
- 20 new datasets per month (average)
- 650 Visitors (monthly average)
- 60 Download Users (monthly average)
- 448,000 Files
- 60 File Formats

The top nine science disciplines as defined by data providers through the NASA Global Change Master Directory (GCMD) keywords represented in the ACADIS data holdings are shown below:

DATASETS	GCMD SCIENCE KEYWORD
109	Biosphere: Alpine Tundra
108	Cryosphere: Snow Cover
107	Paleoclimate: Sediments
88	Terrestrial Hydrosphere: Glaciers
76	Cryosphere: Snow Depth
68	Terrestrial Hydrosphere: Lakes
63	Oceans: Water Temperature
57	Biosphere: Ecosystem Functions
56	Cryosphere: Glaciers

The top nine science disciplines as defined by data providers through GCMD keywords represented in the ACADIS data holdings.

The Arctic Data Explorer (ADE) (http://bit.ly/arcticdatasearch) search portal for Arctic data across agencies, repositories, and nations has greatly increased in speed and efficiency. The search tool now includes over 20,000 datasets across 10 repositories.

ACADIS, funded by NSF, is a joint effort by the National Center for Atmospheric Research (NCAR) (http://ncar.ucar.edu/), University Corporation for Atmospheric Research (UCAR) (http://www2.ucar.edu/), and the National Snow and Ice Data Center (NSIDC) (http://nsidc.org/).

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

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A Jukebox of Oral History—Northern Alaska Sea Ice Observations Through Time

By: Karen Brewster, Research Associate, Oral History Program, University of Alaska Fairbanks

The Oral History Program at the University of Alaska Fairbanks has recently completed the **Northern Alaska Sea Ice Project Jukebox** (http://jukebox.uaf.edu/site7/seaice) available online. People who visit the website can access oral history recordings that offer a rich understanding of sea ice and changing conditions in the North. The goals of this jukebox project are to offer long-term observations about sea ice in northern Alaska in order to inform the scientific community's understanding of sea ice over a longer timeframe and through a broader lens than may otherwise be available, and to help the Iñupiaq community share traditional knowledge between generations.

Local hunter looking at drift ice near the edge of the shorefast ice at Barrow, Alaska. Photo courtesy of Matthew Druckenmiller.

The website includes oral history recordings with 26 residents of the North Slope of Alaska talking about sea ice conditions, observations over time, and changes that are occurring. Included are: interviews recorded from 1978 to 1980 by Dr. Lew Shapiro, Ron Metzner, and Kenneth Toovak for the Geophysical Institute at the University of Alaska Fairbanks (UAF) as part of a study related to potential offshore oil development; interviews recorded from 2008-2009 by Dr. Matthew Druckenmiller as part of his Geophysics PhD project at UAF about sea ice thickness along spring whaling trails offshore of Barrow, Alaska; and recordings made in Barrow in November 2013 by Karen Brewster, Research Associate at Project Jukebox and UAF Geophysics PhD student Oliver Dammann about "unusual" ice conditions in the previous spring and long-term changes experienced by local residents. There is also an interview with sea ice scientist Dr. Lew Shapiro (http://jukebox.uaf.edu/site7/p/2352), talking about his 1970s project as well as his research and career in general.

The Sea Ice Project Jukebox also includes links to related material so that users can begin to understand some of the broader scientific and cultural context surrounding sea ice. Available documents include: the report titled *Historical References to Ice Conditions Along the Beaufort Sea Coast of Alaska* by Lew Shapiro, Ron Metzner, and Kenneth Toovak that is the summation of their interview project; a list of Iñupiaq sea ice terms; some basic diagrams of sea ice features; maps of sea ice trails used by Barrow whalers; and material and websites related to northern Alaska sea ice such as articles, book chapters, the Geophysical Institute's Sea Ice Group and Seasonal Ice Zone Observing Network (SIZONet) (http://www.sizonet.org/), and the Historical Sea Ice Atlas.

Through the stories in this project, it is possible to learn about ice conditions in the Beaufort and Chukchi Seas through time. Going back in time like this provides sea ice researchers a longer perspective on which to base their scientific investigations. One can better assess current conditions by knowing what came before. The material also can be useful to social science researchers wanting to learn more about traditional knowledge and cultural practices, as well as those working on issues related to climate change, adaptation, risk taking, and decision making.

Whaling crew establishing a camp on the shorefast ice during spring whaling at Barrow, Alaska. Photo courtesy of Matthew Druckenmiller.

By listening to accounts from the 1970s, both similarities and differences between them and what local observers report today are revealed. Analysis of the differences can tell us about changing ice conditions. For example, there is variation in the level of discussion about different ice features. One might notice that pile-ups (called ivu in Iñupiaq) are mentioned much more frequently in the older interviews than they are today. This leads to speculation about why. It could be a result of the purpose of the interview and the nature of the questions being asked. It also could be that in earlier times an ivu was a regular event that locals had to deal with so it was something they thought about and talked about a lot, while they rarely happen today and so Iñupiat do not discuss them at the same rate. This then raises the scientific question of why ivus do not happen as often or in the same way as before. In contrast, in the 2008 to 2013 interviews ice break-off events was a main topic that only rarely appeared in the 1970s interviews. Large ice break-off events seem to be happening now nearly every spring at Barrow during whaling. They are often viewed as a new phenomenon, being the result of thinning ice and changing environmental conditions. However, the oral history demonstrates that drifting out on the ice is not new. For instance, in 1978, Henry Nashaknik described two different incidents in the winter of 1932 when seal hunters were caught on ice that drifted out from Cross Island. They were lost for many days, but returned to shorefast ice when in one case their drifting island came back around, and in the other when the men crossed through shifting ice and building pressure

ridges to reach safety.

Ice pressure ridge (ivu) at the open lead north of Point Barrow, Alaska, 30 April 2015. Photo courtesy of Matthew Druckenmiller.

The oral histories also are useful because of how far back in time they can take us. While the earliest recordings in the project are from 1978, the stories and memories of the elder narrators go back more than 50 years into their youth, and sometimes take us into the previous generation when they are able to relay stories that they heard from parents or grandparents:

- In 1979, Otis Ahkivgak (http://jukebox.uaf.edu/site7/p/2109) told a story that he says happened in 1890 when the ice piled up so high onto the bluff in Barrow that it toppled onto a sod house killing its occupant.
- Kenneth Toovak (http://jukebox.uaf.edu/site7/p/2052) relayed a story that tells us something about the ice conditions in the 1930s, when he described seeing ice piled up so high on top of the bluff that he could see it from a mile inland.
- In 2013, Crawford Patkotak (http://jukebox.uaf.edu/site7/p/2104) related a story he'd heard from his father of a big ice pileup in 1957, when many whalers in Barrow had to run for their lives as the ice—being smashed by heavier incoming ice—broke up around them.

Hearing about what the ice, wind and weather was doing at the time can lead to more investigations of ice dynamics and wind, water, and ice interaction.

We are all keenly aware of the huge changes occurring in the Arctic and with northern sea ice. A commonly heard refrain when talking about sea ice conditions with whalers and hunters today is, "I've never seen it like this before." However, it is interesting to note that even as far back as 1978, some of the people interviewed also mentioned how things were different from before. This challenges current assumptions that conditions were more constant in the past, and that dealing with change is a modern climate change-based phenomenon experienced by those living off the sea ice. The oral history shows that Iñupiat have managed for a long time to live with changing conditions, learn from the past, and adapt.

Scientists like to be able to take a long-term view. Such a perspective is especially critical during this period of intense research related to climate change when scientists are trying to understand what is unprecedented versus what has occurred before. By looking into the past, these sea ice oral history recordings can provide that much-needed broader view to inform our current thinking, both scientifically and culturally. By helping us better understand our present, this in turn can lead to more directed research, and perhaps even help us predict our future.

This project was supported by funding from the North Pacific Research Board.

For more information, see the Northern Alaska Sea Ice Project Jukebox website (http://jukebox.uaf.edu/site7/seaice), or contact Karen Brewster (karen.brewster@alaska.edu).

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PolarTREC 2010-14 Product Showcase

By: Sarah Bartholow and Janet Warburton, Education Project Managers, ARCUS

Beginning in April 2014, the most recent cohort of PolarTREC (http://www.polartrec.com/) (Teachers and Researchers Exploring and Collaborating) teachers participated as research team members in scientific expeditions as part of the PolarTREC program. PolarTREC is a professional development, teacher research experience program funded by the National Science Foundation's Division of Polar Programs.

From 2010-2014 four cohorts of teachers were selected through a nationwide search to participate in polar research, working closely with scientists as a pathway to improving science education. Through PolarTREC, selected teachers have the rare opportunity to spend two to six weeks working with a research team in the Arctic or Antarctic. While on field expeditions, teachers and researchers share their fieldwork with scientists, educators, communities, and students of all ages through the use of virtual tools such as online teacher and researcher journals (http://www.polartrec.com/expeditions/antarctic-ice-stream-dynamics/journals), message boards, photo albums (http://media.arcus.org/), learning resources (http://www.polartrec.com/resources), PolarConnect (http://www.polartrec.com/polar-connect) real-time presentations from the field, and online learning resources. After the field experience, teachers and researchers continue to share their experiences with the public and create educational activities to transfer scientific data, methodologies, and technology to classrooms. For an example of how these tools are used, see the Antarctic Ice Stream Dynamics expedition (http://www.polartrec.com/expeditions/antarctic-ice-stream-dynamics).

Teacher Tina Ciarametaro fills up her water bottle with freshly melted glacial water. Sukkertoppen Ice Cap, Greenland. Photo by Tina Ciarametaro (PolarTREC 2014), courtesy of ARCUS.

Each year, the PolarTREC program develops products for dissemination as well as the improvement of existing products to best suit the needs of a growing audience. Teachers develop program portfolios with the major capstone of two lesson plans related to their expedition that adhere to the Next Generation Science (http://www.nextgenscience.org/) Standards (http://www.nextgenscience.org/next-generation-science-standards) as well as local educational standards. Members of their research team review each lesson for scientific accuracy before publication. In turn, researchers are able to review the process of lesson planning and gain an appreciation for the process. To access PolarTREC lessons, users can search by types, topics, age level, keywords, and other fields in the PolarTREC Learning Resources Database (http://www.polartrec.com/resources/search).

New Resources Available

Project Pages (http://www.polartrec.com/projects)

Projects are a collection of PolarTREC expeditions that are related and/or share the same research project. Projects were created as a way to show the depth and breadth of the research that is taking place in the polar regions. The goal is to showcase the on-going PolarTREC contributions to multi-year science initiatives.

Expedition Reports (http://www.polartrec.com/resources/expedition-reports)

These reports succinctly summarize teachers' professional benefits from the field experience, a description of field activities, and a classroom implementation plan. Reports are designed to target an audience of funders, researchers, and future participants. Researchers associated with PolarTREC expeditions will be able to utilize the reports to communicate their science and as a tool to share their broader impacts activities.

Product Pages (http://www.polartrec.com/products)

Beyond the products created by teachers and research teams, products have been created program-wide that serve to illuminate the broader view of PolarTREC impacts. Dissemination of these types of products is a key aspect of synthesis efforts in any science or education program. Researchers, program managers, project leaders, and funders have access to evaluations, publications, presentations and workshop and meeting proceedings and products.

For further information please see the PolarTREC website (http://www.polartrec.com/) or contact Sarah Bartholow and Janet Warburton at info@polartrec.com.

Janet Warburton (left) and Sarah Bartholow (right), the Education Project Managers at the Arctic Research Consortium of the United States, manage the PolarTREC program and provide ongoing support to the teachers and researchers.

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Arctic Ambitions: Captain Cook and the Northwest Passage

By: Harry Stern, Polar Science Center, Applied Physics Laboratory, University of Washington

A new exhibit at the Anchorage Museum, entitled "Arctic Ambitions," (https://www.anchoragemuseum.org/exhibits/arctic-ambitions-captain-cook-and-the-northwest-passage/) examines the log of Captain James Cook, the preeminent navigator of his age, as he sailed north through Bering Strait into the Arctic Ocean in search of the Northwest Passage. The exhibit considers whether Cook would have discovered the passage if sea-ice conditions in 1778 were similar to those of today.

At daybreak on 7 March 1778, "the long looked for Coast of new Albion was seen"[1] (http://www.arcus.org/witness-the-arctic/2015/2/pdf#fn:1) by Captain James Cook from the deck of the *HMS Resolution*. He had come with two ships and 150 men to the northwest coast of North America in search of a Northwest Passage to the Atlantic Ocean. For the next five months he sailed along the coast of present-day British Columbia and Alaska, exploring promising inlets and encountering numerous indigenous peoples.

Figure 1: Detail from "The Resolution beating through the Ice, with the Discovery in the most eminent danger in the distance."; Etching by John Webber, published 1792. Image courtesy of the Arctic Ambitions exhibit.

On 11 August, Cook sailed north through the Bering Strait into the Arctic Ocean. Working his way along the coast of Alaska, his progress was halted a week later by "ice which was as compact as a Wall and seemed to be ten or twelve feet high at least." This marked the farthest north reach of Cook's voyage at 70°44′ N latitude, just west of present-day Wainwright, Alaska. Retreating southward six leagues (about 18 miles), he encountered "a point which was much incumbered with ice for which Reason it obtained the name of Icey Cape" (see Figure 1). According to

Beaglehole[2] (http://www.arcus.org/witness-the-arctic/2015/2/pdf#fn:2) this is 18 August 1778, off Icy Cape, when Cook wrote, "Our situation was now more and more critical, we were in shoald water upon a lee shore and the main body of the ice in sight to windward driving down upon us. It was evident, if we remained much longer between it and the land it would force us ashore." He turned westward, and for the next 11 days sailed close to the ice edge, trying to find an opening to the north. On 29 August having reached the coast of Siberia at 69° N without finding a break in the ice, he abandoned the search, since "so little was the prospect of succeeding." He sailed south through the Bering Strait on 2 September.

Captain Cook is justly famous for his exploration of the South Pacific, but his contributions to the exploration of the North Pacific and the Arctic are arguably equally significant. The exhibit at the Anchorage Museum, Arctic Ambitions: Captain Cook and the Northwest Passage (https://www.anchoragemuseum.org/exhibits/arctic-ambitions-captain-cook-and-the-northwest-passage/), examines the legacy of this northern voyage with artifacts, art, and hands-on activities. The exhibit runs through 7 September 2015, and will open at the Washington State History Museum in Tacoma on 16 October 2015. Accompanying the exhibit is a book also titled Arctic Ambitions (http://www.washington.edu/uwpress/search/books/BARCOO.html)—a collection of essays that shed new light on Cook's northern exploration. The paragraph above is taken from one of the essays, 'Sea Ice in the Western Portal of the Northwest Passage from 1778 to the 21st Century,' in which the author examines historical and modern sea-ice conditions in the region north of the Bering Strait, and asks whether Cook would have discovered the Northwest Passage in 1778 if sea-ice conditions had been as they are today. The answer is suggested in Figure 2, which shows Cook's hypothetical progress in today's Arctic Ocean. By 18 August the sea-ice has typically retreated hundreds of kilometers offshore, opening up a navigable coastal route. Cook would have had time to reach Amundsen Gulf and know that he had discovered a promising passage before returning to the Bering Strait ahead of fall freeze-up.

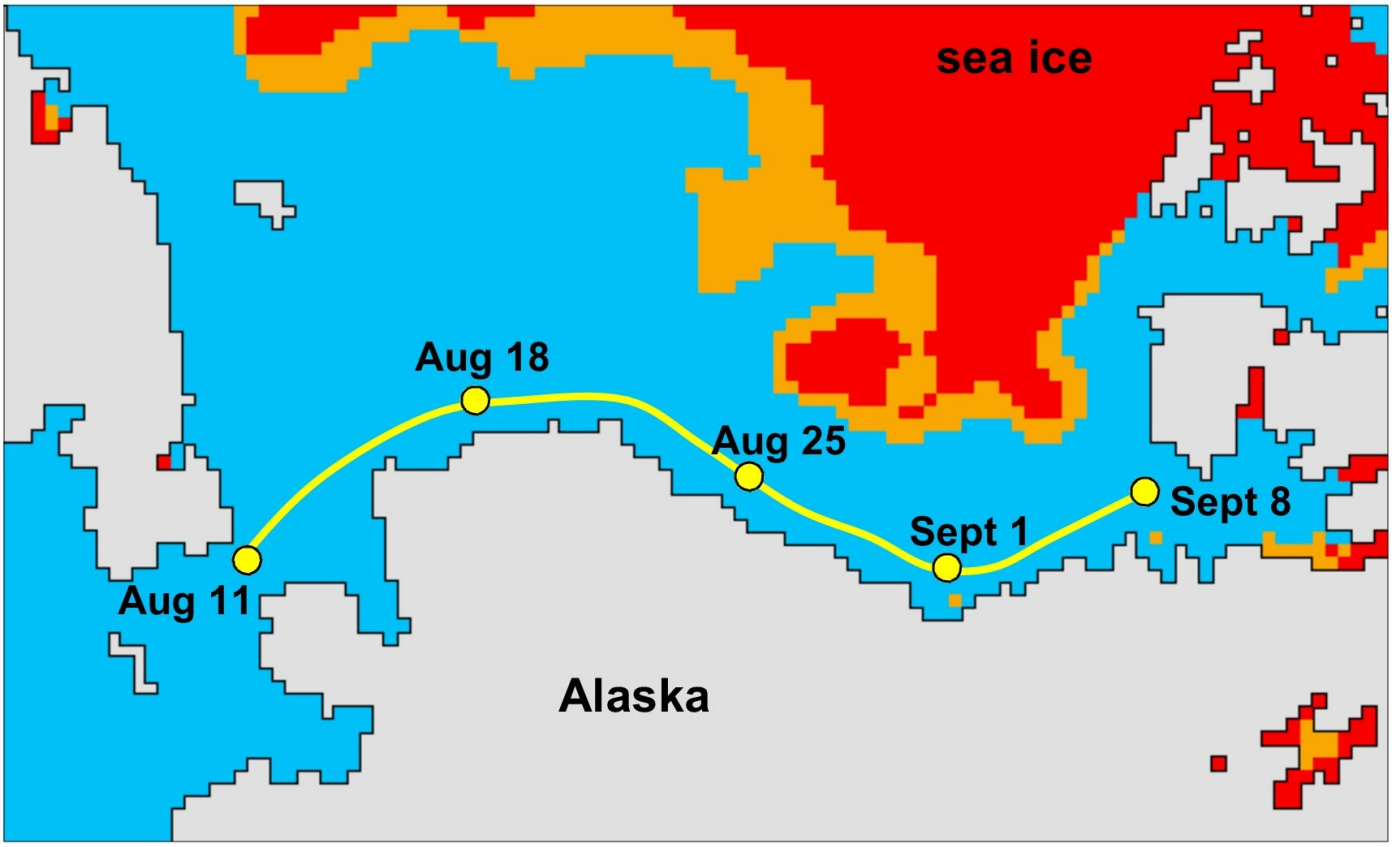

Figure 2: Cook's hypothetical progress along the coast of Alaska and northern Canada under sea-ice conditions of 2002 or later. The sea-ice coverage is shown for 18 August 2011, with red indicating dense pack ice, orange loose ice, and blue open water. Cook would have had plenty of time to return to the Bering Strait from the position of Sept 8: the coastal waters east of Point Barrow do not freeze up until late October nowadays. (Sea-ice data are from the National Snow and Ice Data Center in Boulder, CO). Image courtesy of the Arctic Ambitions exhibit.

Other essays in Arctic Ambitions give the historical context of Cook's voyage; describe his encounters with the indigenous people; and demonstrate that the Arctic is once again a region of strategic significance, where issues of navigability, national sovereignty, and resource extraction are occupying the attention of world powers, just as in Cook's day.

More information is available on the Anchorage Museum website (https://www.anchoragemuseum.org/exhibits/arctic-ambitions-captain-cook-and-the-northwest-passage/).

Acknowledgements

Stern thanks David Nicandri and Julie Decker for their contributions to this article.

Reference notes

1. Quotations are from The Journals of Captain James Cook on His Voyages of Discovery, vol. 3, The Voyage of

the Resolution and Discovery, 1776–1780, ed. J. C. Beaglehole (Cambridge: Cambridge University Press for the Hakluyt Society, 1967). ↩ (http://www.arcus.org/witness-the-arctic/2015/2/pdf#fnref:1)

2. Arctic Ambitions: Captain Cook and the Northwest Passage, edited by James K. Barnett and David L. Nicandri, preface by Robin Inglis, published March 2015, 448 pages with 187 color illustrations, University of Washington Press. See http://www.washington.edu/uwpress/search/books/BARCOO.html ↩ (http://www.arcus.org/witness-the-arctic/2015/2/pdf#fnref:2)

NSF News and Recent Appointments in the Division of Polar Programs

New Arctic Observing Network (AON) Program Director

Dr. William Ambrose will begin service as new Program Director of the Arctic Observing Network program in the Arctic Sciences (ARC) section on 15 June 2015. He follows Dr. Erica Key who completed her three-year appointment as the AON Program Director on 28 April 2015. Dr. Ambrose will be joining NSF from Bates College, Maine where he holds an appointment as Professor of Biology and has served as Chairman of the Department of Biology. Dr. Ambrose is an Arctic scientist with a research career in Arctic benthic ecology and Arctic environmental change. He is experienced in international collaborative research, including serving as a Fulbright Professor at the University of Oslo, Norway and Visiting Professor at the University of Tromso, Norway.

New Face in the Arctic Systems Science (ARCSS) Program

Diane McKnight has been appointed as a Program Director in the Arctic Sciences Section in the Division of Polar Programs. Dr. McKnight's primary assignment is to join Dr. Neil Swanberg in managing the ARCSS program. She will begin her service at NSF on 15 June 2015. Dr. McKnight comes to NSF from the University of Colorado where she holds an appointment as Professor of Civil, Environmental, and Architectural Engineering and a Fellow of the Institute of Arctic and Alpine Research. She also serves as Director of the Center for Water, Earth Science, and Technology. Dr. McKnight is a hydrologist who studies coupled ecological, biogeochemical, and hydrologic processes in lakes, streams, and watersheds, primarily in polar and mountain regions. She is a member of the National Academy of Engineering and a Fellow of both the American Geophysical Union and the American Association for the Advancement of Science.

New Section Head for the Polar Environment, Safety, and Health Section

Susanne LaFratta has been appointed as the Section Head for the Polar Environment, Safety, and Health Section (PESH), Division of Polar Programs (PLR). Ms. LaFratta has been with Polar Programs since January 2003, first as the Deputy for what was then known as the Polar Research Support Section and more recently as Senior Advisor. During her tenure she has been responsible for the successful execution of many significant activities, including the annual budget process, the Antarctic Support Contract transition, executive support for the U.S. Antarctic Program Blue Ribbon Panel and NSF's official response to the influential report. Over the years she has held many short-term assignments within Polar Programs, including periods as the Environmental Officer, Safety and Health Officer, Facilities Manager, and Executive Officer. Before joining the Office of Polar Programs, she held positions in NSF's Office of Inspector General and in Budget, Finance, and Award Management, where she was instrumental in developing NSF's Large Facilities Office. Ms. LaFratta has degrees in business and law, and brings to the position significant management experience, including 13 years managing research laboratories and programs at Harvard Medical School. Ms. LaFratta replaces Mr. Arthur Brown who was Acting Section Head following Dr. Montopoli's departure in 2013.

Arctic Field Safety Risk Management Report in Pre-Publication

"Supporting a Culture of Safety in Arctic Science - Workshop Report: Arctic Field Safety Risk Management" is now in pre-publication. The report will include sections on Arctic field safety risk management, identifying and assessing risk, utilizing institutional risk management offices, crisis communication, incident reporting, training and mentorship, and implementation of a community of practice. Publication of the report will be announced via ArcticInfo and through other community venues.

Teaching an Old Submarine Data Collection Program New Tricks

By: Ann Windnagel, National Snow and Ice Data Center and Jackie Richter-Menge, Cold Regions Research and Engineering Laboratory

The Arctic is a harsh environment for performing scientific research and there remain significant logistical challenges when it comes to sampling the Arctic Ocean. Satellites have helped to increase our understanding of this variable region of the Earth by providing surface measurements and sea ice extents. However, what about measurements under the sea ice? How can we synoptically collect data about Arctic Ocean bathymetry, sea ice draft, hydrography, and water chemistry? This is where U.S. Navy (USN) nuclear submarines come into play. They offer a unique observational platform because, unlike surface ships, they can operate and take measurements regardless of sea ice cover, weather conditions, and time of year.

With the end of the Cold War, the U.S. submarine fleet suddenly found itself with fewer operational tasks. A quick thinking retired U.S. Navy Captain, George Newton, saw the possibilities immediately (see sidebar: A Labor of Love Brings Together Civilian Scientists and the U.S. Navy). Would it be possible to use these submarines to collect scientific data? Newton thought so, and worked tirelessly to bring together a unique collaboration between military and civilian communities. In 1993, his hard work paid off when the first feasibility test of this idea came to reality as five civilian scientists joined the crew of the *USS Pargo* for 19 days to utilize this unique platform to gather data about the Arctic Ocean. The test was a success, and the Submarine Arctic Science Program (SCICEX) was launched.

The USN, the Office of Naval Research (ONR) (http://www.arcus.org/witness-the-arctic/2015/2 /://www.onr.navy.mil), the National Science Foundation (NSF) (http://www.nsf.gov/), the National Oceanic and Atmospheric Administration (NOAA), (http://www.noaa.gov/) and the U.S. Geological Survey (USGS)

Figure 1: Polar bears investigate a U.S. Navy submarine that has just emerged through a lead in the Arctic sea ice. Image courtesy of U.S. Navy Arctic Submarine Laboratory.

(http://www.usgs.gov/) signed an agreement to facilitate five more such dedicated missions between 1995 and 1999. During this time, the submarines were modified with temporary alterations of scientific instruments including downward looking sonars to collect bathymetric data and modified valves in the torpedo room for collecting through-hull water samples. However, many of the submarine systems designed for safety could also be used to gather data for scientific studies. For instance, the upward looking sonar provide measurements of sea ice draft, and sail-mounted sensors routinely collect information on water conductivity and temperature.

Beginning with the proof-of-concept mission in 1993, the SCICEX program has been collecting unique data on Arctic Ocean bathymetry; sea ice draft; ocean nutrients; and ocean hydrography in the form of conductivity, temperature, and density (CTD) ever since.

Bathymetry is measured using the submarine's fathometer. SCICEX data contributed to the International Bathymetric Chart of the Arctic Ocean (IBCAO) (http://ibcao.org/) and led to first-order changes in the mapped positions and depths of major bathymetric features. Knowledge of seafloor topographic features is important for studies of Arctic Ocean circulation, seafloor volcanism, and hydrothermal circulation, and has informed scientific ocean drilling. The SCICEX dedicated science missions systematically mapped portions of several major topographic provinces—Gakkel Ridge, Lomonosov Ridge, and Chukchi Borderland—that have been inaccessible to icebreakers because of perennial sea-ice cover (Edwards and Coakley, 2003).

Ice draft measurements are collected using the submarine's upward looking sonar. By comparing ice draft data collected by SCICEX with previously published data, scientists established that sea ice thinned significantly within the areas where data were collected between 1958 and 1976 and in the 1990s (Rothrock et al., 2008).

Ocean nutrient data are acquired using through-hull water sampling. These data show that the rate of carbon dioxide (CO_2) uptake by the Arctic Ocean is twice the average for the global ocean, leading to acidification of the Arctic Ocean (SCICEX Science Advisory Committee, 2010). Estimates of chlorophyll and oxygen reflect the response of Arctic productivity to decreased sea ice extent during summer. SCICEX observations also contribute to a better understanding of freshwater flows, the determination of biochemical conditions such as the levels of

nutrients and organic matter at the end of winter, and detection and quantification of the exchange of water between the peripheral shelves and the deep basins.

Figure 3: Navy Crewman "Ted" Groustra loads an XCTD for launching. Image courtesy of U.S. Navy Arctic Submarine Laboratory.

Figure 2: Oceanographer, Steve Okkonen, fills water bottles with sea water using a through-hull valve in the submarine's torpedo room. Image courtesy of U.S. Navy Arctic Submarine Laboratory.

SCICEX has collected hundreds of measurements by CTD instruments mounted on the sail of the submarine or cast when the submarine surfaced, and from expendable CTDs (XCTDs) launched while the submarine is at depth. Hydrographic data provide definitive, synoptic evidence of upper ocean circulation pathways, and evidence of warming and penetration of Atlantic water as it propagates along basin peripheries and ridges. As the SCICEX data archive has grown, it has played a greater role in climate and modeling studies to validate model results of temperature and salinity distributions. These data have been used to validate numerical model results of temperature and salinity distributions (Karcher et al, 2003), and to evaluate the dynamical implications of mixing parameterization in Arctic regional models (Zhang and Steele, 2007).

In 1998, due in part to a drastic reduction in the size of the nuclear submarine fleet, the Navy announced that they would no longer facilitate the dedicated scientific missions following the scheduled 1999 cruise. Rather than let the program die out, the Navy worked with research funders and the scientific community to come up with a new "bag

of tricks" for a modified approach that has been employed since with support from the USN, ONR, and NSF (SCICEX SAC, 2010).

In the new phase of SCICEX, time is set aside for Navy personnel, instead of civilian scientists, to collect unclassified scientific data during otherwise classified submarine exercises. These Science Accommodation Missions (SAMs), as they have been named, are facilitated by the Navy's Arctic Submarine Laboratory.

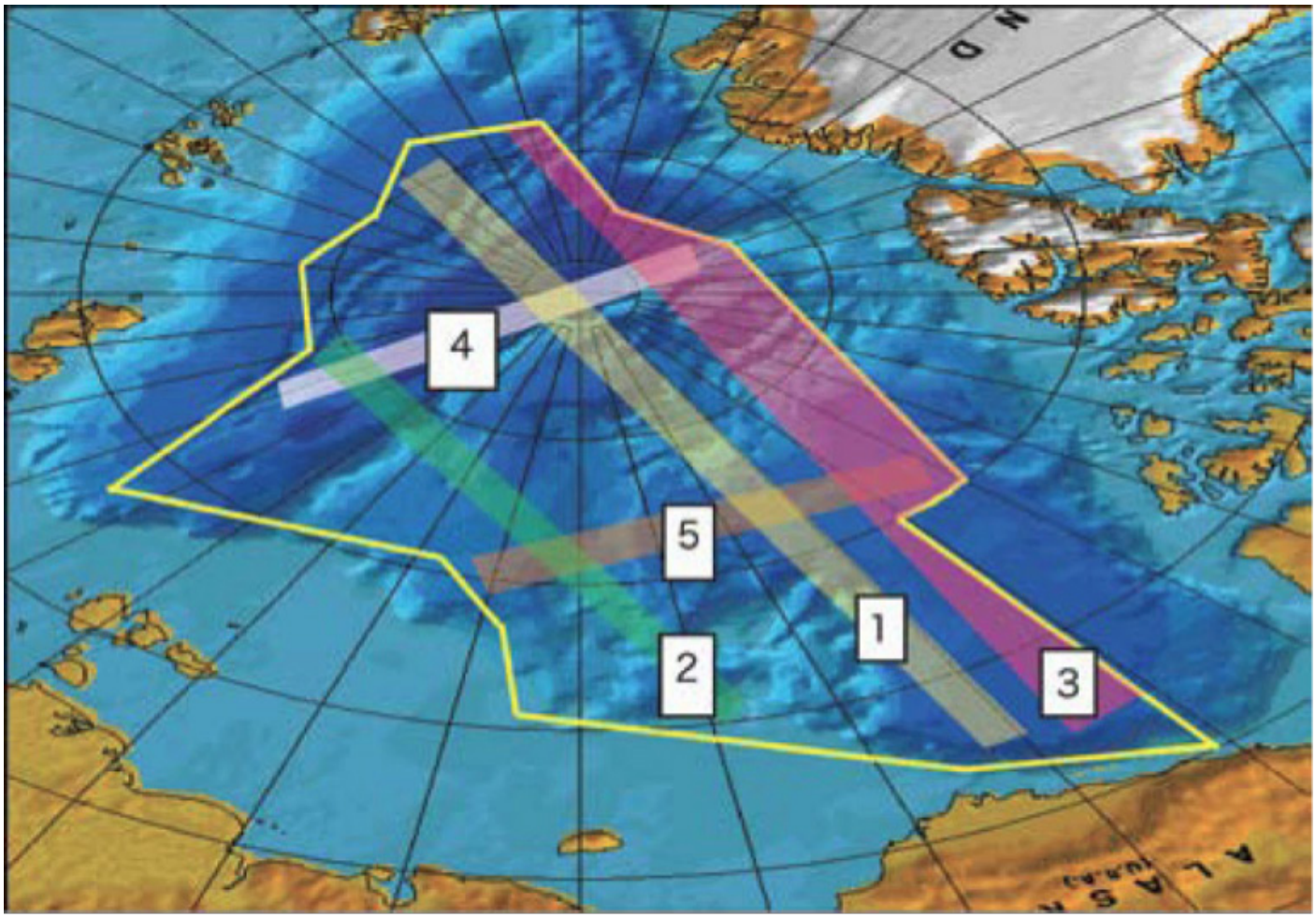

Figure 4: The five swaths are recommended corridors for data acquisition. The area outlined in yellow is approved for declassification. Image courtesy of U.S. Navy Arctic Submarine Laboratory.

Data collection during a SCICEX SAM is restricted to a certain area of the Arctic Ocean that the Navy has approved for declassification and release of data. As part of the modified approach, scientists have created recommended corridors for data acquisition within this approved area (Figure 4). As of 2014, there have been 13 missions, 6 of which were dedicated and 7 of which were SAMs. More SAMs are in plans for the future. In 2009, the National Snow and Ice Data Center (NSIDC) became the SCICEX data manager and host of the SCICEX website, providing a comprehensive archive and information hub for the program. Much of the data from the historic dedicated missions are available, while processing of some of the newest SAM data is ongoing (Figure 5). On the website, you can register for data announcements so that you are notified when new data are released.

Today, SCICEX and its bag of tricks continue to flourish with SCICEX data available from 1999 through 2014 via the SCICEX website (http://www.arcus.org/nsidc.org/scicex) and more to come in 2016.

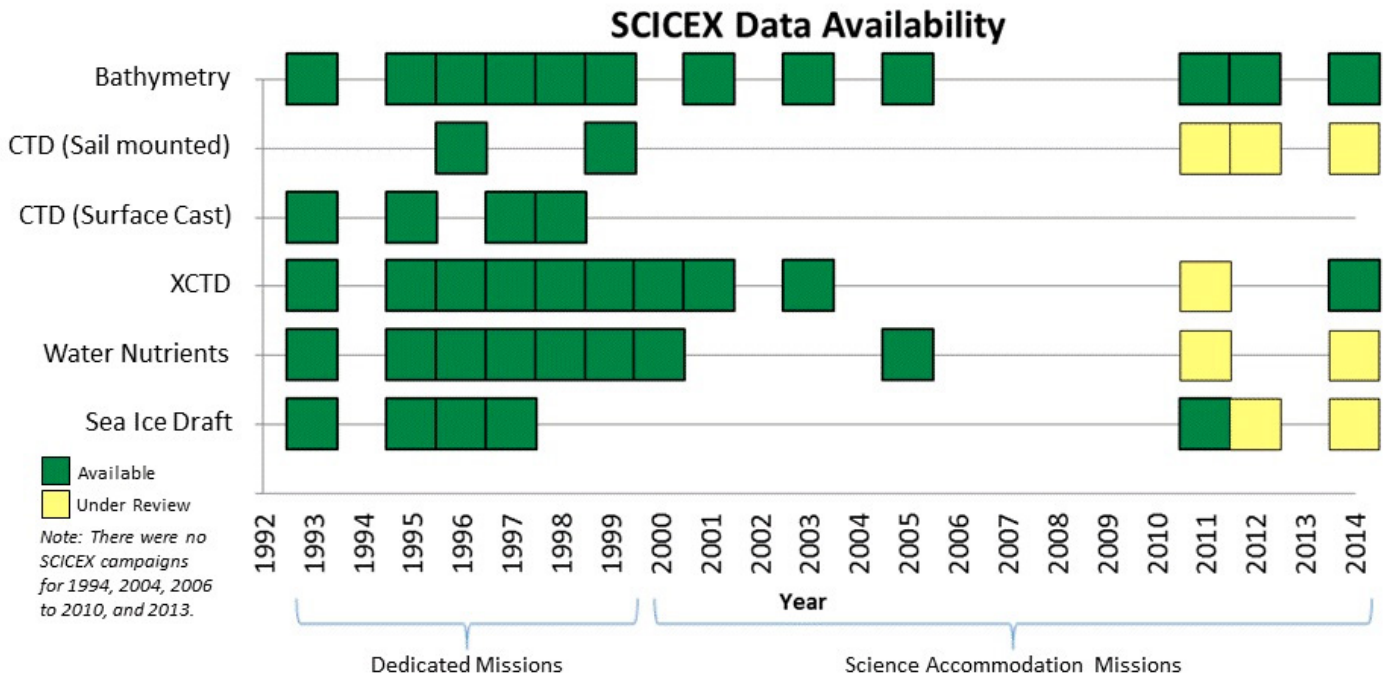

Figure 5: Summary of SCICEX data available at NSIDC. Image courtesy of NSIDC.

More information is available on the SCICEX web site (http://www.arcus.org/nsidc.org/scicex). Or, contact Ann Windnagel (ann.windnagel@nsidc.org) or Jackie Richter-Menge (Jacqueline.A.Richter-Menge@usace.army.mil).

Acknowledgements

We would like to thank the USN, the USN Arctic Submarine Laboratory, ONR, the U.S. Arctic Research Commission, and NSF for their continued support for SCICEX.

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A Labor of Love Brings Together Civilian Scientists and the U.S. Navy

By: Ann Windnagel, National Snow and Ice Data Center

George Newton, retired chairman of and current acting advisor to the U.S. Arctic Research Commission. Image courtesy of NSIDC.

The Submarine Arctic Science Program (SCICEX) is a collaboration among the U.S. Navy, national research agencies, and the research community to use nuclear-powered submarines for scientific studies of the Arctic Ocean. Bringing the program to fruition was no small feat. It took a persistent retired Navy Captain, George Newton, over a decade of work, plus a little bit of good timing, to bridge the gap between an open and flexible scientific community and an organization like the Navy with traditions and strict operating procedures. "It is one of those things that emerges from being active in a particular area and seeing an opportunity and being able to exploit it successfully," said Newton in an April 2013 interview.

In the early 1980's, newly retired Captain Newton had an innovative idea that Navy submarines could be used to collect data about the Arctic Ocean for scientific analysis. "The advantage to the Navy," Newton said, "would be maintaining a level of proficiency in an ocean that was misunderstood or not understood at all; and, at the same time, if it was a dedicated science cruise, you would be able to give science the additional information it was seeking in a more comprehensive, broader form." This would benefit both the military and the civilian science community. After retiring from the Navy, Newton began working for a consulting firm that wanted to establish business in the Arctic. Through this position, he was able to pitch his idea to both civilian scientists and Navy personnel; and in the late 1980's, it started gaining traction.

In 1988, Newton became an advisor to the U.S. Arctic Research Commission. The position afforded him the opportunity to meet Dr. Peter McRoy, a professor at the University of Alaska Fairbanks. McRoy and Newton created a water sampling procedure and persuaded the Navy to utilize it during a classified mission to the Arctic in early 1989. The water samples were collected by Navy personnel, frozen for transport, and brought to Halifax, Nova Scotia. The samples were handed off to one of Newton's team members for repackaging and shipping to

Alaska. However, the samples did not reach their destination before melting because, in March 1989, the Exxon Valdez oil spill occurred off the coast of Alaska and disrupted shipping in that area. Even though the samples melted, the test did show that samples could be collected from the submarine and then delivered to a civilian scientist. However, Newton had his eye set on a much larger vision for the project, where civilian scientists could participate onboard the submarine.

In 1992, a number of things occurred that brought Newton's idea to a head. First, the former Soviet Union was collapsing and the Cold War was ending. Consequently, the U.S. found itself with a huge Navy with fewer missions. Second, Rear Admiral Paul Ryan became the head of the Submarine Warfare Branch. This was significant because Ryan was not only a submarine officer in position to command the resources of a nuclear submarine and her crew, he also had a PhD in Oceanography, which allowed him to see the value of using submarines to study the Arctic and how it would benefit the Navy. Finally, Newton was appointed as a member of the U.S. Arctic Research Commission by President G. H. W. Bush, which allowed Newton to assemble a science team for the mission. With that, a successful feasibility cruise was conducted in the late summer of 1993 with five civilian scientists aboard the *USS Pargo* where the boat surfaced 17 times to collect samples. Newton recalls, "The submarine spent 19 days under the Arctic sea ice, and for the first time ever, the science community had a synoptic view of the Arctic Ocean."

In 1994, the U.S. Navy, the Office of Naval Research, the National Science Foundation, and the U.S. Geological Survey signed a memorandum of agreement to facilitate five more missions from 1995 through 1999. Those dedicated science missions gave the research community and the Navy a wealth of new information. Today, SCICEX exists in a more simplified version by way of SCICEX Accommodation Missions or SAMs. During a SAM, no civilian scientists are aboard the submarines; instead, Navy personnel follow sampling protocols to collect data that are forwarded to the scientists. From 2000 to 2014, there have been seven SAMs, and more are being planned for the future. Although SCICEX "has proceeded with some fits and starts, starts and stops, as time has worn on," as Newton puts it, the program continues to provide valuable data about the Arctic Ocean now and into the future.

The content for this article was taken from an interview with George Newton, retired chairman of and current acting advisor to the U.S. Arctic Research Commission. For more SCICEX history, visit the SCICEX history webpage (http://www.arcus.org/nsidc.org/scicex/history.html) to hear the complete interview with Newton.

USARC Releases 2015-16 Report on the Goals and Objectives for Arctic Research

By: Cheryl Rosa, Deputy Dirctor, U.S. Arctic Research Commission

On May 21st, the U.S. Arctic Research Commission (USARC) (http://www.arctic.gov/) released its newly updated goals report. Under the Arctic Research and Policy Act, the Commission biennially recommends key goals and objectives for the U.S. Arctic Research Program Plan (https://www.whitehouse.gov/sites/default/files/microsites/ostp/2013_arctic_research_plan.pdf). To prepare this report, the Commission sought input, through public meetings, from scientific researchers, policymakers, the public in Alaska and throughout the United States, and in the growing number of nations with Arctic interests. The Commission also cosponsored meetings, workshops, and studies such as the 2014 National Academies studies, "The Arctic in the Anthropocene" (http://www.nap.edu/openbook.php?record_id=18726) and "Responding to Oil Spills in the US Arctic Marine Environment," (http://www.nap.edu/openbook.php?record_id=18625) to help inform its research goals and policies.

The USARC Goals Report identifies frozen debris lobes (slow-moving landslides) as a potential threat to the infrastructure of the Dalton Highway in the Brooks Range, Alaska. Image courtesy of Scott McMurren.

The Commission is an independent federal agency that was established in 1984 by the Arctic Research and Policy Act. The report is published biennially and is available here (http://www.arctic.gov/reports_goals.html). The report states that in response to rapid changes in the Arctic, scientific research should be expanded and focused on six major themes.

The six priority research goals are to:

1. Observe, Understand, and Predict Arctic Environmental Change
2. Improve Arctic Human Health
3. Advance Knowledge of Arctic Natural Resources: A Focus on Renewable Energy
4. Advance the Arctic "Built Environment"
5. Explore Arctic Cultures and Community Resilience
6. Enhance International Scientific Cooperation in the Arctic

In its 2015-16 Goals Report, the USARC encourages additional civil engineering research toward developing a system of deep." Port of Nome, Alaska is pictured here. Image courtesy of the U.S. Army Corps of Engineers.

The report provides examples of research topics affiliated with each of the six goals. These examples serve as illustrations of the broad range of Arctic research areas. Of note, a new goal related to international scientific cooperation has been added to this report. This goal was introduced in response to the research community's need to build synergies between national programs and create efficiencies for the best use of limited resources to address Arctic scientific challenges that often extend beyond the jurisdiction of any one nation.

The Commission's research goals help shape the nation's Arctic Research Plan, the most recent version of which was released by the White House on 19 February 2013 and can be found here (https://www.whitehouse.gov/sites/default/files/microsites/ostp/2013_arctic_research_plan.pdf). Implementation of this plan, developed by the Interagency Arctic Research Policy Committee (IARPC) (http://www.iarpccollaborations.org/index.html) under the auspices of the National Science and Technology Council (https://www.whitehouse.gov/administration/eop/ostp/nstc), involves 12 teams from 14 federal agencies and nonfederal partners, constituting over 250 individuals. IARPC is currently considering how it will update this research plan.

The Commission's goals report will also inform the work of the Arctic Executive Steering Committee that was created by President Obama's Executive Order (https://www.whitehouse.gov/the-press-office/2015/01/21/executive-order-enhancing-coordination-national-efforts-arctic) 13689, released in January 2015.

Fran Ulmer, who was recently reappointed Chair of the Commission by President Obama, presented Secretary of State John Kerry with the report on 21 May at the Department of State reception in celebration of the U.S. Chairmanship of the Arctic Council (http://www.arctic-council.org/index.php/en/about-us/arctic-council/u-s-chairmanship). Last July, Kerry named Ulmer "Special Advisor on Arctic Science and Policy." Ulmer said, "Dramatic changes in the Arctic environment and the pace of resource development combine to make it very important that public and private decision makers have access to relevant research, including timely and comprehensive information and a more thorough understanding of Arctic ecosystems, resources, and infrastructure challenges. The Commission strives to be an effective link between the people who do the research and those who need the results."

During its chairmanship of the Arctic Council, the United States will pursue an international agreement that coordinates and promotes improved scientific research cooperation among the eight Arctic states. Secretary of State John Kerry arrives in Iqaluit, Canada, for the 2015 Arctic Council Ministerial Meeting. Image courtesy of USARC.

USARC's mission is to develop and recommend U.S. Arctic research policy to the President and to Congress, and to build cooperative links in Arctic research within the federal government, with Arctic residents, the State of Alaska, researchers, and international partners.

For more information, visit the USARC website (http://www.arctic.gov/) and subscribe to our daily electronic newsletter, the "Arctic Update," which provides useful information about recent events, conferences, research initiatives, and news.

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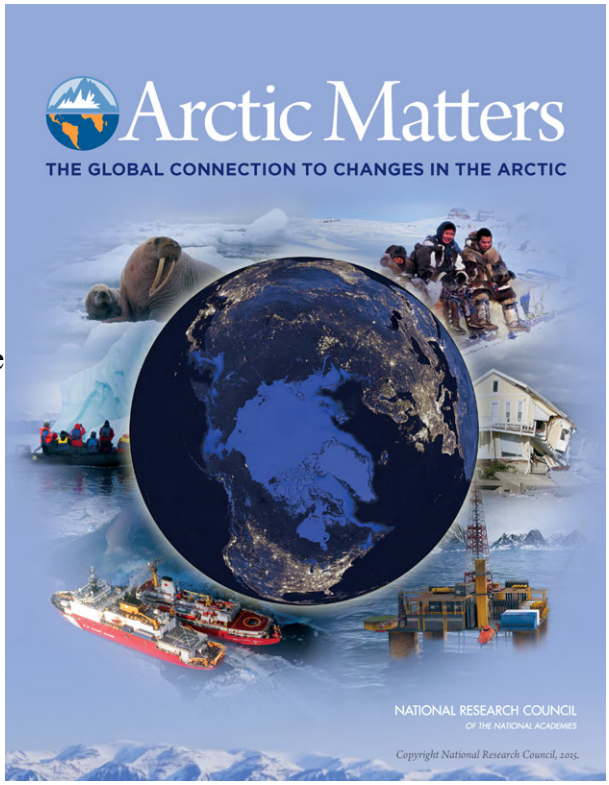
Arctic Matters: New Educational Booklet and Interactive Website from the Polar Research Board

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



Climate changes currently underway in the Arctic are a driver for global sea-level rise, offer new prospects for natural resource extraction, and have rippling effects through the world's weather, climate, food supply, and economy. A new booklet and interactive website from the U.S. National Academies (http://www.nationalacademies.org/)' Polar Research Board (PRB) (http://dels.nas.edu/prb/) introduces the threats and opportunities of the Arctic's rapidly changing environment and explains why the Arctic matters—to all of us.

Drawing on a collection of peer-reviewed reports of the National Research Council (NRC) (http://www.nationalacademies.org/nrc/)—as well as other national and international reports—the booklet and website provide a brief, reader-friendly primer on the complex ways in which the Arctic and its diverse people, resources, and environment affect the entire globe.

The new resources are part of a larger Arctic Matters initiative (http://nas-sites.org/americasclimatechoices/more-resources-on-climate-change/arctic-matters-the-global-connection-to-changes-in-the-arctic-2/) that the PRB has launched to coincide with the U.S. chairmanship of the Arctic Council (http://www.arctic-council.org/index.php/en/about-us/arctic-council/u-s-chairmanship). With the goal of expanding public understanding and interest in Arctic changes and their global linkages, the effort will include a large public symposium in early 2016, featuring a series of engaging presentations. A special planning committee has been appointed to help shape the goals and content of the symposium.

The booklet, interactive website, archived webinar, and other resources are available here (http://nas-sites.org/americasclimatechoices/more-resources-on-climate-change/arctic-matters-the-global-connection-to-changes-in-the-arctic-2/).

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

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ASSW 2015 Conference Statement: Integrating Arctic Research - A Roadmap for the Future

By: Members of the ICARP III Steering Group

The Arctic Science Summit Week (ASSW) 2015 (http://assw2015.org/) held in Toyama, Japan from 23-30 April brought together over 700 international scientists, students, policy makers, research managers, indigenous peoples and others interested in developing, prioritizing and coordinating plans for future Arctic research. The Conference was organized by the International Arctic Science Committee and the Science Council of Japan, with the support of many other international partners.

The Toyama meeting was the main event of the 3rd International Conference on Arctic Research Planning (ICARP III) (http://icarp.arcticportal.org/). It was a critical step in the international Arctic research planning process involving hundreds of scientists from 27 countries working to improve our understanding of the consequences of changes taking place in the Arctic region, and their connection to global environmental, economic and social processes. The ASSW 2015 Conference Statement highlighted several overarching messages that emerged during the week:

- Changes in the Arctic are challenging our understanding of their consequences and our ability to provide knowledge for decision-makers.
- There needs to be a greater sense of urgency among decision-makers and awareness by the general public regarding the global importance of changes taking place in the Arctic.
- It is critical to anticipate changes in the Arctic rather than respond to them, but to do this requires sustained observations and improved understanding of local, regional, and global processes. These research challenges must be addressed in a coordinated and timely manner to ensure sustainable development and resilient Arctic communities and ecosystems.
- The rapidly changing Arctic initiates changes that cascade through the global system impacting weather, commerce, and ecosystems in the more temperate regions. Linkages across disciplines, scales, and diverse knowledge systems must be addressed in future research activities.
- Understanding the vulnerability and resilience of Arctic environments and societies requires increased international scientific cooperation, including contributions from non-Arctic states.
- More effective use must be made of local and traditional knowledge by engaging northern and indigenous communities in setting priorities, the co-design and co-production of research, and the dissemination of this knowledge by ensuring appropriate access to research data and results.
- It is essential to build long-term human capacity to support relevant observations and research among scientists, decision-makers, and Arctic residents, through education and effective public engagement and by adopting shared principles to guide research activities.
- New markets for Arctic resources and associated activities, including trade, tourism, and transportation, will likely emerge faster than the necessary infrastructures on land and sea. Sustainable infrastructure development and innovation to strengthen the resilience of Arctic communities requires a collaborative approach involving scientists, communities, governments, and industry.

The outcomes of ICARP III include a catalogue of summaries and reports from the numerous activities conducted by partner organizations and groups, the Toyama Conference Statement, and a synthesis report that will provide a roadmap for implementing ICARP III outcomes over the next decade. Image courtesy of ICARP III.

The Final Report from ICARP III, guided by discussions and contributions from many partner organizations, will be completed later in 2015. This Report will catalyze and inform the implementation of critical, cooperative, international Arctic research programs over the next decade.

Further information about ICARP III is available here (http://icarp.iasc.info/), via email (icarp@iasc.info), or contact David Hik, Chair, ICARP III (dhik@ualberta.ca).

Preparations Underway for the 2016 Arctic Science Summit Week and Arctic Observing Summit

By: Kristin Timm, International Arctic Research Center, University of Alaska Fairbanks

It may be a year away, but planning for the 2016 Arctic Science Summit Week (ASSW2016) (http://www.arcus.org/ASSW2016.org) and Arctic Observing Summit (AOS) (http://www.arcticobservingsummit.org/aos-2016-and-themes) is well underway. Scheduled for 12-18 March 2016 in Fairbanks, Alaska, the week includes several separate but related activities to strengthen international coordination in Arctic science and policy. Beyond ASSW and AOS, there will be meetings of the Arctic Council (http://www.arctic-council.org/index.php/en/) Senior Arctic Officials, U.S. Arctic Research Commission (http://www.arctic.gov/), European Polar Board (http://www.europeanpolarboard.org/), Model Arctic Council (http://narfu.ru/en/projects/mac/), and several other side meetings and workshops.

Initial program development and outreach to potential conference participants has been central to the organizing effort. The new ASSW 2016 website (http://www.arcus.org/assw2016.org) was launched in mid-April and is the hub for news, travel information, program updates, side meetings and more. Information is currently available for organizations scheduling side meetings and a sign up form for requesting meeting space during the Summit is available online. The University of Alaska Fairbanks will be hosting most of the conference activities and has a range of meeting spaces, library resources, food and beverage service, and nearby attractions like the University of Alaska Museum of the North.

Coordinated by the International Study of Arctic Change (ISAC) (http://www.arcticchange.org/), the Arctic Observing Summit (AOS) (http://www.arcticobservingsummit.org/aos-2016-and-themes) is beginning to take shape and themes have been identified. AOS is a forum for solutions-oriented discussion, planning and priority-setting to link stakeholder needs with Arctic observing systems design, data collection, analyses, and the creation of audience-appropriate data products. The upcoming Summit builds on the momentum, themes, and recommendations from previous Summits and includes six overarching themes: 1) international frameworks and national strategies for funding and support, 2) technology, 3) global linkages, 4) stakeholder engagement and

needs, 5) private sector, and 6) traditional knowledge and environmental science.

In addition to formal conference activities, the Local Organizing Committee is planning a series of informal networking opportunities to promote conversation between meeting participants and with other Arctic and Alaska research, industry, and indigenous groups. They have also been working closely with the Fairbanks Convention and Visitors Bureau (http://www.explorefairbanks.com/) to arrange field trips so that conference participants can experience Alaska, local research stations, and local attractions such as ice carving, hot springs, and the northern lights.

To learn more and subscribe for updates, visit the ASSW2016 website (http://www.arcus.org/ASSW2016.org).

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Looking North -- A Note from the ARCUS Executive Director

Robert H. Rich, PhD, CAE

Facilitating and supporting connections within and beyond the Arctic research community is what ARCUS has been doing for you for more than 20 years. We do it through specific programs such as SEARCH, the Sea Ice Outlook, PolarTREC, and the Sea Ice for Walrus Outlook, and more broadly through workshops, strategic planning, and cooperation-building between researchers, policymakers, Arctic residents, and other stakeholders. The staff, board, and volunteers work together to provide this key interdisciplinary, inter-institutional, and international connectivity that enables and leads the best research and understanding. In today's climate, we need to continue to build upon that legacy, and take it to the next level.

That is why I was so excited to be asked by the ARCUS Board to begin serving the Arctic research community as Executive Director last month. I come to this position from a career as a PhD scientist leading scientific organizations in support of the potential of research and education to improve people's lives. I know that there is enormous potential for Arctic research to benefit people, within the region and around the globe. Hopefully, together we can realize that potential.

The Arctic is a hot topic of conversation these days in Washington, D.C. Numerous government agencies and not-for-profit groups are asserting interests in a better understanding of the region. From the White House on down, there is much desire for cooperation, collaboration, and understanding the changing Arctic in a systematic way. Such connections, in terms of relationships and in terms of thought, are needed now more than ever. To best enable connections, I'll be based in Washington, DC, where we've set up an office within the Consortium for Ocean Leadership's community of geoscience organizations. Think of me as ARCUS' voice in the science policy and funding conversations taking place here.

This summer, I will be exploring the nuances of research in the Arctic and how it can advance. You may see me up on the North Slope, or in Fairbanks, Anchorage, and some coastal communities. Later this year, I'll be working with the Board to refine our priorities to be of most value in support of our Vision: 'ARCUS envisions strong and productive linkages among international Arctic researchers, educators, communities, and other stakeholders that promote discovery and understanding of the Arctic and inform sound decisions related to the Arctic.'

As I get familiar with the Arctic research landscape, I'd love to hear from you. What do you think are the most important priorities for ARCUS to pursue? How can this consortium be of most value to its members and the broader research enterprise? What do you think have been the strongest contributions we've made, and where should we do more? You can reach me at bob@arcus.org, during our events at the American Geophysical Union meeting this December, or out and about in the D.C. research community.

Have a great summer and thank you for everything that you do in support of Arctic research.

Robert H. Rich, PhD, CAE
Executive Director, ARCUS

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A Note from the ARCUS President

On behalf of the ARCUS Board of Directors I am very pleased to welcome Robert H. Rich, PhD, CAE as our new Executive Director. Dr. Rich brings a long track record of success in support of scientific collaboration and discovery. He will be based in the Washington, D.C. area allowing ARCUS to increase its presence and strengthen its ability to establish new collaborations within the national and international science community. Rich assumed the duties of leading our staff on 18 May 2015 and succeeds Acting Executive Director Helen Wiggins, who will remain as Director of Programs.

Most recently, Dr. Rich served as Director of Strategy Development for the American Chemical Society (ACS), where he served for 16 years in a variety of roles including career development, research grants, membership, and strategy. Prior to joining the ACS, he worked at the American Association for the Advancement of Science (AAAS) Research Competitiveness Program and at the U.S. National Institutes of Health in fundamental research and in the Office of Science Policy.

Rich earned a Ph.D. from the University of California, Berkeley, a Master's degree from Harvard University, and a Bachelor's degree from the Massachusetts Institute of Technology, all in chemistry. He resides in Bethesda, Maryland with his wife and daughter.

As our ARCUS Treasurer Jay Gulledge observed, "With the United States becoming the Chair of the Arctic Council, and the recent rollout of President Obama's National Arctic Strategy Implementation Plan, the need for leadership on Arctic research has never been more pressing."

We look forward to working with Dr. Rich to advance the role of ARCUS in development of collaborative and interdisciplinary partnerships that will maximize the impact of Arctic research. Please join me in welcoming Dr. Rich to our community.

Michael Retelle
President, ARCUS Board of Directors

Meet Craig Dorman


Craig Dorman

Craig Dorman was elected to the ARCUS Board of Directors in 2014. His three-year term ends in 2017. Craig received his PhD in oceanography from the Massachusetts Institute of Technology/Woods Hole Oceanographic Institute and had a 26-year career in the U.S. Navy from which he retired in 1989 at the rank of Rear Admiral. During the last half of that career the Arctic and its physical environment were a major cold war concern because of the then-USSR's reliance on its Northern Fleet. Craig later served as Director of the Woods Hole Oceanographic Institute, Technical Director of the Office of Naval Research International Field Office, visiting professor at Imperial College, and Vice President for Research for the University of Alaska System. Craig writes, "Given the nature of my responsibilities during all my working years, rather than being a researcher myself I have been a sponsor, manager, administrator, promoter, and user of research, which has led to a very broad interest in all aspects of the circumpolar Arctic and its inhabitants, from art to geopolitics.

"Having been intimately involved with polar research for well over 40 years I have seen U.S. Arctic interest and funding wax and wane more than once. We're currently in a period of high and growing interest in the Arctic, and I see no reason why that should diminish for at least the next decade. I am very pleased that current concerns across the U.S., as expressed in our national Arctic policy and strategy, are much broader than they were in the days of the 'cold war,' and in particular that the interests of Alaska Natives and other indigenous peoples of the North are central to other priorities, be they environmental, economic, or national security.

"The role of ARCUS has similarly grown and diminished through the years. I'm pleased to be on the Board when a rejuvenated ARCUS is greatly needed by the nation to help pull together the entire civilian research community —academic and industrial, communities and individuals—to parallel and underpin federal efforts through IARPC and other mechanisms to meet the challenges we face in the Arctic. I can state my own views no better than the criteria for ARCUS membership: 'ARCUS members shall have a common purpose of advancing science, promoting the application of their knowledge to circumpolar Arctic problems, and addressing in concert those scientific and technological questions that require the collaborative skills and resources of scientists, engineers, and others throughout the world.' ARCUS as an organization is the nation's key resource for building a common purpose toward addressing today's pressing Arctic issues."

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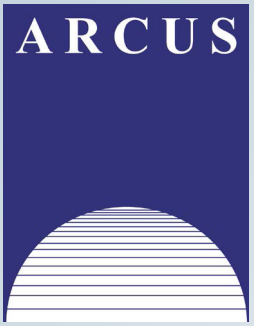
Archived issues of Witness the Arctic are available at: www.arcus.org/witness-the-arctic



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