



# *Witness The* **ARCTIC**

Chronicles of the NSF Arctic Science Section

Winter 2014, Volume 18 Number 1

## IN THIS ISSUE

### **Member Highlight** (pgs 2-3)

- Texas A&M University

### **Study of Environmental Arctic Change** (pgs 4-5)

- Study of Environmental Arctic Change (SEARCH) News

### **Arctic Research Support and Logistics** (pgs 6-7)

- NSF Hosts Arctic Field Safety and Risk Management Workshop

### **Data Management** (pgs 8-11)

- ACADIS Data Management Services Expanded
- Alaska Energy Data Gateway Provides New Services

### **Science Policy News** (pgs 12-14)

- Implementation Plan for National Strategy for the Arctic Region
- U.S. State Department Announces Plans to Create High Level Arctic Representative Position
- Department of Defense Rolls Out Arctic Strategy

### **National Science Foundation News** (pgs 15-17)

- Updates from NSF's Arctic Sciences Town Hall Meeting

### **Interagency News** (pgs 18-32)

- Sea Ice Prediction Network Launches Series of Community Activities
- NOAA's 2013 Arctic Report Card Now Available
- Ocean Acidification Along the Rapidly Changing Alaskan Coast
- Collaborative Research Projects Investigate Impacts of Climate Change on Arctic Archaeology

### **International News** (pgs 33-36)

- Icelandic Research Centre Supports Unique Study of the Arctic Fox

### **From the ARCUS Board** (pgs 37-39)

- Meet the Board of Directors—Michael (Mike) Retelle, President
- Meet the Board of Directors— Johannes (Hans) Verlinde, Secretary

# Witness the ARCTIC

ARCUS Member Highlight

Texas A&M University



**TEXAS A&M**  
UNIVERSITY

Texas A&M University (TAMU), a long-standing ARCUS Member Institution, is a Land Grant, Sea Grant and Space Grant institution with its main campus in College Station, Texas. TAMU<sup>®</sup> is dedicated to the discovery, development,

communication, and application of knowledge in a wide range of academic and professional fields. With more than \$700 million in research expenditures generated by faculty-researchers, the school has over 58,000 students—including 12,000 graduate students—enrolled in 10 academic colleges. The University supports several Arctic research efforts including those in the Colleges of Geosciences, Agriculture and Life Sciences, and Liberal Arts.

## ARCTIC OCEAN RESEARCH SPOTLIGHT

*Franco Marcantonio, Department of Geology and Geophysics, College of Geosciences*

Marcantonio's research focuses on application and development of isotope and trace element geochemical proxies to further understand past and present Earth surface processes. Marcantonio, Tom Bianchi (University of Florida), TAMU PhD graduate Katie Schreiner, and colleagues at the University of Texas are currently developing a detailed paleoclimate record from sediment cores taken in lagoons adjacent to rivers emptying into the Beaufort Sea. Initial results suggest these cores, which contain high quality sediment records, hold a history of system response to climate change on the adjacent continent and terrestrial-marine linkages. They record input from three distinct sources: rivers draining the Brooks Range and the Arctic Coastal Plain, eroded shoreline deposits, and marine production (e.g., phytoplankton, ice algae, benthos), each of which have distinct mineral and particulate organic carbon composition. The research team believes the temporal variations observed in the cores will provide proxy information about climate changes in the source areas.

For more information, see:

<http://geoweb.tamu.edu/profile/FMarcantonio>.



The Colville River drains the Brooks Range across the Arctic Coastal Plain and provides distinct source sediment to lagoons on the coast. Photo courtesy of Andrea Jo Miller, University of Texas.



The research team retrieves sediment cores. Photo courtesy of Mead Allison, University of Texas.



Brooks working with custom-built ice nucleation instrument inside Convair 580. Image courtesy of Sarah Brooks.

### ARCTIC ATMOSPHERIC RESEARCH SPOTLIGHT

*Sarah Brooks, Department of Atmospheric Sciences, College of Geosciences*

Brooks' research focuses on understanding how natural and anthropogenic aerosol particles influence aerosol-cloud interactions on local to global scales. Her research group uses novel analytical techniques to observe ice cloud nucleation under atmospheric conditions and explore how concentration, chemical composition, surface chemical reactions, and shape of aerosols impact cloud formation and properties.

In a recent research effort, Brooks and others analyzed ambient particles and the dry residuals of mixed-phase cloud droplets and ice crystals that were collected near Barrow, Alaska. Results show that cloud droplet residuals differ from the ambient particles in both size and composition, suggesting that both properties may impact the cloud-nucleating ability of aerosols in mixed-phase clouds and that that chemical processing of aerosols may improve their cloud-nucleating ability.

For more information, see: <http://atmo.tamu.edu/profile/SBrooks>.

Convair 580 on tarmac in northern Alaska. Image courtesy of Sarah Brooks.

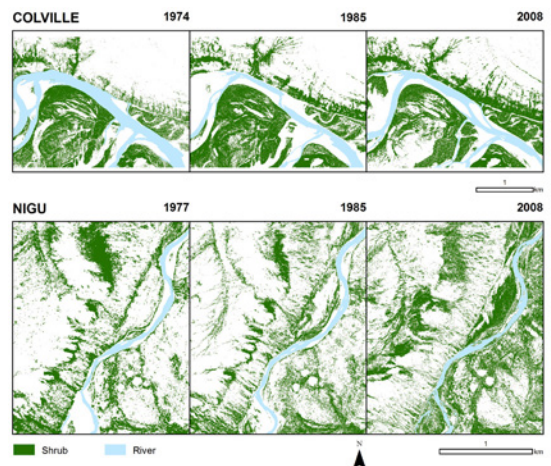


### ARCTIC TERRESTRIAL ECOSYSTEM AND PERMAFROST RESEARCH SPOTLIGHT

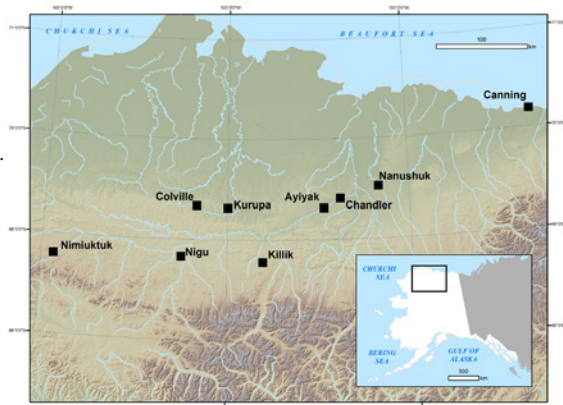
*David Cairns, Department of Geography, College of Geosciences*

Cairns' research concentrates on the impacts of climate change on vegetation at short and long time scales in a variety of environments. His work has focused on the transition zones between different vegetation types, including in tundra environments on the North Slope of Alaska. In recent work, Cairns and PhD student Adam Naito studied the association between topographically derived hydrologic characteristics and shrub cover change in five areas in northern Alaska between the 1970s and 2000s. Results show that shrubs are preferentially expanding into areas where the potential for moisture accumulation or drainage is greater.

For more information, see: <http://geography.tamu.edu/profile/dcainrs>.



Results also show a strong association of floodplain shrub development with high topographic wetness and a decreasing average distance between shrubs and the riverbank, which suggests an interacting influence of substrate removal and stabilization as a consequence of increased vegetation cover. Image courtesy of Adam Naito.



Location map of study area. Image courtesy of Adam Naito.

To learn more about TAMU and its associated research programs, please visit their website: <http://www.tamu.edu/about/departments.html>.  
For questions, please contact Dr. David Cairns, ARCUS Board of Directors, at: [cainrs@tamu.edu](mailto:cainrs@tamu.edu).

# Study of Environmental Arctic Change (SEARCH) News

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## Arctic Observing Network/System

Online proposals are being solicited for funding support to enable discussions related to long-term observing management and governance. Supported discussions will focus on development of best practices in long-term observing, lessons learned from other long-term observing activities, and other related issues. Funding for these discussions is being provided through a cooperative agreement to [ARCUS \(www.arcus.org\)](http://www.arcus.org) from NSF's Arctic Observing Network (AON) Program. Submissions will be accepted from U.S. proposers for telecommunications assistance, meeting room rental, and professional facilitation for discussions. Proposals will be accepted on a continuous basis until 1 June 2014. More information and the online application form can be found [here. \(http://www.arcus.org/search-program/aon/discussion-funding-form\)](http://www.arcus.org/search-program/aon/discussion-funding-form)

Planning has begun for an AON Open Science Meeting, which will be held in late 2014, pending funding. The AON Open Science Meeting will be designed to:

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

In addition, representatives from the SEARCH Science Steering Committee (SSC) participated in a January meeting organized by the White House Office of Science and Technology Policy on interagency prioritization, implementation, and sustaining of long-term Arctic observations.



*Study of Environmental Arctic  
Change (SEARCH) News*

# Sea Ice Prediction Network

The [Sea Ice Prediction Network project \(http://www.arcus.org/sipn\)](http://www.arcus.org/sipn), which is considered a contribution to SEARCH, is underway; more information can be found in [this article. \(http://www.arcus.org/witness-the-arctic/2014/1/article/20439\)](http://www.arcus.org/witness-the-arctic/2014/1/article/20439)

## SEARCH Implementation Proposal

The SEARCH Science Steering Committee (SSC) is awaiting final news for a proposal that the SEARCH SSC and ARCUS submitted to NSF and other SEARCH Interagency Program Management Committee agencies in support of a new organizational structure and framework (see the [main SEARCH website \(http://www.arcus.org/search-program\)](http://www.arcus.org/search-program) for a PDF summary of the new SEARCH framework).

For more information about SEARCH activities, see the [SEARCH website \(http://www.arcus.org/search-program\)](http://www.arcus.org/search-program) or contact Helen Wiggins, ARCUS (SEARCH Project Office) at [helen@arcus.org](mailto:helen@arcus.org) (<mailto:helen@arcus.org>) or Hajo Eicken, UAF (SEARCH SSC Chair) at [hajo.eicken@gi.alaska.edu](mailto:hajo.eicken@gi.alaska.edu) (<mailto:hajo.eicken@gi.alaska.edu>).

## NSF Hosts Arctic Field Safety and Risk Management Workshop

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NSF's Arctic Research Support and Logistics (RSL) program hosted an Arctic Field Safety Risk Management Workshop on 4-5 February 2014 to initiate a discussion of Arctic field safety risk management. Over 50 participants attended representing diverse academic disciplines, facility managers, university risk management offices, field support providers and incorporating experiences from across the Arctic. The RSL program managers partnered with NSF's Polar Programs (PLR) [Environment, Safety and Health \(ESH\)](http://www.nsf.gov/geo/plr/esh/) (<http://www.nsf.gov/geo/plr/esh/>) Section and the risk



*Zodiacs return to the Nathaniel B. Palmer from Robertson Island. Aboard the Nathaniel B. Palmer icebreaker near Robertson Island, Antarctica.*

management team at [CH2M HILL Polar Services \(CPS\)](http://cpspolar.com/) (<http://cpspolar.com/>) to develop the workshop goals of discussing current policies with the Arctic research community, exploring field safety risk management at other agencies and organizations, increasing engagement from the research community and research institution level, and developing a community of practice about Arctic field safety risk management that would continue well beyond the two-day workshop.

Several keynote and informational talks framed the topics while break-out sessions explored Arctic field safety risk management in detail. On the second day, a table-top exercise allowed participants to work through an incident in the field, facilitated by CPS and the [National Outdoor Leadership School \(NOLS\)](http://www.nols.edu/) (<http://www.nols.edu/>). Two professional facilitators from [SRA International](http://www.sra.com/) (<http://www.sra.com/>) facilitated discussion and break-out group products. Together with with ARCUS staff, the facilitators maintained the meeting flow and captured meeting discussion and outcomes for the workshop report. The workshop report will be available for comment by summer 2014.

Key themes included the responsibility of everyone in a field team to participate in risk assessment and risk management, the importance of mentoring and education to develop proficiency among research personnel in safely performing fieldwork, and the understanding that grantee institutions have responsibility for activities performed under the grant. Further to this, nearly all participants recognized

that their university or institution's risk management office may have an important role to play to assess and manage risk, ensure that appropriate insurance is in place, and to serve as a 24-hour emergency point of contact should anything go awry in the field.

Major take-away messages will be more thoroughly developed in the workshop report, but include the need to involve institution risk management offices, the need to shift the culture of risk management to embrace sharing of close-calls or near-misses to inform others and avoid repeating mistakes. The culture at NASA (<http://www.nasa.gov/>) of 'confessing' safety situations to peers and the annual publication of *Accidents in North American Mountaineering* (<http://www.americanalpineclub.org/>) by the American Alpine Club (<http://www.americanalpineclub.org/>) are examples of how this can be an effective preventative to more serious incidents. NSF will continue to evolve the field safety training and preparation materials available through the RSL program and CH2M HILL Polar Services with input from the workshop. In addition, the workshop participants and anyone interested in being part of the community of practice for Arctic field safety risk management will continue to build on these services and other information and approaches that will help reduce field safety risk in the Arctic.

For more information, see the workshop webpage (<http://rslriskworkshop.com/> (<http://rslriskworkshop.com/>)) or contact Renee Crain ([rcrain@nsf.gov](mailto:rcrain@nsf.gov) (<mailto:rcrain@nsf.gov>)) or Pat Haggerty ([phaggert@nsf.gov](mailto:phaggert@nsf.gov) (<mailto:phaggert@nsf.gov>)).

## ACADIS Data Management Services Expanded

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, and sharing services.



- The ACADIS team made several presentations during the 2013 American Geophysical Union (AGU) fall meetings. Jim Moore, Project Lead Principal Investigator, presented an invited talk about ACADIS services and the challenges of supporting data management for the diverse data sets submitted and used by NSF ARC supported research scientists. The team also held a panel discussion on cryosphere career development, and additional presentations managing big data sets, discovery and access to polar data, building an international polar data coordination network, metadata standards in theory and practice.
- An updated dataset documentation template to help researchers describe their data is now available as a [Readme file](https://www.aoncadis.org/media/ACADIS_doc_template.docx). ([https://www.aoncadis.org/media/ACADIS\\_doc\\_template.docx](https://www.aoncadis.org/media/ACADIS_doc_template.docx))
- ACADIS has embarked on a repository-wide metadata cleanup. These updates will ultimately improve data search services and help assure the long-term access to all investigator datasets. Some Principal Investigators may be asked to participate and will be notified via email. The cleanup project will be complete by April 2014.
- The Arctic Data Explorer (ADE) search portal for Arctic data across agencies, repositories, and nations has greatly increased in speed and efficiency. The latest feature is a "temporal duration" filter that allows for quick discovery of datasets covering longer time series.

### Members of the ACADIS Community Support Team

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



- The newest member of the ACADIS team, Karen Andersen assumes the role of project manager. She comes most recently from project management in private industry with previous program management experience at NASA and university projects.

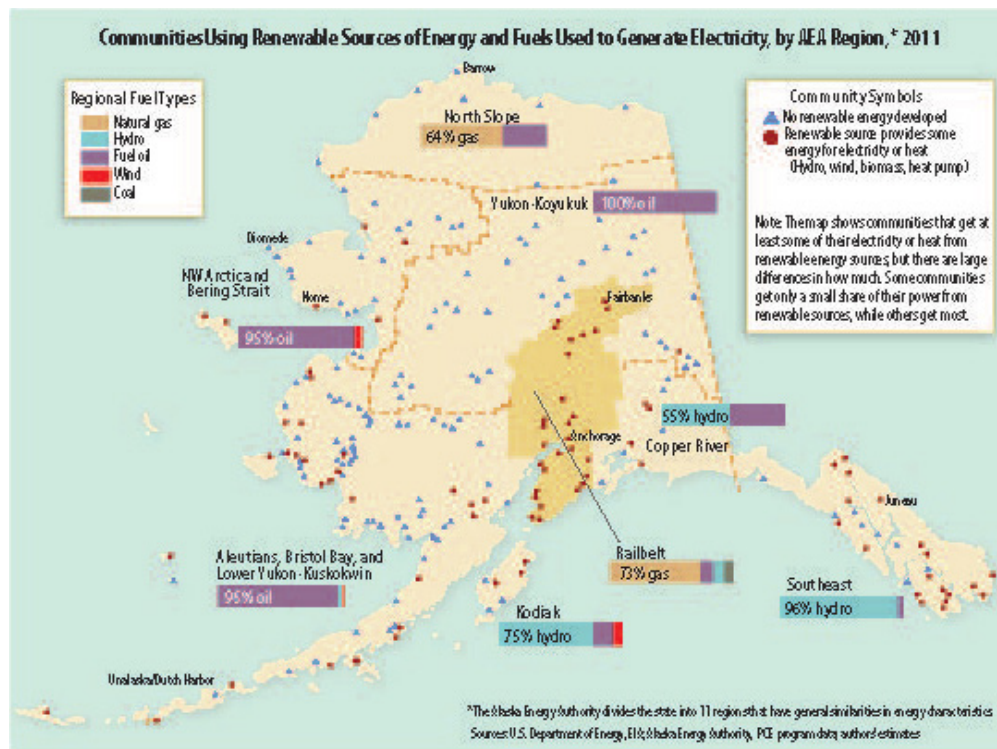
ACADIS, funded by NSF, is a joint effort by the National Center for Atmospheric Research (NCAR), University Corporation for Atmospheric Research (UCAR), and the National Snow and Ice Data Center (NSIDC).

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

# Alaska Energy Data Gateway Provides New Services

By: Ginny Fay and Ben Saylor, Institute of Social and Economic Research, University of Alaska Anchorage, <http://www.iser.uaa.alaska.edu> (<http://www.iser.uaa.alaska.edu>)

The Institute of Social and Economic Research (ISER) (<http://www.iser.uaa.alaska.edu>) recently launched the Alaska Energy Data Gateway (<https://akenergygateway.alaska.edu>), a new online database containing energy data—most of it at the community level—from across Alaska. The site provides data from many sources, in a user-friendly format and through a single access point with data available for download in a variety of file formats.



Communities by region

The purpose of this new data gateway is to make it easier for Alaskans—including project developers and researchers—to get the energy information they need to make informed practical decisions about energy production and use for Alaska communities. Developed in cooperation with the Alaska Energy Authority, and housed at the University of Alaska’s Arctic Region Supercomputing Center in Fairbanks, the Data Gateway represents the first time that such broad energy data has been made available online for Alaska projects and energy.

Currently the site contains a number of datasets including Alaska Power Cost Equalization, electric power generation and capacity, historic and projected fuel prices, renewable energy projects, and population and employment. Complete datasets can be viewed and downloaded or selected data can be filtered, viewed, and downloaded. In addition, a community can be selected and an energy data summary is displayed and available to download or query more deeply. A tutorial is available to guide the data search process.

Development of the Gateway was funded in part by a U.S. Department of Energy award, *Making Wind Work for Alaska: Supporting the Development of Sustainable, Resilient, Cost-Effective Wind-Diesel Systems for Isolated Communities*. Funding contributed by the Alaska Energy Authority made it possible to expand the site to include additional data on renewable and non-renewable energy in Alaska.

This initial release of the Alaska Energy Data Gateway contains only part of the information ISER intends to include in the future. For example, ISER is also working closely with the Alaska Center for Energy and Power, at the University of Alaska Fairbanks, to add high-resolution engineering data to the site.

For those interested in more IT details, the Alaska Energy Data Gateway is implemented as a Django-based web application that interfaces with an open source PostgreSQL (<http://www.postgresql.org>) relational database.

ISER encourages users to provide feedback that will help expand and improve the site. To provide feedback, see the [Alaska Energy Data Gateway website \(https://akenergygateway.alaska.edu/\)](https://akenergygateway.alaska.edu/), or email comments to [akenergygateway@alaska.edu \(mailto:akenergygateway@alaska.edu\)](mailto:akenergygateway@alaska.edu).

For more information, contact Ginny Fay ([vfay@alaska.edu](mailto:vfay@alaska.edu)) or phone: 907-786-5402; or Ben Saylor ([bsaylor1@alaska.edu \(mailto:bsaylor1@alaska.edu\)](mailto:bsaylor1@alaska.edu)) or phone: 907-786-5412.

# Implementation Plan for National Strategy for the Arctic Region

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On 30 January 2014 the Obama Administration released the [Implementation Plan for the National Strategy for the Arctic Region \(Implementation Plan\)](http://www.whitehouse.gov/sites/default/files/docs/implementation_plan_for_the_national_strategy_for_the_arctic_region_-_fi....pdf) ([http://www.whitehouse.gov/sites/default/files/docs/implementation\\_plan\\_for\\_the\\_national\\_strategy\\_for\\_the\\_arctic\\_region\\_-\\_fi....pdf](http://www.whitehouse.gov/sites/default/files/docs/implementation_plan_for_the_national_strategy_for_the_arctic_region_-_fi....pdf)). This plan sets forth the methodology, process, and approach for executing the [National Strategy for the Arctic Region \(Strategy\)](http://www.whitehouse.gov/sites/default/files/docs/nat_arctic_strategy.pdf) ([http://www.whitehouse.gov/sites/default/files/docs/nat\\_arctic\\_strategy.pdf](http://www.whitehouse.gov/sites/default/files/docs/nat_arctic_strategy.pdf)), which the Obama Administration released on 10 May 2013. (For more information about the Strategy, see: "[White House Announces National Strategy for the Arctic Region](http://www.arcus.org/witness-the-arctic/2013/2/article/19962)" (<http://www.arcus.org/witness-the-arctic/2013/2/article/19962>) in *Witness the Arctic -Spring 2013*).



NATIONAL STRATEGY  
FOR THE ARCTIC REGION

*National Strategy for the Arctic  
Region*

According to its overview, the Implementation Plan complements and builds upon existing initiatives by Federal, State, local, and tribal authorities, the private sector, and international partners. It upholds national interests in safety, security, and environmental protection and it works with international partners to pursue global objectives of addressing climatic changes.

According to the White House press release, "While the Implementation Plan is designed to guide the activities of Federal Departments and Agencies, successful implementation will depend upon active engagement and coordination with Alaska Natives and the State of Alaska." The Implementation Plan will be reviewed on an annual basis. Progress on implementation actions by Federal Departments and Agencies will be provided through an annual report to the President.

The full Implementation Plan for the National Strategy for the Arctic Region can be found [here](http://www.whitehouse.gov/sites/default/files/docs/implementation_plan_for_the_national_strategy_for_the_arctic_region_-_fi....pdf) ([http://www.whitehouse.gov/sites/default/files/docs/implementation\\_plan\\_for\\_the\\_national\\_strategy\\_for\\_the\\_arctic\\_region\\_-\\_fi....pdf](http://www.whitehouse.gov/sites/default/files/docs/implementation_plan_for_the_national_strategy_for_the_arctic_region_-_fi....pdf)).

For further information about the National Strategy for the Arctic Region and source material for this article, see the White House [press release](http://www.whitehouse.gov/blog/2014/01/30/white-house-releases-implementation-plan-national-strategy-arctic-region) (<http://www.whitehouse.gov/blog/2014/01/30/white-house-releases-implementation-plan-national-strategy-arctic-region>).

## U.S. State Department Announces Plans to Create High Level Arctic Representative Position

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United States Secretary of State, John Kerry, announced plans to create a Special Representative for the Arctic Region. These plans were announced 14 February 2014 and communicated to U.S. Senators Mark Begich and Lisa Murkowski from Alaska. In his statement, Secretary Kerry said, "The great challenges of the Arctic matter enormously to the United States, and they hit especially close to home for Alaska."



*State Department*

According to the press release from the State Department, the Special Representative will be a high-level official of substantial stature and expertise who will play a critical roll in advancing American interests in the Arctic Region as the Administration prepares for the U.S. to Chair the Arctic Council in 2015.

Kerry's letter to Senator Begich is available [here](http://assets.nationaljournal.com/pdf/130214_BegichKerry.pdf). ([http://assets.nationaljournal.com/pdf/130214\\_BegichKerry.pdf](http://assets.nationaljournal.com/pdf/130214_BegichKerry.pdf))

For further information about these plans and source material for this article, see the State Department [press release](http://www.state.gov/secretary/remarks/2014/02/221678.htm). (<http://www.state.gov/secretary/remarks/2014/02/221678.htm>)

## Department of Defense Rolls Out Arctic Strategy

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The Defense Secretary Chuck Hagel announced the Department of Defense (DOD) [Arctic Strategy](http://thehill.com/sites/default/files/arctic_0.pdf) ([http://thehill.com/sites/default/files/arctic\\_0.pdf](http://thehill.com/sites/default/files/arctic_0.pdf)) during the Halifax International Security Forum on 22 November 2013. The new strategy outlines American military's role in carrying out the [National Strategy for the Arctic Region](http://www.whitehouse.gov/sites/default/files/docs/nat_arctic_strategy.pdf) ([http://www.whitehouse.gov/sites/default/files/docs/nat\\_arctic\\_strategy.pdf](http://www.whitehouse.gov/sites/default/files/docs/nat_arctic_strategy.pdf)), including maintain peace and security in a frontier being changed by climate forces.



*Department of Defense 2013  
Arctic Strategy*

According to the Strategy's executive summary, security in the Arctic encompasses activities ranging from resource extraction and trade to activities supporting safe commercial and scientific operations to national defense. DOD's desired end-state for the Arctic is identified in the Strategy as a secure and stable region where U.S. national interests are safeguarded, the U.S. homeland is protected, and nations work cooperatively to address challenges. The Strategy articulates U.S. interest in the Arctic and the DOD supporting objectives.

The full DOD Arctic Strategy can be found [here](http://thehill.com/sites/default/files/arctic_0.pdf). ([http://thehill.com/sites/default/files/arctic\\_0.pdf](http://thehill.com/sites/default/files/arctic_0.pdf))

For further information about the DOD Arctic Strategy for and source material for this article, see the U.S. Department of Defense [news](http://www.defense.gov/news/newsarticle.aspx?id=121220). (<http://www.defense.gov/news/newsarticle.aspx?id=121220>)

## Updates from NSF's Arctic Sciences Town Hall Meeting

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Arctic Natural Sciences Program Director William Wiseman hosted NSF's Arctic Sciences Town Hall meeting on 10 December 2013 during the American Geophysical Union (AGU) fall meeting in San Francisco. Polar Cyberinfrastructure Program Director Marco Tedesco and Research Support and Logistics program contractor Jennifer Mercer joined Wiseman at the meeting to provide news from the Arctic Sciences Section, program updates, and an open forum for questions about NSF activities.



### Arctic Sciences Section News Summary

Funding challenges in the Arctic Sciences Section include budgets that are based on earlier funding levels. As a result NSF budgets are likely to remain flat, at best. With recent efforts to reinvigorate the Arctic System Science (ARCSS) program (see: *Witness the Arctic*, Fall 2013) the Arctic Environmental Science competitions have been eliminated. The Arctic Section will continue to fund fieldwork, but researchers are encouraged to consider proposing creative activities that make use of existing and archived data.

NSF has openings for program officers in permanent positions and rotating positions through the Intergovernmental Personnel Act (IPA) assignments. Additional and ongoing opportunities for developing Arctic Science Section programs are based, in part, on both the national priorities for understanding the Arctic and good inter-community communications. Wiseman reiterated the message that NSF Program Managers welcome questions and he encouraged community members to make contact by phone, email, or stopping to chat.

## Research Support and Logistics Program News Summary

NSF sponsored a Research Support and Logistics (RSL) workshop in early October 2013 to solicit input from the community on future needs for Arctic research. As a preliminary outcome of the workshop, participants identified the need for more scalability and flexibility with facilities, more international collaboration, and increased cooperation and synthesis of data. ARCUS facilitated the workshop and is writing a report, which will be available in spring 2014.

Other RSL meetings include an Arctic Risk Management workshop scheduled for early February 2014 to address field safety and risk management (see [here \(http://www.arcus.org/witness-the-arctic/2014/1/article/20430\)](http://www.arcus.org/witness-the-arctic/2014/1/article/20430)) and a Greenland/Summit Station Town Hall at AGU, which convened 11 December 2013, to discuss plans for redevelopment at Summit Station. Discussions were to address the long-term plans to mitigate the impact of air pollution at Summit Station such as moving non-clean air/snow research activities away from the Summit Observatory to a new operations site called Isi Station, located 5 kilometers north of the current station. Isi Station will also house a Smithsonian 12-meter telescope that will be situated on the Greenland ice sheet. Other plans include moving the NEEM camp closer to Summit in 2015 and travel to Nuuk to discuss NSF research activities in Greenland.

## Polar Cyberinfrastructure Program News Summary

NSF sponsored a workshop on Cyberinfrastructure (CI) for Polar Sciences in September 2013 to promote the growth of a cyberinfrastructure polar community and to encourage community-driven design and architecture of a polar science CI that is aligned with the end-users' needs. A survey of workshop participants identified four high priority polar CI components: data as a service, education and training, communication and networking, and community building and community portals. (For more information about the workshop, see: "[Cyberinfrastructure for Polar Sciences](http://www.arcus.org/witness-the-arctic/2013/3/article/20198)" (<http://www.arcus.org/witness-the-arctic/2013/3/article/20198>) in *Witness the Arctic - Fall 2013*).

One outcome of the workshop was the discussion about the formation of a consortium of Arctic and Antarctic data centers, with attention to understanding the needs of curating data and the meta-data landscape—or how to data centers "talk" to each other. Of importance are, among other things, the social and cultural barriers between the cyberinfrastructure and the polar science communities, including language barriers, which are often more challenging than the technical barriers. For example, the cyberinfrastructure community has many tools and needs to know how they would be used by the polar



community—and the polar community, which is interdisciplinary in nature, needs to understand what tools are available to address their needs. To advance the related community building needs, the workshop participants encouraged the program to bring cyber people to the field to see how data is developed and collected and field people to the data management centers to see what tools are available. Another important aspect discussed at the workshop was the interaction between data curators and polar scientists during the life of a research project. Tedesco also called for involving more students and early career scientists in Polar CI community activities.

For further information about the Arctic Sciences Section and these programs, contact William Wiseman ([wwiseman@nsf.gov](mailto:wwiseman@nsf.gov) (<mailto:wwiseman@nsf.gov>)), Marco Tedesco ([mtesesco@nsf.gov](mailto:mtesesco@nsf.gov) (<mailto:mtesesco@nsf.gov>)), Jennifer Mercer ([jmercerc@nsf.gov](mailto:jmercerc@nsf.gov) (<mailto:jmercerc@nsf.gov>)), or Renee Crain ([rcrain@nsf.gov](mailto:rcrain@nsf.gov) (<mailto:rcrain@nsf.gov>)).

## Sea Ice Prediction Network Launches Series of Community Activities

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*Photo by Jeff Peneston (PolarTREC 2008/2009), Courtesy of ARCUS*

The [Sea Ice Prediction Network \(SIPN\)](http://www.arcus.org/sipn) (<http://www.arcus.org/sipn>), launched in late 2013, is a collaborative network of scientists and stakeholders seeking to advance research on Arctic sea ice prediction and communication of sea ice knowledge and tools. With funding from NSF's Arctic Sciences Section, the Office of Naval Research (ONR), the National Oceanic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA), and the Department of Energy (DOE), SIPN builds

on the [Sea Ice Outlook \(SIO\)](http://www.arcus.org/search-program/seaiceoutlook) (<http://www.arcus.org/search-program/seaiceoutlook>) project with effort focused on seasonal forecasting. SIPN objectives include coordinating and evaluating sea ice prediction activities; integrating, assessing, and guiding sea ice observations; synthesis of observations and predictions; disseminating predictions; and engaging key stakeholders.

The SIPN leadership team has organized initial activities to introduce the project and build the network. The first event, a Town Hall meeting on 3 December during the American Geophysical Union (AGU) fall meetings, provided a project overview of the project and introduced several efforts, including an analysis of recent contributions to the SIO.

Two other sea ice prediction events organized for the community include an open webinar, held on Thursday, 20 February, and a workshop scheduled for 1-2 April 2013.

The webinar will present a brief summary of SIPN project goals and begin discussions on how to improve sea ice predictions, with emphasis on planning for 2014 Sea Ice Outlook. Presentations during the webinar will provide a prelude to the April workshop. More information and registration is available on the [SIPN website](http://www.arcus.org/sipn/webinars/register) (<http://www.arcus.org/sipn/webinars/register>).

The Sea Ice Prediction workshop will be held 1-2 April 2014 in Boulder, Colorado at the National Center

for Atmospheric Research (NCAR). Funded in part by DOE, the workshop goals include planning for the 2014 SIO and advancing the science of sea ice prediction by coordinating experiments, defining and developing data sets for initialization and validation, creating new and better metrics for evaluation, and discussing stakeholder needs. Anticipated workshop participants will include SIO contributors, data experts, sea ice experts, experts on prediction from other fields, and U.S. agency program managers.

For further information about SIPN, please see the [SIPN website \(http://www.arcus.org/sipn\)](http://www.arcus.org/sipn) or contact Julienne Stroeve ([stroeve@nsidc.org \(mailto:stroeve@nsidc.org\)](mailto:stroeve@nsidc.org)), Cecilia Bitz ([bitz@uw.edu \(mailto:bitz@uw.edu\)](mailto:bitz@uw.edu)), or Helen Wiggins ([helen@arcus.org \(mailto:helen@arcus.org\)](mailto:helen@arcus.org))

## SIPN Leadership Team

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(NSIDC)

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Cecilia Bitz, University of Washington

ONR Principal Investigator

Walt Meier, NASA

Co-Principal Investigator

Hajo Eicken, University of Alaska Fairbanks

Co-Principal Investigator

Larry Hamilton, University of New Hampshire

Co-Principal Investigator

Helen Wiggins, Arctic Research Consortium of the U.S.  
(ARCUS)

ARCUS Principal Investigator

Philip Jones, Los Alamos National Laboratory

DOE Principal Investigator

Jim Overland, NOAA/University of Washington

Muyin Wang, NOAA/University of Washington

Jenny Hutchings, Oregon State University

Adrienne Tivy, National Research Council of Canada

Edward Blanchard-Wrigglesworth, University of Washington

Elizabeth Hunke, Los Alamos National Laboratory

# NOAA's 2013 Arctic Report Card Now Available

The 2013 Arctic Report Card was released on 12 December 2013 during a press conference led by Dr. Martin Jeffries, Principal Editor of the Arctic Report Card and science advisor to the U.S. Arctic Research Commission (<http://www.arctic.gov/>). This annual update from the National Oceanic and Atmospheric Administration (NOAA) reports on key indicators and components being tracked in the Arctic. The 2013 update contains 18 essays by 147 authors from 14 countries describing the state of the Arctic environmental system.

**Arctic Report Card: Update for 2013**  
Tracking recent environmental changes

Home About Printouts Previous Report Cards NOAA Arctic Theme Page Contacts

**HOME**  
Executive Summary

**ATMOSPHERE**  
Air Temperature  
Clouds & Surface Radiation  
Ozone  
UV Radiation  
Black Carbon

**SEA ICE & OCEAN**  
Sea Ice  
Ocean Temperature & Salinity

**MARINE ECOSYSTEMS**  
Sea Ice Biota  
Marine Fishes  
Benthic Communities

**TERRESTRIAL ECOSYSTEMS**  
Vegetation  
Muskoxen  
Caribou & Reindeer

**TERRESTRIAL CRYOSPHERE**  
Snow  
Glaciers & Ice Caps  
Greenland Ice Sheet  
Lake Ice  
Permafrost

**What's new in 2013?**

**There were fewer snow and ice extremes than in 2012.** Many regions and components of the Arctic environment were closer to their long-term averages, but the effects of a persistent warming trend that began over 30 years ago remain clearly evident.

The impacts of the warming climate on the physical environment during those 30 years are influencing Arctic ecosystems on the land and in the sea.

**Highlights**

**Summer surface air temperatures were particularly low** across the central Arctic Ocean, northern Canada and Greenland relative to 2007-2012 (a period of pronounced summer sea ice retreat), and were somewhat lower than the long-term average of 1981-2010.

**Snow extent in May 2013 reached a new record low** in Eurasia, while Northern Hemisphere-wide snow extent was below average for spring (April, May, June).

**Minimum sea ice extent in September 2013** exceeded the record low of 2012, but was the 6th lowest since observations began in 1979 despite the relatively cool summer of 2013. The seven lowest minimum ice extents have occurred in the last seven years, 2007-2013.

**Arctic tundra vegetation greenness** (a measure of productivity) and growing season length have continued to increase since observations began in 1982.

**Large land mammals convey a mixed message**, with muskox numbers stable/increasing since the 1970s, while many caribou and reindeer herds currently have unusually low populations for the period 1970-2013.

**Changes in fish and bottom dwelling organisms** include continued northward migration of species not previously seen in the Arctic.

Arctic Report Card 2013  
**Arctic Report Card Update 2013**  
[www.arctic.noaa.gov/reportcard](http://www.arctic.noaa.gov/reportcard)

0:00 / 3:14

Arctic Report Card Website

The 2013 update revealed that there were fewer snow and ice extremes than in the previous year. Many regions and components of the Arctic environment were closer to their long-term averages, but the effects of a persistent warming trend that began over 30 years ago remain clearly evident. Relatively cool air temperatures in summer 2013 across the central Arctic Ocean, Greenland, and northern Canada facilitated an increase in the summer sea ice extent and a decrease in the extent and duration of melting at the surface of the Greenland ice sheet. In contrast, the summer of 2013 was one of the warmest on record in Alaska, where new record high temperatures were set at some permafrost observatories. Fairbanks, near the center of the state, experienced a record 36 days with temperatures of 27°C or higher. Overall, the impacts of the warming climate on the physical environment continue to influence Arctic ecosystems on the land and in the sea.

## Highlights from the 2013 update include

- Summer surface air temperatures were particularly low across the central Arctic Ocean, northern Canada and Greenland relative to 2007-2012.
- Snow extent in May 2013 reached a new record low in Eurasia, while snow extent was below average for spring across the Northern Hemisphere.
- Minimum sea ice extent in September 2013 exceeded the record low of 2012, but was still the 6th lowest since observations began in 1979 despite the relatively cool summer of 2013.
- Arctic tundra vegetation greenness (a measure of productivity) and growing season length have continued to increase since observations began in 1982.
- Large land mammals convey a mixed message, with muskox numbers stable/increasing since the 1970s, while many caribou and reindeer herds currently have unusually low populations for the period 1970-2013.
- Changes in marine fish and bottom dwelling organisms include continued northward migration of species not previously seen in the Arctic.

The Arctic Report Card is supported by the [Arctic Research Program](http://www.arctic.noaa.gov/arp/) (<http://www.arctic.noaa.gov/arp/>) in the [NOAA Climate Program Office](http://cpo.noaa.gov/) (<http://cpo.noaa.gov/>). The preparation of Arctic Report Card 2013 was directed by a U.S. inter-agency editorial team with representatives from [NOAA](http://www.noaa.gov/) (<http://www.noaa.gov/>), the [Cold Regions Research and Engineering Laboratory](http://www.crrel.usace.army.mil/) (<http://www.crrel.usace.army.mil/>) and the [U.S. Arctic Research Commission](http://www.arctic.gov/) (<http://www.arctic.gov/>). Independent peer-review of the Report Card was facilitated by the [Arctic Monitoring and Assessment Program](http://www.amap.no/) (<http://www.amap.no/>).

For more information on the origin and history of the Arctic Report Card, see "[The Arctic Report Card: Past and Present](http://www.arcus.org/witness-the-arctic/2013/1/article/19615)" (<http://www.arcus.org/witness-the-arctic/2013/1/article/19615>) in *Witness the Arctic - Winter 2013*.

The 2013 Arctic Report Card, a link to a YouTube video, and previous report cards, are available on the [NOAA website](http://www.arctic.noaa.gov/reportcard/) (<http://www.arctic.noaa.gov/reportcard/>).

For more information regarding the Arctic Report Card, please contact Monica Allen, NOAA Communications and NOAA Research, ([monica.allen@noaa.gov](mailto:monica.allen@noaa.gov) (<mailto:monica.allen@noaa.gov>)) or phone: 301-734-1123.

Many thanks to Martin Jeffries and Jackie Richter-Menge for their review and contributions to this article.

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(<http://www.arctic.noaa.gov/reportcard>)

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## Ocean Acidification Along the Rapidly Changing Alaskan Coast

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*By: Jeremy T. Mathis, Supervisor of Oceanography at NOAA Pacific Marine Environmental Laboratory*

Since the pre-industrial era, human activities have increased atmospheric carbon dioxide (CO<sub>2</sub>) concentrations by about 40% to values near 400 ppm, which is higher than at any point during the last 800,000 years. During this rapid loading of the atmosphere, the ocean has absorbed more than 25% of the total emitted anthropogenic CO<sub>2</sub>, helping to offset atmospheric warming, but fundamentally changing ocean chemistry. The uptake of CO<sub>2</sub> triggers a series of well-understood reactions in the surface ocean called ocean acidification (OA) that has already reduced the global surface ocean pH by about 0.1 units, making the ocean 30% more acidic than in pre-industrial times.

During this process, biologically important carbonate minerals are diminished, which makes it more difficult for organisms like mollusks to create and maintain their shells, especially during early life stages.

High-latitude oceans, like those around Alaska, have naturally low carbonate ion concentrations due to low sea surface temperatures and increased solubility of CO<sub>2</sub> and are thus considered to be more vulnerable to the impacts of OA on shorter timescales. Accordingly, the uptake of anthropogenic CO<sub>2</sub> further reduces carbonate ion concentrations, pushing the high-latitude waters closer to the threshold where shell dissolution can occur.



*Jeremy T. Mathis, PhD, is also the Director of the Ocean Acidification Research Center at University of Alaska Fairbanks. Photo courtesy of Jeremy Mathis.*



Waters that are potentially corrosive to carbonate shells in the western Arctic Ocean and the Bering Sea are found in the central Canada basin, on the Chukchi and Beaufort Sea shelves, in outflow waters on the Canadian Arctic Archipelago shelf, and across the expansive northern and southern Bering Sea shelf. In the Chukchi Sea and Bering Seas, waters that are potentially corrosive to carbonate shells occur seasonally near the bottom due to the combination of natural respiration of large quantities of organic matter transported from the surface and the intrusion of anthropogenic CO<sub>2</sub> from the atmosphere. These processes are creating an ever-expanding environment where the intensity, duration, and extent of low-pH events are increasing in one of the most productive and diverse ecosystems on Earth (see Figure 1).



*Figure 1 – Benthic grab from the bottom of the Bering Sea showing the diversity of organisms, many of which are calcifiers that could be impacted by ocean acidification. Photo courtesy of Jeremy Mathis.*

While there have been few comprehensive studies, OA appears to act more strongly on certain species, but lower pH environments can fundamentally alter ecosystem composition toward dominance by non-calcifying organisms. Mollusks, such as oysters and clams, appear to be the calcifying group most negatively affected by OA. However, crustaceans such as the red king crab and tanner crab species exhibit negative responses that included slower growth and lower survival rates when they are exposed to high-CO<sub>2</sub>, lower-pH water.

Alaska's heavy dependence on marine organisms for both commercial and subsistence activities implies that ecosystem services based on these species could change as OA continues to progress. As this happens over the next 50 to 100 years, the region could be impacted through changes in food security or shifts in livelihoods. In many communities around the State, large portions of the economy are tied directly to the extraction of living marine resources. Alaska's western and southern rural areas are likely at the highest risk from OA due to a confluence of factors, including: subsistence fishing for near-shore species like clams and crabs, more rapid projected OA, lower industry diversity, economic dependence on fishery harvests, lower income, and higher food prices.

While the only way to mitigate the impacts of OA is through the reduction of CO<sub>2</sub> emissions to the atmosphere, there are some adaptive strategies that can be implemented in the near-term to help managers and policymakers deal with any disruptions in marine ecosystem services. Careful monitoring of coastal marine environments, particularly in regions of societal and economic importance is a critical first step in addressing the challenges of OA. Beginning in 2012, a number of Federal and private agencies as well as the state of Alaska began to fund the development of an ocean acidification-monitoring network (see Figure 2) in key regions around the state. Data from each location can be found at <http://www.pmel.noaa.gov/CO> (<http://www.pmel.noaa.gov/CO>)<sub>2</sub>/story/Coastal+Mooring.

This network is made up of fixed buoys, oceanography research cruises, and unmanned vehicles; along with a citizen-monitoring program where fisherman, school children and concerned citizens collect water in their own regions for scientific analysis. By monitoring sensitive areas and the keystone species that inhabit these environments it will be possible to detect the detrimental consequences brought on by OA before a complete collapse of a fishery occurs.

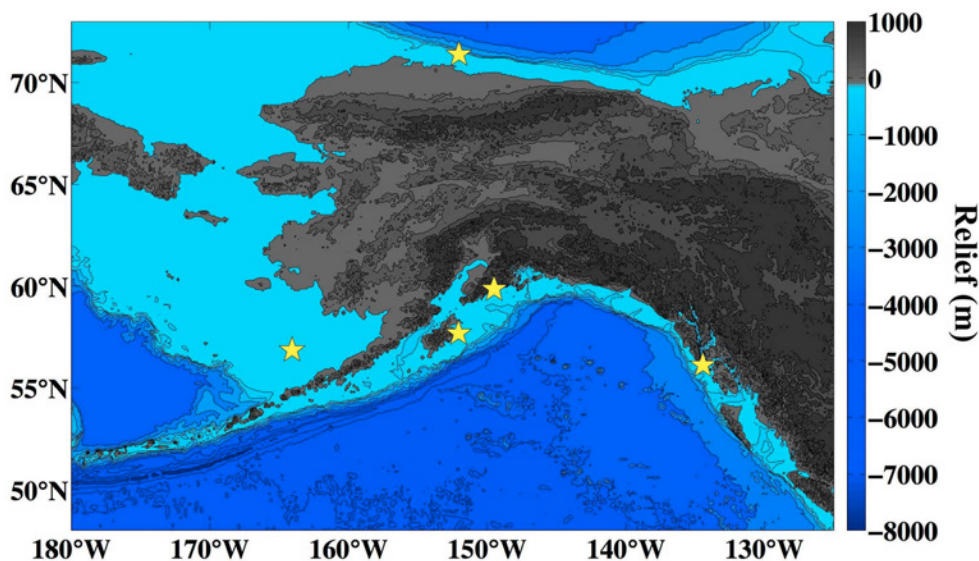


Figure 2. Map showing the location (yellow stars) of the buoys around Alaska that are measuring ocean acidification parameters in real-time. Image courtesy of Jeremy Mathis.

In the meantime, Alaskans, particularly those in the most vulnerable areas must work to diversify their regional economies so that they are not solely dependent on a few commercially important marine species. Alaskan commercial fisheries have a long history of opportunistically switching to different species based on availability and marketability. This suggests that the socio-economic system may have some ability to

adapt to future conditions. However, every effort should be made to develop other industries and resources (e.g., fur seals, gold, timber) so that if a worse case OA scenario occurs, the consequences can be managed in a way that leaves both coastal communities and the state on sound financial footing.

For further information contact Jeremy Mathis ([jeremy.mathis@noaa.gov](mailto:jeremy.mathis@noaa.gov) (<mailto:jeremy.mathis@noaa.gov>)).

# Collaborative Research Projects Investigate Impacts of Climate Change on Arctic Archaeology

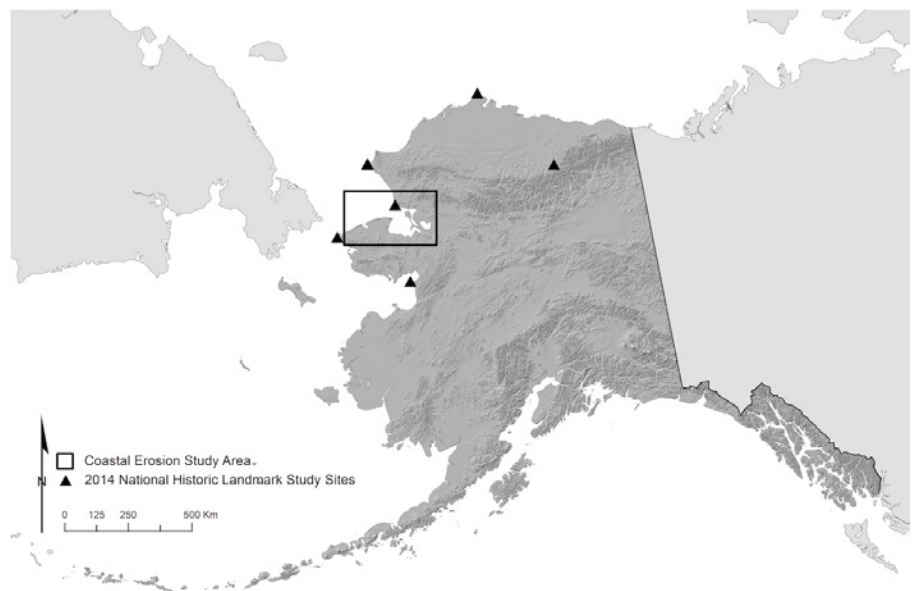
By: *Shelby Anderson, Assistant Professor, Portland State University*

## Introduction

While the impacts of climate change on natural systems and contemporary northern communities are fairly well established, current and future climate change impacts on the archaeology of the north are not well understood. The general threat of climate change to Arctic archaeological sites is apparent (Blankholm 2009). Sea level rise, increased storm frequency, warming, and permafrost melting will increase rates of coastal archaeological site erosion across Arctic seacoasts.

Warming, melting, and increased water run-off will similarly impact

sites located in interior areas of the Arctic. At the same time climate change will continue to reveal new sites through erosive and warming forces. An example of this is the increase in alpine archaeological sites emerging from glacial ice patches as they melt (Reckin 2013). In jeopardy is an irreplaceable long-term record of Arctic life in the past. This record includes cultural and paleoenvironmental data on past human-environment interactions that provides important context for contemporary climate change issues (Hudson, et al. 2012; Rockman 2011). Not all archaeological sites can be saved, so how do archaeologists focus their efforts on the most threatened and important archaeological sites across vast Arctic spaces? This problem is the subject of two on-going collaborative research projects undertaken by Shelby Anderson,



*Figure 1. 2012-2014 Northern Alaskan study area and sites mentioned in text. Image courtesy of Shelby Anderson.*

Portland State University (PSU) (<http://www.pdx.edu/>), and colleagues Dael Devenport, Michael Holt, and Jeremy Karchut at the National Park Service (NPS) (<http://www.nps.gov/index.htm>).

## Present Studies



Figure 2. Archaeologists surveying for coastal archaeological sites on the northern Seward Peninsula in 2013. Photo courtesy of Shelby Anderson.

As part of the National Park Service (NPS) funded *Climate Change and Archaeology in Northwest Alaska: Nuluk Study* (<http://www.nps.gov/kova/blogs/Ikpekapalooza.htm>), Anderson and Holt are collaborating in an initial study of the impacts of climate change on coastal archaeological sites of northwest Alaska. The focus is on an approximately 56 km (35 mile) stretch of coastline along the northern Seward Peninsula and within the Bering Land Bridge National Preserve (see Figure

1). This region was selected for study because approximately two-thirds of the study area has never been investigated for archaeological sites. The rest of the study area was the subject of archaeological research more than 20 years ago; the sites have not been visited since and their current condition was unknown at the outset of the project. The coasts of northwest Alaska are considered highly vulnerable to future climate change impacts, with study of coastal erosion along the northern Seward Peninsula coast indicating erosion rates between 0.54 and 1.25 m/year (Jordan 1988; see also Manley, et al. 2007). The goals of the current study are to evaluate why and how people adapted to and altered their environment during past episodes of Arctic environmental variability and to evaluate how modern climate change is impacting archaeological sites in the study area. Two years of fieldwork are now complete and analysis of archaeological and climate change impact data are underway (see Figure 2). The survey identified 30 new sites and relocated 21 previously identified sites. More than half of these sites are moderately to severely damaged and there is significant loss of data in many cases (see Figures 3 and 4). The primary cause of site damage in the study area is wind erosion, with coastal erosion a secondary impact on site condition.

Karchut and Anderson are collaborating on a second NPS funded project, *Northern Alaska National Historic Landmark Condition and Vulnerability Assessment*, that involves developing methods for assessing climate change impacts to archaeological sites and determining site vulnerability to future climate change in a variety of northern geographic settings. This study builds on field methods implemented in the Nuluk study described above and expands climate change impact assessment to a range of geographic areas, including both coastal and interior sites. Six highly significant archaeological sites, all listed as National Historic Landmarks, will serve as study sites for testing climate change hazard and vulnerability assessment methods in summer 2014 (see Figure 1).



*Figure 3. Mapping an eroding archaeological site. Note the wooden house posts and other archaeological material exposed in the eroding bank. Photo courtesy of Shelby Anderson.*

## Future Work

Next steps on these projects include refining field assessment methods with summer 2014 fieldwork and combining newly collected data with an ongoing NPS effort to develop a coastal vulnerability model for archaeological sites in northwest Alaska. Devenport and Karchut are using a Geographic Information System (GIS) platform to combine a model of future climate change impacts to coastal areas of northwest Alaska with a model that predicts archaeological site locations in previously uninvestigated areas. New survey data and the results of on the ground assessments described above will help refine this predictive model. The project GIS can then be used to prioritize specific northern coastal areas for future



Figure 4. Historic structure eroded by wind and exposed in active dune system. Photo by Shelby Anderson.

investigation that take into account both the likelihood of archaeological site presence and the predicted threat of climate change impacts in a given coastal area.

For further information about this project, contact Shelby Anderson

([ashelby@pdx.edu](mailto:ashelby@pdx.edu)

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Additional information can also be found at: <http://shelbylanderson.com/> (<http://shelbylanderson.com/>).

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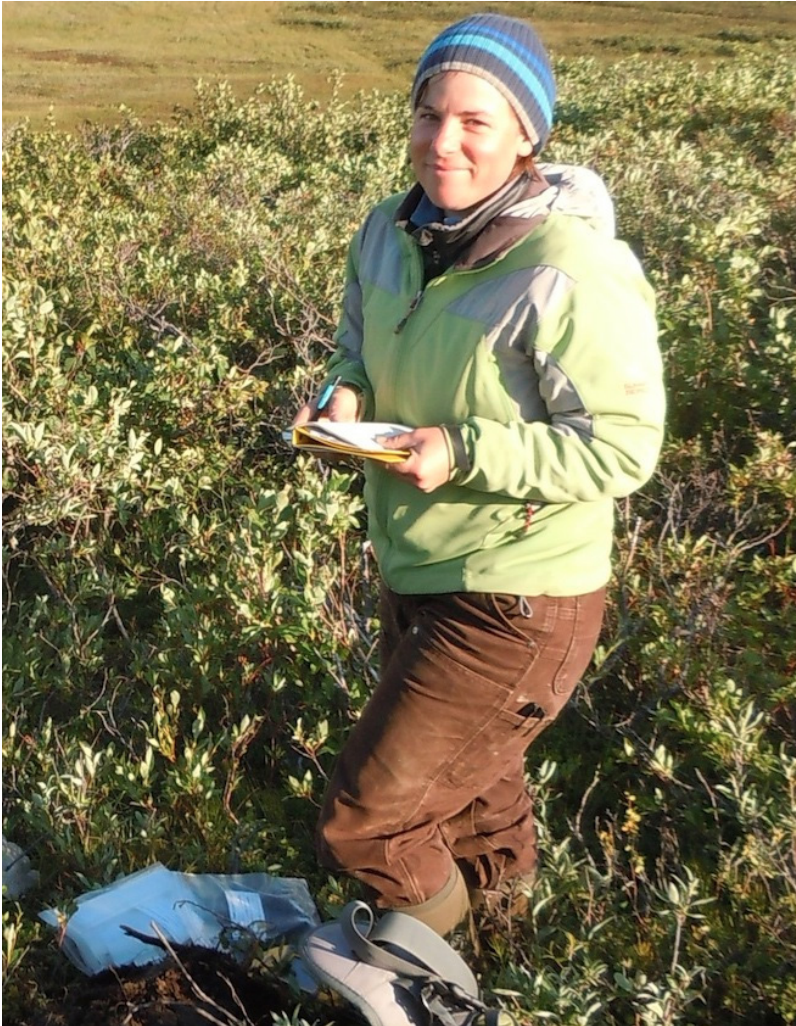
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*Shelby Anderson*

Shelby Anderson is an Assistant Professor in the Anthropology Department at Portland State University. Research interests include past coastal hunter-gatherer societies, human ecodynamics, evolutionary theory, ceramic technologies, applied archaeology, and archaeology of the Arctic, Sub-arctic and Pacific Northwest. Cross-cutting these interests is a long-term commitment to community engagement and collaborative research in all aspects of her work.



## Icelandic Research Centre Supports Unique Study of the Arctic Fox

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*By: Juliann Schamel, Arctic Fox Centre, Sudavik, Westfjords, Iceland*

The [Arctic Fox Research Centre \(http://melrakki.is/about\\_us\)](http://melrakki.is/about_us), located in Sudavik, Westfjords, Iceland, opened in September of 2007 to conduct primary research on the arctic fox (*Vulpes lagopus*) and to inform and develop sustainable tourism practices for visiting and viewing the arctic fox in Iceland's national parks and preserves. Research at the Centre is supported by [University Centre of the Westfjords \(http://hsvest.is/the\\_university\\_centre\\_of\\_the\\_west\\_fjords/about\\_the\\_university\\_centre\)](http://hsvest.is/the_university_centre_of_the_west_fjords/about_the_university_centre), the [Icelandic Institute of Natural History \(http://en.ni.is/\)](http://en.ni.is/), and the Nordic project [The Wild North \(http://melrakki.is/projects/the\\_wild\\_north\\_2\)](http://melrakki.is/projects/the_wild_north_2).



*Juliann Schamel has worked the Arctic Fox Centre as field assistant and exhibition guide. Photo courtesy of Juliann Schamel.*

The arctic fox is Iceland's only native terrestrial mammal.

These fox are sustained mainly on seabirds and seabird eggs, insects, berries, and on beach carrion during the winter (see Figure 1). Fox have been hunted in Iceland since the first humans arrived 1,100 years ago. Hunted for fur and for sport, the fox are also are seen as a threat to livestock and eider farms and as competition for the seabirds and seabird eggs that were an important traditional food source for Icelanders. In 1295 hunters were hired to kill foxes in proportion to the number of sheep being farmed and government payment for fox corpses has continued in some form since then.

Legislation passed in 1994 provided conservation status to the arctic fox in some national parks and nature preserves on the island. The [Hornstrandir Peninsula Preserve \(http://www.westtours.is/trip-categories/hornstrandir-nature-reserve\)](http://www.westtours.is/trip-categories/hornstrandir-nature-reserve) is both large enough and remote enough to provide protection to a viable arctic fox population. Nature tourism in Hornstrandir, with fox encounters as the main event, is growing in popularity and new generations of foxes in the nature preserve are losing their fear of humans (see Figure 2).



Figure 1. An adult arctic fox peruses the beach for washed-up carrion in Hornstrandir, stronghold of the Icelandic arctic fox. Photo courtesy of Juliann Schamel.

long-term monitoring project records the annual population, density, den use, and productivity (i.e., number of pups) of foxes in the preserve as well as the effect of tourism (human presence) on the behavior of denning foxes (see Figure 3). The study revealed a relatively stable social system with pairs returning to den in the same territory for up to five consecutive years. However, some pairs demonstrated stress behaviors such as moving farther up the cliff sides to dens inaccessible to humans with the males guarding the den and the females remaining underground for long hours. Volunteers observed that both parents visited the den with food less frequently later in the summer than they had earlier in the same summer and less frequently than they had at the same time in previous summers. From results thus far Unnsteinsdottir believes that human presence is having a negative effect on denning success as foxes spend less time caring for and feeding their pups and more time guarding or avoiding the den. She has recommended to local tourism companies that they reduce the time

Centre Director Ester Rut Unnsteinsdottir is investigating how fox productivity and behavior are affected by increased tourism and the additional presence of dogs brought onshore. Since 2009 she has lead groups of volunteer research assistants to record the behavior of foxes in the presence of humans. Each volunteer works six-hour shifts for five days each month and is responsible for recording data at one den site. This



Figure 2. The Hornstrandir Nature Reserve in Westfjords, Iceland is increasingly popular as a nature tourist destination. Photo courtesy of Juliann Schamel.

of individual encounters with foxes and restrict dogs in the preserve.



Figure 3. An arctic fox pup waits outside the den in Hornstrandir Nature Preserve. Photo courtesy of Juliann Schamel.

placental scars or pups). This information indicates that most of the fox shot in Iceland, including the breeders, are one year old or younger and that fertility is low. Breeding during the first year is an indication of a stressed population struggling to reach carrying capacity.

A recent review by the [International Union for the Conservation of Nature](https://www.iucn.org) (<https://www.iucn.org>) suggests that many factors related to climate change will threaten the arctic fox species worldwide. These factors include decreased habitat as the tree line moves north, severe changes in prey abundance with fluctuations in lemming populations, and associated competition by the larger red fox.

Iceland, which is largely tree-free and has neither a population that relies on

The Centre also works with Icelandic hunters. Since 1958 the Icelandic government has collected and registered hunting data on the arctic fox, providing a long-term database. Hunters have donated over 10,000 fox carcasses from hunting or trapping activities since 1979. Work with the carcass collection and dissections has allowed researchers at the Centre to collect information about fox distribution, size, color morph, condition (i.e., fat reserves), sex, age, diet, and fertility (e.g., number of



Figure 4. During the 4th International Conference on Arctic Fox Biology in October 2013, hosted by the at Arctic Fox Centre, investigators from across the Arctic shared current research on the state of the arctic fox. Photo courtesy of Ester Rut Unnsteinsdottir.

lemmings nor a red fox population, offers a unique environment for the arctic fox population. The Arctic Fox Centre provides a platform for scientists, hunters, tourists, and policy makers to collaborate in efforts to shape the future for the species in Iceland.

For further information on the Arctic Fox Research Centre, see their [website \(http://melrakki.is/about\\_us\)](http://melrakki.is/about_us), or contact Ester Rut Unnsteinsdottir ([melrakki@melrakki.is \(mailto:melrakki@melrakki.is\)](mailto:melrakki@melrakki.is)).

## Meet the Board of Directors—Michael (Mike) Retelle, President

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Michael J. Retelle is President of the ARCUS Board of Directors. Elected to the board in 2007, and as its president in July 2013, his term ends in 2016. Mike also served on the ARCUS board in the 1990's.

Mike is currently the Geology Department Chair as well as a Professor of Geology at Bates College in Lewiston, Maine. His primary research interests are in glacial and post-glacial environments and environmental change. He and his students have worked extensively on projects in northern New England, the Canadian arctic and in the high latitude North Atlantic. His research in the Shetland Islands is part of an



*Michael J. Retelle*

interdisciplinary geo-archaeology project investigating the occupation and abandonment of a 17th century farmstead, which was likely overtaken by thick windblown deposits during the Little Ice Age, and reconstructing a related paleoclimate/paleoenvironment record from local lake sediment. Mike is currently the co-director of the National Science Foundation sponsored Svalbard REU (Research Experience for Undergraduates) program, which is studying modern glacial and lacustrine processes and climate change in Svalbard.

Mike observes that, "In recent years we've witnessed significant environmental changes across the Arctic. Amplification of the warming climate in Arctic regions has influenced retreat of glaciers, loss of sea ice,

and changes to permafrost, vegetation and marine organisms. Understanding the causes and impacts of Arctic environmental change is a challenge to the Arctic research community involved in monitoring programs and studying past changes that place recent and current changes in a longer term context.

"I was very pleased when Bates College, a relatively small undergraduate institution with a handful of Arctic researchers, was invited to join ARCUS. ARCUS programs and meetings fostered connections for my colleagues and I with researchers across the Arctic community and opportunities to help shape and participate in new and exciting Arctic research initiatives."

## Meet the Board of Directors— Johannes (Hans) Verlinde, Secretary

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Johannes (Hans) Verlinde is Secretary of the ARCUS Board of Directors. Elected to the Board in 2008, and as its secretary in 2013, his term ends in 2014.

Hans is a Professor of Meteorology at Pennsylvania State University. He holds degrees from the University of Pretoria in South Africa and Colorado State University. Hans is an observational atmospheric scientist interested in understanding the physical processes in clouds using surface based remote sensing tools and airborne platforms. His primary research interests are clouds and cloud processes in the Arctic and how these impact climate. Lately he has looked at ways to optimize field experiment decision-making. Hans serves as the Site Scientist for the U.S. Department of Energy's Atmospheric Radiation Measurement Program Climate Research Facilities at Barrow and Oliktok Point on the North Slope of Alaska.



*Johannes (Hans) Verlinde*

Hans observes that, "The ongoing changes in the Arctic environment and their impact on global atmosphere and ocean circulation patterns confirm the need for ongoing research of those physical processes that determines the response of the system to forcing. There is a great need for ongoing measurement campaigns in the Arctic as most atmospheric models rely on understanding of the processes developed from mid-latitude measurements, which does not directly transfer to higher latitude environments. Arctic atmospheric processes depend strongly on and influence the underlying surface, which itself undergoes a strong seasonal changes. ARCUS fulfills a critical role in the community by providing a bridge for researchers from different communities to come together to identify integrated cross-disciplinary research objectives."

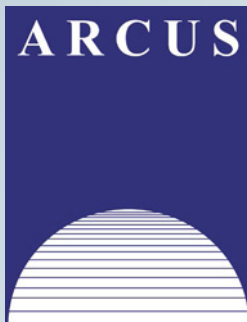
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ARCUS is a nonprofit organization consisting of institutions organized and operated for educational, professional, or scientific purposes. Established by its member institutions in 1988 with the primary mission of strengthening arctic research, ARCUS activities are funded through member dues and contracts and grants with federal and private entities.

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