Witness the ARCTIC

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In this Issue

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University of Virginia's New Arctic Research Center: Supporting Collaborative Research

ARCUS member institution, the University of Virginia (UVA), has recently formed the Arctic Research Center (UVAARC). This marks the beginning of a new platform for collaborative Arctic research at the University of Virginia (UVA) (https://www.virginia.edu/). Building on decades of Arctic-focused research, education, and outreach efforts —spanning environmental sciences, engineering, architecture, landscape architecture, social sciences, data sciences, art, and music—UVAARC brings together undergraduate and graduate students, postdocs, and faculty from four different schools across UVA, as well as a national and international network of colleagues and institutional collaborators. These collaborations include the recent formation of an Institutional Partnership with the US Army Corps of Engineers Cold Regions Research and Engineering Laboratory (CRREL) (https://www.erdc.usace.army.mil/Locations/CRREL/) and a longstanding collaboration with the National Renewable Energy Laboratory (NREL) Cold Climate Housing Research Center (CCHRC) (https://www.nrel.gov/about/alaska.html) in Fairbanks, Alaska.

The UVA Arctic Research Center faculty members include:

- Howard Epstein, Xi Yang, and Claire Griffin (School of Environmental Sciences (https://evsc.as.virginia.edu/about));
- Matthew Jull and Leena Cho (Arctic Design Group (https://www.arch.virginia.edu/news/uvas-arctic-design-group-advance-research-on-the-co-design-of-future-arctic-cities-through-nsf-funded-grant) in the School of Architecture (https://www.arch.virginia.edu/about/research-centers));
- Matthew Burtner (UVA College of Arts and Sciences Department of Music (https://music.virginia.edu/));
- Caitlin Wylie (Science, Technology and Society Faculty of the Department of Engineering and Society (https://engineering.virginia.edu/departments/engineering-and-society/people/sts-faculty); and
- Luis Felipe Rosado Murillo (School of Data Sciences (https://datascience.virginia.edu/)).

Collectively, these faculty are involved with nine different externally funded grants and projects related to

the Arctic (https://www.virginia.edu/search/site/Arctic%20Research%20Centerr#?cludoquery=Arctic%20Research%20Centerr&cludopage=1&cludorefurl=https%3A%2F%2Fwww.virginia.edu%2F&cludorefpt=The%20University%20of%20Virginia&cludoinputtype=standard). These include awards from the National Science Foundation (NSF) Arctic System Sciences and Arctic Natural Sciences programs to study the dynamics of ice-wedge polygonal systems in tundra (See: COLLABORATIVE RESEARCH: Patterns, Dynamics, and Vulnerability of Arctic Polygonal Ecosystems: From Ice-Wedge polygon to Pan-Arctic Landscapes (https://www.nsf.gov/awardsearch/showAward?AWD_ID=1721030&HistoricalAwards=false)) and the seasonal ecophysiologies of different boreal forest types (See: Collaborative Research: Environmental and Biological Controls on Carbon Uptake Phenology in Permafrost Affected Boreal Forests (https://www.nsf.gov/awardsearch/showAward?AWD_ID=2023205&HistoricalAwards=false). Other awards from NSF focus on Arctic urban sustainability (47 cities total), including a new five-year NSF Navigating the New Arctic (NNA) Collaboratory Award that will produce in-depth, broad-themed studies of five cities, Fairbanks (US), Yellowknife (Canada), Lulea (Sweden), Naryan Mar (Russian Federation), and Yakutsk (Russian Federation) to develop urban sustainability indicators and best planning and design practices with local government and community leaders. We also have several awards from the National Aeronautics and Space Administration (NASA) focusing on remote sensing of tundra and organic carbon in Arctic rivers, along with simulations of the tundra-taiga ecotone, and involvement with NASA's Arctic Boreal Vulnerability Experiment (ABoVE) (https://above.nasa.gov/) program. Finally, the UVA Arctic Research Center is leading an NSF NNA award on understanding interactions between the built and natural environments in the Arctic community of Utqiaġvik, Alaska (See: NNA Track 1: Understanding the Changing Natural-Built Landscape in an Arctic Community: An Integrated Sensor Network in Utqiagvik, Alaska (https://www.nsf.gov/awardsearch/showAward?AWD_ID=2022639&HistoricalAwards=false)).

The latter NSF NNA project is currently the centerpiece of efforts by the UVA Arctic Research Center. For this project, our overall objective is to use terrestrial and aquatic sensor networks, along with geophysical surveys, throughout the community of Utqiaġvik, Alaska (https://arcticslope.org/about/communities/utqiagvik) to understand how the built and natural environments interact in the face of climate change—informing future building design practices. Project collaborators are (CRREL) (https://www.erdc.usace.army.mil/Locations/CRREL) and the (CCHRC) of the National Renewable Energy Laboratory (NREL) (https://www.nrel.gov/about/alaska.html)). Community collaborators/partners include TRIBN, LLC (https://tribn.pro/), Utqiaġvik Iñupiat Corporation (UIC) (https://uicalaska.com/about-uic), North Slope Borough Planning and Public Works (https://www.north-slope.org/departments/public-works), and the Tagiuġmiullu Nunamiullu Housing Authority (TNHA) (https://tnha.info/). The project began with a virtual kick-off meeting in January 2020, but our chances of having a field season and in-person meetings in

2020 were squashed with COVID-19. Instead of completely wasting a field season, Matthew Jull led a practicum in the Fall 2020 semester, during which he and several Architecture students deployed and tested a network of terrestrial sensors at various locations around a building at a UVA field facility. We also brought on two PhD students, Mirella Shaban and Mackenzie Nelson, and are in the process of hiring our second postdoc (in addition to Claire Griffin), who will work on co-production and the social sciences aspects of the project with Wylie and Rosado Murillo.

Figure 1. Project team members at our University of Virginia testing facility for terrestrial sensing equipment. From left to right: Mirella Shaban, PhD student; Caitlin Wylie, Assistant Professor - Science, Technology, and Society; Mikal Nelson, student from Utqiaġvik, Alaska; Lars Nelson, consultant, TRIBN, Inc. consultant, Utqiaġvik; Luis Felipe Rosado Murillo, Associate Researcher, School of Data Sciences; Leena Cho, Assistant Professor, Landscape Architecture; Matthew Jull, Associate Professor, Architecture; Rebecca Deeds, Manager, Morven Farms; and Howard Epstein, Professor, Environmental Sciences. Photo courtesy of Jordan Heres.

Figure 2. Team members conducting ground penetrating radar (GPR) at different locations within Utqiaġvik, Alaska. Photo courtesy of Luis Felipe Rosado Murillo.

Figure 3. Team members conducting electrical resistivity tomography (ERT) at different locations within Utqiaġvik, Alaska. Photo courtesy of Luis Felipe Rosado Murillo.

The summer of 2021 was somewhat better than 2020 with regard to COVID, however, the restrictions in travel again forced us to develop creative ways for making progress on the project. We were able to get a small team of researchers in Utqiaġvik at the end of August 2021 to conduct geophysical surveying (ground penetrating radar and electrical resistivity tomography) at three locations within Utqaiġvik: Cake Eater Road, TNHA Apartments and Barrow High School, and Samuel Simmonds Memorial Hospital. Mackenzie Nelson and Luis Felipe Rosado Murillo from UVA joined the team from CRREL (led by Stephanie Saari) in Utqiaġivik to conduct these surveys over a three-day period, but an extended stay was cut short due to a local surge in COVID cases. We also have a sensor base station with several satellite nodes being assembled in Utqiaġvik by a local collaborator (Lars Nelson, TRIBN, Inc.) and a high school student (Mikal Nelson) for possible deployment this winter. A subset of our team, led by Mirella Shaban and Rosado Murillo, is working on developing tools and scripts for data storage, processing, and analysis, using the test data collected at UVA, so that these are ready to go once we begin deployment of the sensor network in Utqiaġvik.

Figure 4. Mikal Nelson erecting an environmental sensor station at the TRIBN office in Utqiaġvik. Photo courtesy of Lars Nelson.

Finally, other important aspects of the project on which we have been working are data management, governance, and accessibility (Rosado Murillo), and Caitlin Wylie is studying our project team as we co-produce information collaboratively among the various within-team entities (e.g., academic researchers, government researchers, and local officials, planners, consultants, and community members). We also continue to engage with local organizations and municipalities in Alaska and abroad through courses at UVA, lectures, and exhibitions—most recently as part of the 2021 International Architecture Biennale in Venice, Italy.

For more information, please feel free to contact the entire group (uvaarc@virginia.edu), Howard Epstein (hee2b@virginia.edu), or Matthew Jull (mj5kh@virginia.edu).

Diverse Collaborators Co-Produce Understanding of Arctic Change

By: Athena E. Copenhaver, Assistant Director of the Study of Environmental Arctic Change (SEARCH) ; Brendan P. Kelly, Director and Chief Scientist of SEARCH; and George W. Kling, Professor of Ecology and Evolutionary Biology at the University of Michigan

The National Science Foundation's Office of Polar Programs recently funded the University of Alaska Fairbanks and six other institutions to synthesize what is known about the changing Arctic environment and its consequences.

Over the next five years, the Study of Environmental Arctic Change (https://searcharcticscience.org/our-work/), known as SEARCH, will bring together scientific, Indigenous, and decision-making experts to more fully understand environmental change in the Arctic. They'll make the results available to decision-makers in local communities, multiple levels of government, and the private sector.

SEARCH will employ co-production, a method that has for decades been considered a more inclusive and equitable means of creating new knowledge, better understandings, and more meaningful sharing of that new knowledge.

"The Arctic is witnessing rapid and sudden changes," said Brendan Kelly, the project's chief scientist and a professor with the UAF International Arctic Research Center. "And understanding the impacts of those accelerating changes — on people, business and the Arctic ecosystem—requires the expertise of diverse disciplines and knowledge systems, as well as of those who use the understanding in decision making."

Partners include the Alaska Business Forum, ArcticNet in Canada, the Chukotka Branch of the North Eastern Federal University in Russia, the Fram Centre in Norway, and the Pacific Northwest Economic Region. SEARCH brings together experts from these organizations and others to create new knowledge and practices for advancing understanding of the rapidly changing Arctic.

SEARCH will form three co-production teams—each including scientific, Indigenous, and decision-making experts — dedicated to understanding the multifaceted nature of changes in the Arctic. One team will focus on the processes and ecological consequences of Arctic change. Another will be committed to understanding human well-being in the changing Arctic. The third will illustrate the consequences of environmental change

for geopolitical and economic stability in the region. The combined findings will be shared in plain language and in technical publications.

The project was conceived and designed by the International Arctic Research Center, the Alaska Native Tribal Health Consortium, the Eskimo Walrus Commission, the National Center for Atmospheric Research, Oregon State University, Stantec Inc., the University of Michigan, and the Wilson Center's Polar Institute. It will build a novel synthesis spanning multiple knowledge systems and disciplines based on the extensive knowledge of scientific and Indigenous experts.

"This is a truly collaborative effort; we have been involved in every step," noted Vera Kingeekuk Metcalf, Executive Director of the Eskimo Walrus Commission in Nome and a co-leader on the project.

Renee Crain, Arctic Sciences Research Support and Logistics Manager at the National Science Foundation, expects the project to address pressing issues in the Arctic. "This collaboration addresses equity and evidence-based decision making, recognizing the value of different knowledge systems that are integral to the resilience of people and communities in the Arctic," Crain said.

For more information, please contact Athena Copenhaver, SEARCH Assistant Director, aecopenhaver@alaska.edu.

About the Authors

Athena E. Copenhaver serves as Assistant Director of SEARCH. She is also a writer, editor, science communicator, and climate interpreter. She's worked in the environmental and nonprofit sectors for nearly a decade and specializes in managing scientific research, operations, and strategic communications. She holds degrees in English and environmental studies from Santa Clara University, and in 2009, she earned her master of art degree in culture and modernity from the University of East Anglia in England. Athena's award-winning debut novel will be published in early 2022.

Brendan P. Kelly is the Director and Chief Scientist of the Study of Environmental Arctic Change. He is a Professor of Marine Biology with the University of Alaska Fairbanks' International Arctic Research Center and a Senior Fellow with the Middlebury Institute of International Studies at Monterey. A marine ecologist with a focus on sea ice environments, Dr. Kelly has participated in and led collaborative research in the North Pacific Ocean, the Arctic Ocean, the Sea of Okhotsk, the Baltic

Sea, and Antarctica. Previously, he served as Deputy Director of the Arctic Division at the US National Science Foundation, Assistant Director for Polar Science in the White House Office of Science and Technology Policy, Executive Director of the Interagency Arctic Research Policy Committee, Chief Scientist at the Monterey Bay Aquarium, and as a science adviser to Indigenous organizations in Alaska. Dr. Kelly received degrees in Biology from the University of California Santa Cruz (BA), the University of Alaska Fairbanks (MS), and Purdue University (PhD). Outside of research, Dr. Kelly enjoys sailing, hiking, and serving in a fire lookout in the Los Padres National Forest.

George W. Kling is a Professor of Ecology and Evolutionary Biology at the University of Michigan, and he is currently the chief editor of publication and outreach products for SEARCH including the "Arctic Answers" science briefs. Since the mid-1980s he has studied ecosystem ecology in relation to environmental problems from the Arctic to the tropics. Dr. Kling has specialized in communication with policy makers and the public on topics ranging from climate change to scientific integrity to natural disasters, and he was the lead author of the Union of Concerned Scientists–Ecological Society of America publication 'Confronting Climate Change in the Great Lakes Region'. Dr. Kling received degrees from the University of Colorado (B.A.) and Duke University (PhD).

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SIPN2 News

By: Betsy Turner-Bogren, Project Manager, Arctic Research Consortium of the US

The Sea Ice Prediction Network–Phase 2 (SIPN2) is a network of US and international members working to advance research on the processes driving sea-ice predictability, prediction products, and the communication of findings to interested stakeholders. SIPN2 is funded by NSF-Arctic Sciences Section and the UK Natural Environment Research Council (NERC), with several collaborators and partners.

The Sea Ice Outlook (SIO) provides an open process for those interested in Arctic sea ice to share ideas and predictions for Arctic ice extent, sea-ice probability, ice-free date, and other variables. In 2021, the SIO monthly reports produced in June, July, August, and September contained a variety of perspectives on Arctic sea ice—from observations of current conditions, to advanced numerical models, to qualitative perspectives from citizen scientists.

In response to discussion during the 2021 SIO Contributors Forum (https://www.arcus.org/sipn/meetings/2021/contributors-workshop), three new items were added to 2021 SIO solicitations, including contributions of pan-Arctic sea-ice extent anomalies, which was motivated by the large spread in SIO predictions of mean September sea-ice extent; contributions to a new SIO monthly report for September (based on May, June, July, and August data); and contributions of sea-ice advance dates to the August report.

The SIPN2 Project Team hosted two webinars during the 2021 SIO season:

- Mitch Bushuk presented "Prospects for Improved Regional Predictions of Arctic Sea Ice" (https://www.arcus.org/sipn/meetings/webinars/july-2021) on 13 July, providing an overview of a newly developed dynamical seasonal prediction system and its performance in predicting regional Arctic sea-ice conditions.
- SIPN2 Project Team members provided a Post-Season Review and Discussion of the 2021 Sea Ice Outlook (SIO) on 11 October. This event included an overview of observed conditions during the 2021 Arctic sea-ice retreat season, a summary of skill of 2021 SIO extent and sea-ice probability forecasts, and an overview of lessons learned. Open discussion followed each of the three presentations. An archive of the presentation slides and a recording of the event is available on the webinar webpage (https://www.arcus.org/sipn/meetings/webinars/october-2021).

More information can be found on the Sea Ice Outlook webpages (https://www.arcus.org/sipn/sea-ice-outlook).

For questions, please contact Betsy Turner-Bogren, ARCUS (betsy@arcus.org).

About the Author

Betsy Turner-Bogren is a Project Manager at ARCUS who provides staff support to the SIPN2 project and its team members. She also manages the NSF-supported publications, *Witness the Arctic* and *Witness Community Highlights*.

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Tracking the Spatiotemporal Dynamics of the COVID-19 Pandemic in the Arctic

By Andrey N. Petrov, ARCTICenter, University of Northern Iowa

Since the beginning of the pandemic and as of 9 November 2021, 896,232 Arctic residents were infected with COVID-19 and 18,628 died.

The Tracking the Spatiotemporal Dynamics of the COVID-19 Pandemic in the Arctic Project (COVITA) is funded by the National Science Foundation Arctic Social Sciences Program. (See: NSF RAPID Award Abstract # 2034886 (https://www.nsf.gov/awardsearch/showAward?AWD_ID=2034886&HistoricalAwards=false)) The project, also known as Arctic COVID-19 (https://arcticcovid.uni.edu/) has developed and deployed a real-time web-based COVID-19 data hub (https://univnortherniowa.maps.arcgis.com/apps/opsdashboard/index.html#/b790e8f4d97d4414b10c03d5139ea5d5) managed by an interdisciplinary team of experts in data science, geoinformatics, epidemiology, and geography. The team is collecting, analyzing, and disseminating data on the spatial and temporal dynamics of the COVID-19 infections and deaths in the Arctic from day-one of the pandemic, as well as vaccination in Arctic regions. Both unique datasets and analyses of spatiotemporal trends at the subregional level are made available to stakeholders, including Arctic residents, researchers, and policy makers (arcticcovid.uni.edu, Petrov et al., 2020, 2021a). Pandemic data are contextualized through the collection of first-person accounts of the COVID-19 experience in Arctic communities. The team is also developing geovisualization tools and analyzing datasets to address urgent questions related to the spread and geography of COVID-19 in the Arctic, assessing containment and mitigation policies and evaluating whether case fatality rates are affected by environmental, socioeconomic, and/or geographic variables. Long-term curation of Arctic COVID-19 data and data products will ensure availability for future analysis, historical study, and policy consideration.

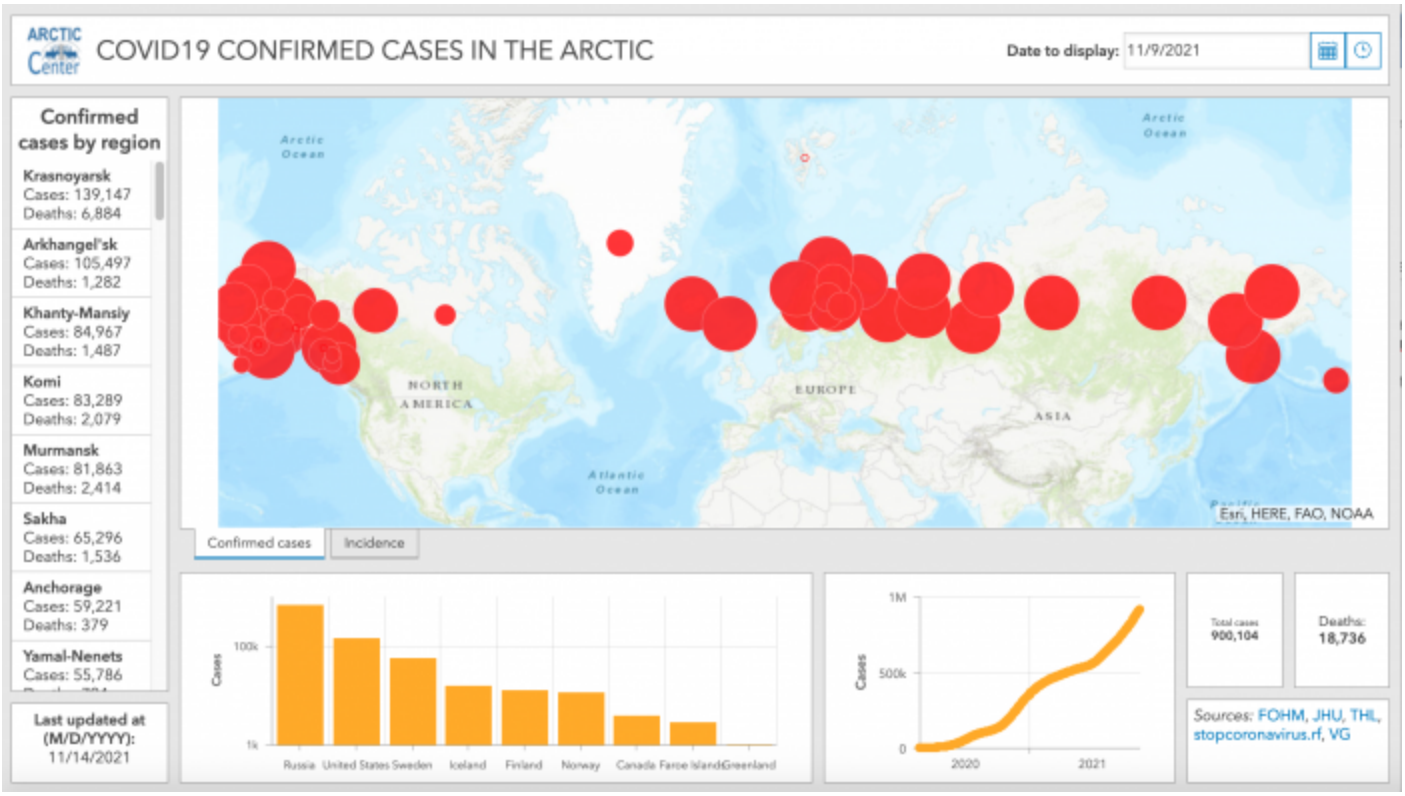

Figure 1. Screenshot of confirmed cases by region, as of 9 November 2021, on the Arctic COVID-19 Tracker website. Image courtesy of the ARCTIC Center.

The research team builds on their expertise in collection and analysis of diverse, multilingual datasets relevant to the incidence and spread of COVID-19 in the Arctic. Georeferenced quantitative data from North America, Scandinavia, and Russia are being collected from publicly available databases; variables will include basic demographic data, and rates of testing, morbidity, and mortality. Qualitative data on pandemic response, quarantine measures, mitigation efforts, and official announcements are being geotagged and catalogued for theme- and location-based searches. Multilingual narrative accounts of the experience of COVID-19 in Arctic communities will be collected virtually and, with informed consent, made available on the project's data hub.

In a recently published Nature Medicine article (https://www.nature.com/articles/s41591-021-01473-9) (Petrov et al., 2021b), the COVITA researchers examined COVID-19's impact on Indigenous populations in the Arctic and how it could be crucial to addressing the pandemic both today and in future epidemics. The study identified how the unique factors of the Arctic both aided and hindered the region's response to the first two major waves of the pandemic, which in many cases was more successful than in less remote areas in the same countries. However, regions that relaxed restrictions prematurely while remaining largely unprepared to tackle a possible surge and low vaccination rates (such as parts of Alaska and northern Russia) experienced a dramatic COVID-19 wave in the fall 2021.

The study finds that lessons learned in the Arctic may provide important resiliency tools against the spread of COVID-19 among vulnerable populations in other parts of the world, particularly in remote or Indigenous

communities. We also conclude that places in which Indigenous knowledge and traditions were combined with effective public-health interventions may have had an advantage in fighting the pandemic.

Community testimonies demonstrate that although many Indigenous Arctic residents suffered from COVID-19, traditional subsistence practices and Indigenous knowledge provided strong emotional, mental, spiritual, and physical support throughout the pandemic. Places of traditional subsistence, such as tundra, rivers, lakes, and forests became zones of safety where Indigenous people were able to continue living without worries about getting infected, as well as avoiding hunger due to the store closures in the settlements.

In terms of cultural sustainability, the disproportionate impact of COVID-19 on elders, who have a special role in Indigenous societies, may also lead to the loss of tradition and language. At the same time, Indigenous Arctic residents possess unique sources of resilience embedded in Indigenous knowledge, according to the study. Generations-long disease-fighting experience and memory of previous pandemics, such as the 1918 influenza pandemic, have become relevant today, when bridging Indigenous and western scientific knowledge is viewed as a source of solutions for the COVID-19 crisis.

The study also found the remoteness of the region, coupled with strong isolation measures, allowed some communities with high socioeconomic and health vulnerabilities to weather the early stages of the pandemic and to be more prepared for the arrival of COVID-19. At the early stages of the pandemic, the Indigenous communities were able to battle the pandemic effectively with robust public health policies, such as rapid vaccinations, strong mandates for masking, medical isolation of those testing positive, tracing of cases, and curfews affecting social gatherings. However, the wave of infections during the second half of 2020 and in fall of 2021 exposed the "curse" of remoteness, with an explosive growth of SARS-CoV-2 in places with weak or too-quickly-relaxed measures.

More information on COVID-19 in the Arctic can be found at the Arctic COVID-19 project website (https://arcticcovid.uni.edu/).

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About the Author

Andrey N. Petrov (https://sites.uni.edu/apetrov/research.html) is ARCTICenter Director and Associate Professor of Geography at the University of Northern Iowa. Dr. Petrov is an economic and social geographer who specializes in Arctic economy, regional development and post-Soviet society, with an emphasis on the Indigenous Peoples and local communities in Russia and other circumpolar countries. His current research is focused on regions of the Arctic and concerns regional development, spatial organization, and restructuring of peripheral economies, human wellbeing, dynamics of social-ecological systems and sustainable development. He has published on issues pertaining to socio-economic change, development, and demographic dynamics of Indigenous and non-Indigenous populations, relationships between communities and extractive industry, sustainability science and sustainable development in the Arctic. Dr. Petrov is the President of the International Arctic Social Sciences Association (IASSA) (https://iassa.org/).

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New Community Engagement and Outreach Coordinator Joins the Arctic Data Center Team

By: Natasha Haycock-Chavez, Community Engagement and Outreach Coordinator, Arctic Data Center

My name is Natasha Haycock-Chavez, and I am the new Community Engagement and Outreach Coordinator at the Arctic Data Center (https://arcticdata.io/). An integral part of our mission at the Center is to engage with the National Science Foundation (NSF) Arctic research communities. As Community Engagement and Outreach Coordinator, I will practice meaningful engagement with NSF-funded and other Arctic researchers, external research organizations and networks, students and educators, and will also strive to enhance connections with Arctic communities to promote usage of the open-access data repository.

Figure 1. Natasha Haycock-Chavez, Community Engagement and Outreach Coordinator, Arctic Data Center. Photo courtesy of Natasha Haycock-Chavez.

I received an MA in Geography from Memorial University in Newfoundland, where I specialized in Indigenous-led conservation. My master's research took place in Sanikiluaq, Nunavut, Canada, where I worked with the Inuit community of Sanikiluaq, as they planned and developed a protected area, known as Qikiqtait Protected Area. Qikiqtait Protected Area is based on a collaborative community-planning framework led by Sanikiluaq.

Lessons from Community-led Conservation in Nunavut

Sanikiluaq, Nunavut, is a community of about 900 people located in the Belcher Islands in the eastern heart of Hudson Bay. Sanikiluarmuit (residents of Sanikiluaq) pride themselves on being environmental stewards of the region, and formally designating the Belcher Islands as a federally recognized protected area is an achievement they have been working towards for decades.

I was invited to be a part of this project to produce a background report that identified research gaps that could be integrated into the protected area planning (such as species monitoring), as well as conduct a spatial analysis of the study area. The purpose of this analysis was to examine how an Indigenous, community-driven approach to protected area planning differs from the model more typically used by conservation and government agencies in Canada. Specifically, my research compared potential conservation plans of the Belcher Islands from World Wildlife Fund (WWF) Canada and spatially compared them with Sanikiluaq's spatial conservation plan. The analysis concluded that the biggest difference was spatial scales used by each party, and that if WWF's solutions were used alone, there was a potential to miss crucial areas for nonmigratory species.

Lessons from this research point to the importance of community leadership and participation in conservation work and research. Furthermore, bottom-up approaches to conservation projects tend to have greater success than top-down approaches because community engagement and support is crucial to a protected area's success.

Moving Forward

I plan to leverage this experience in community engagement for the benefit of the Arctic Data Center and the community supported by our tools, services, and infrastructure. Part of my research emphasized how Indigenous research methodologies and self-determination can be integrated into conservation planning, as well Arctic research in general. I am excited to integrate some of these lessons into this role, in addition to my focus on researchers across a broad diversity of disciplines.

More information is found on the Arctic Data Center website (https://arcticdata.io/).

Highlights from ARCUS' Community and Citizen Science in the Far North Conference

By: Audrey Taylor, University of Alaska Anchorage and ARCUS Board Member

ARCUS hosted the first ever conference on the topic of community and citizen science in the Arctic and Far North on 5—7 October 2021. The Community and Citizen Science in the Far North (CCSFarNorth) (https://www.arcus.org/meetings/2021/arctic-ccs) conference was held entirely virtually, and was focused on discussing the myriad aspects of conducting community and citizen science research in the circumpolar north. The conference was conceived in response to the need to recognize, connect, and support a growing community of researchers, communities, and visitors that are interested in engaging in community and citizen science in some way. Although many resources regarding community and citizen science exist, they are not specific to the Arctic or Far North, hence the primary goal of the conference was to provide an opportunity to share knowledge and increase networking among researchers, community members, and other practitioners of community and citizen science in the circumpolar north.

Conference participants hailed from all corners of the circumpolar north, with over 19 countries represented and more than 280 registered participants. More than 40 inspiring presentations were given by a diverse mix of researchers, practitioners, community members, and Arctic adventurers across the three days of the conference. Each day opened with a land acknowledgement followed by a keynote presentation, a series of 15-minute talks, three-minute "lightning" talks, panel discussions, and a number of pre-recorded presentations hosted on YouTube. Presentations focused on a variety of subjects, from research and monitoring projects engaging Indigenous observers, to Arctic expedition reports, discussions of data management techniques and different platforms for collecting citizen science data, and reflections on how to improve relationships between researchers and the Arctic communities they hope to engage.

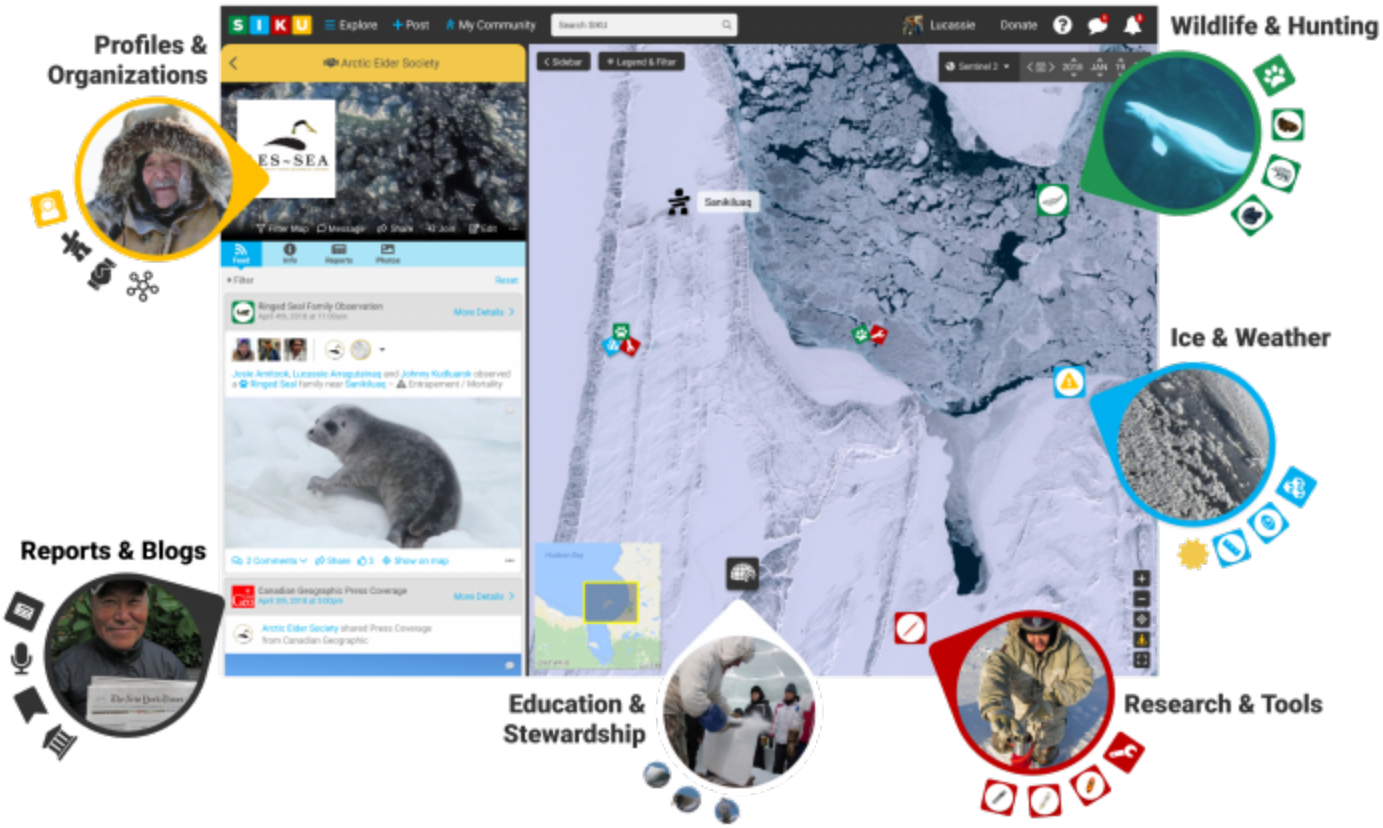

Figure 1. SIKU online platform showing left side timeline and right side map windows with various features of the platform lighted. From Day keynote talk by Joel Heath of the Arctic Eider Society. Image courtesy of SIKU.

For further information about the SIKU network, see their website (https://siku.org/).

Presentations were organized into four specific sessions: "Unique to the Far North," "Just Sharing," "All About the Data," and "Lessons Learned;" sessions were intentionally kept broad to encourage interdisciplinary participation and facilitate the sharing of experiences across projects and topics. Although the subject matter of the talks varied widely, almost all presenters emphasized increasing awareness of the need to be respectful of the time and constraints of people living and working in the Arctic, and the growing desire of communities to be equal partners in the development and implementation of community and citizen science projects in their region. The conference was made light-hearted by the inclusion of themed music during session breaks, door prizes, and many enthusiastic moderators and speakers. The positive energy around the overall topic was palpable, and post-presentation question and answer sessions spurred interesting and engaging discussions.

Figure 2. Screenshot from the Day 2 keynote talk by Kaare Sikuaq Erickson, Ikaagun Engagement, addressing important questions regarding why and how to involve Arctic communities in community and citizen science research. Image courtesy of the Community and Citizen Science in the Far North conference.

For further information about the Ikaagun Engagement, see their website (https://www.ikaagun.com/).

Feedback from the post-conference survey indicated that conference organizers were successful with the goals of sharing and networking. As one participant said, "It was fascinating to learn about so many projects occurring circumpolarly, which are co-creations with local people incorporating their knowledge and having relevance!"

Currently, conference organizers are planning a follow-up webinar on 30 November 2021 for anyone interested in continuing the discussions and networking activities that were begun at the conference. The webinar is open to anyone with interest (not just conference attendees), and details can be found on the event webpage (https://www.arcus.org/meetings/2021/arctic-ccs-webinar). A post-conference summary report is also planned, which will contribute to the shared knowledge base, long-term goals, and available resources of the growing community of practice related to community and citizen science in the Arctic and Far North.

The conference could be found on social media using #CCSFarNorth at @ArcticResearch on Twitter and Facebook, and more information plus links to the conference agenda and archived presentations can be found on the conference webpage (https://www.arcus.org/meetings/2021/arctic-ccs).

About the Author

Audrey Taylor is an Associate Professor in the Department of Geography and Environmental Studies, University of Alaska Anchorage. Audrey earned her PhD in Wildlife Biology from University of Alaska Fairbanks and has conducted field-based research across the US, Central and South America, and China. Her current research focuses on Arctic-breeding shorebird populations with particular focus on the impacts of climate change and industrial development along Alaska's coastlines.

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Northern Farmers and UAF Researchers Team up to Sustainably Manage Permafrost-Agroecosystems

By: Melissa K. Ward Jones, University of Alaska Fairbanks (UAF); Benjamin M. Jones, UAF, Glenna Gannon, UAF; Tobias Schwoerer, UAF; Mikhail Kanevskiy, UAF; Jill Russell, Boreal Peonies; Dave Russell, Boreal Peonies; and Iris Sutton, Ice Wedge Art and Farm

We acknowledge our research takes place on the traditional homelands of the Lower Tanana Dene, Chena Athabascan, Inupiaq, Yup'ik, and Sakha (Yakut) peoples.

Polar Peonies, LLC, located in Fairbanks, was the first commercial peony farm in Alaska. The field was cleared in 2001 and peonies were planted in 2002. The owners took pride in cultivating on permafrost-affected soils, however, starting around 2014, the land surface began to dip, and sinkholes began to appear, causing some peony plants to die. Now, the peonies have been moved to a new field and the original was abandoned in 2019 (Figure 1). What happened at Polar Peonies' farm is an example of permafrost degradation that can happen in agricultural fields containing ice-rich permafrost (Figures 1–3). These agricultural fields can experience topographic changes and land surface subsidence (Figure 3, bottom) as a result of permafrost thaw that occurs after land clearing removes the protective vegetation layer. Widespread, near-surface permafrost degradation has been observed in recent decades (e.g., Nitze et al., 2018), driving cascading biophysical changes that affect Arctic ecosystems, communities, and economies, including agriculture (Desyatkin et al., 2021). Like Polar Peonies, permafrost degradation causing land surface subsidence from melting ground ice (Figure 3, bottom) can drive farmers to abandon their fields (Rockie 1942; Pewe 1954).

Figure 1. Image taken in September 2021 of the abandoned Polar Peonies, LLC, field. Photo courtesy of Melissa Ward Jones.

Figure 2. Examples of ground ice exposures taken at the CRREL Permafrost Tunnel in Fox, just outside of Fairbanks, Alaska. Photos courtesy of Benjamin Jones.

The history of farming in permafrost regions of the Circumpolar North varies. For thousands of years, 20 different Indigenous Arctic peoples from Eurasia have herded semi-domesticated reindeer over vast distances (Magga et al., 2009). The Tlingit and Haida people cultivated potatoes as far north as southeast Alaska (Zhang et al., 2009). Within Europe and Siberia, conventional farming began in the 1600s (Poeplau et al., 2019; Desyatkin et al., 2021). By contrast, in North America, farming activities increased in the late 1800s through the northern influx of trappers, traders (Robinson 2010), and later by miners during the Gold Rush era (Miller 1951). In response to the population boom in Alaska, US Agriculture Agent, Charles C. Georgeson was tasked by Congress in 1898 to determine if Alaska had any agriculture and horticulture development potential. Tackling every challenge with optimism and enthusiasm, Georgeson was unperturbed by skeptics, including miners who, "looked on me and my mission with pity and derision" at his desire to grow strawberries in Sitka. He succeeded at developing a hybrid variety in seven years that was later planted around the state, including Fairbanks (Figure 3 top; UAF AFES, 1998, p. 26). Georgeson was a forward-thinker who established experimental stations and an agricultural research program in Alaska that continues today.

Figure 3. Top image, taken some time between 1905 and 1918, shows John Scharle's Strawberry Ranch in Fairbanks. Bottom image, taken in 1939 at the Experimental Farm in Fairbanks, now part of the University of Alaska Fairbanks, shows land surface subsidence from ground ice melt in the field, which was originally level in 1932. Photos (UAF-1989-166-552 and UAF-1968-4-1346) are courtesy of the Alaska and Polar Region Collections and Archives at the University of Alaska Fairbanks.

Since the research efforts of Georgeson, northern high latitude areas are expected to become the next agricultural frontier due to climate warming that is driving an increase in summer air temperatures and growing season length (Figure 4). Hannah et al. (2020) predict that boreal regions of the Northern Hemisphere and mountainous areas will see the greatest increases in suitable land area for growing globally important crops resulting from climate-driven warming under both RCP 4.5 and RCP 8.5 scenarios by 2060–2080. Most predicted areas within the new agriculture frontier also contain permafrost, and we define

these systems as permafrost-agroecosystems. Already, in the US, the number of new farms and farmers coming to Alaska has been increasing since 1992 (Figure 5) and while new farms in Alaska increased by 30% between 2012 and 2017, there was a 3.2% decline during the same period in the contiguous US (USDA, NASS, 2019). For the ongoing agricultural expansion to be successful and solution-oriented, its development needs to account for variability in permafrost conditions, the complexity of existing social-ecological systems in the Arctic, and needs to include Arctic resident farmers in research efforts.

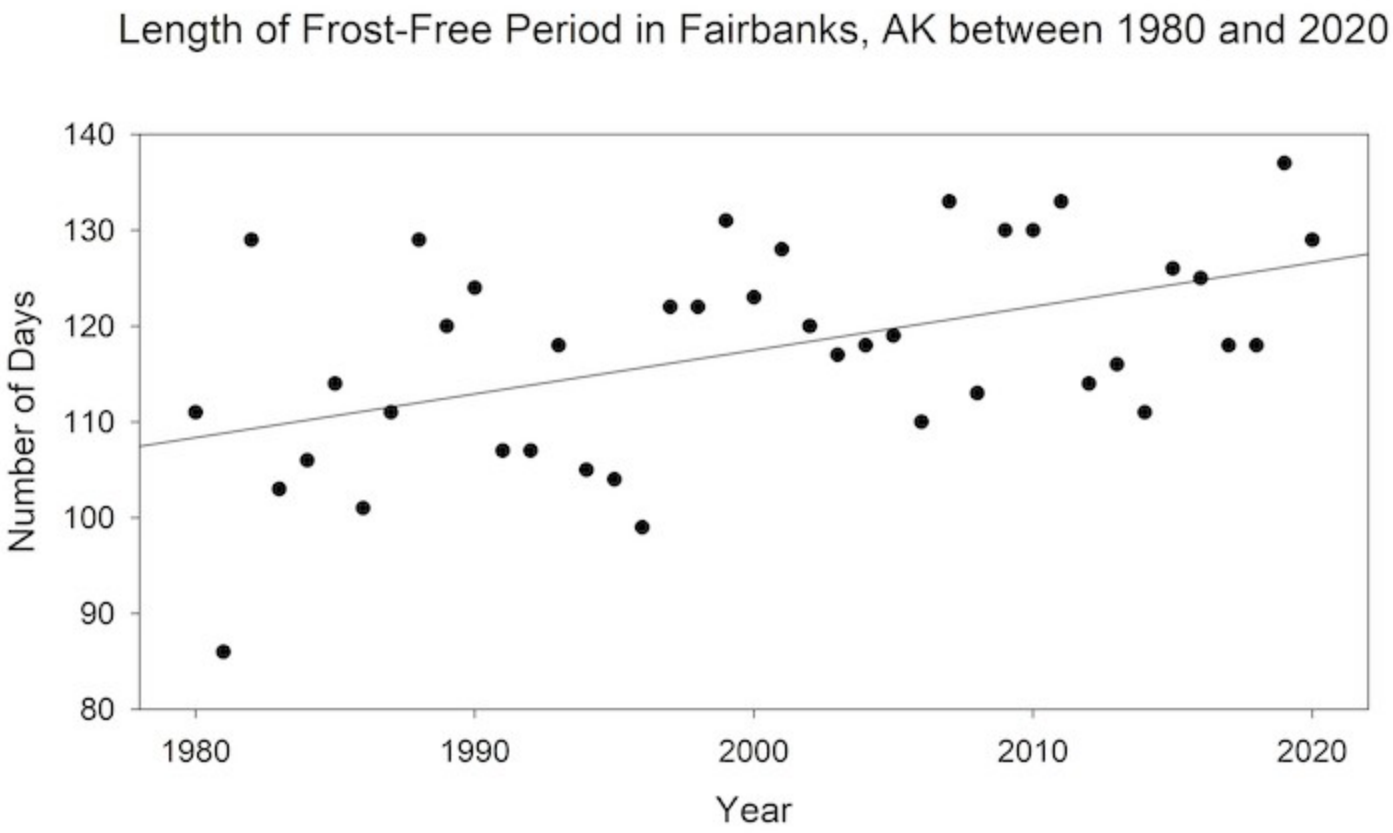

Figure 4. Length of frost-free period in Fairbanks, Alaska. Frost-free period is considered the number of days in a continuous, unbroken period where all daily minimum temperatures are above 0 °C. The frost-free period has increased by 18% between 1980 and 2020. Image courtesy of Melissa Ward Jones.

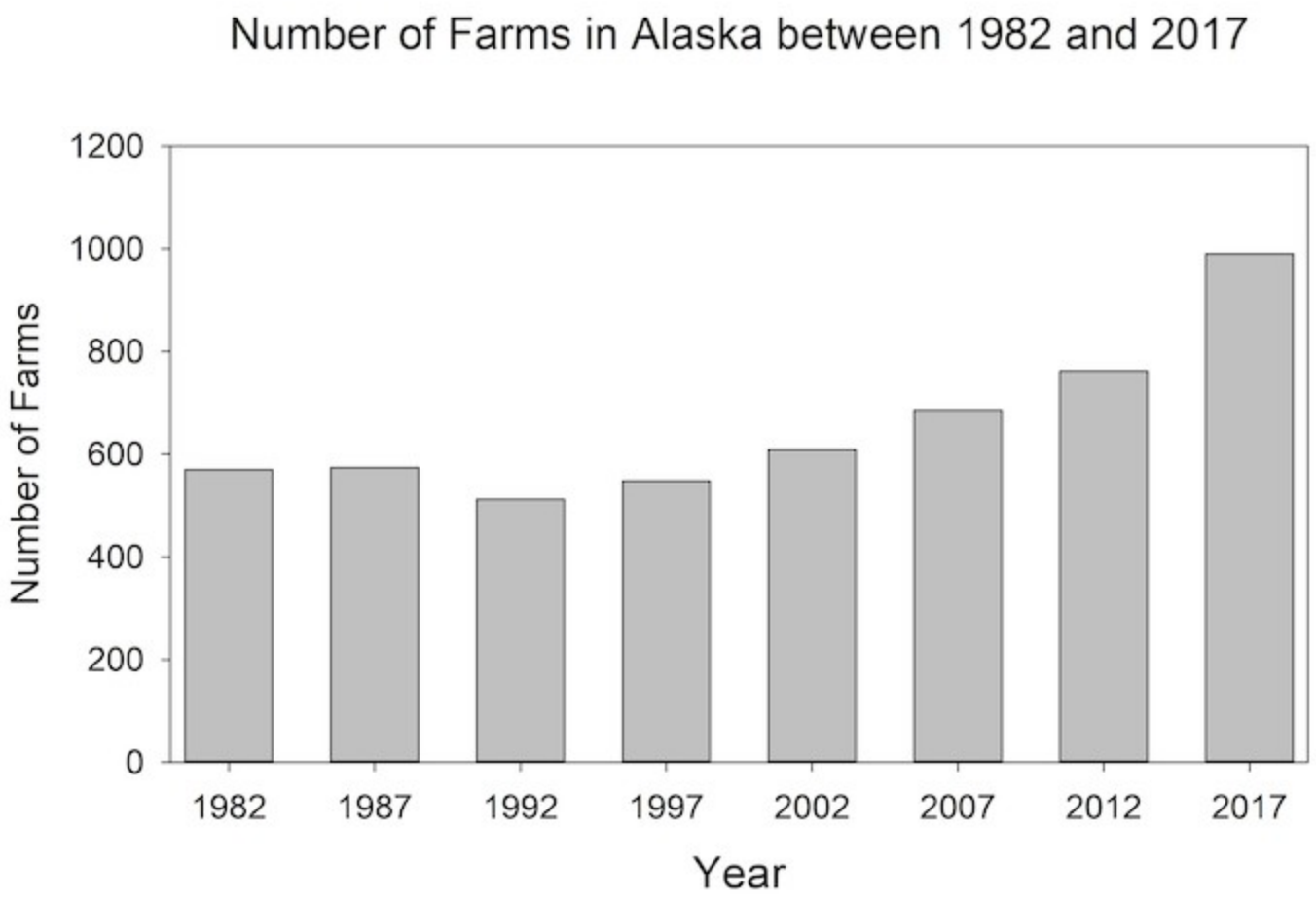

Figure 5. Number of farms in Alaska. After a slight decrease in the 1980s, the number of farms has been increasing since the 1992 agricultural census. Figure courtesy of Melissa Ward Jones.

Note: Data in Figure 5 is accessed at the USDA National Agriculture Statistics Service (https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Census_by_State/Alaska/index.php).

Our new project, Permafrost Grown, is a five-year, $3 million transdisciplinary project funded by the National Science Foundation's Navigating the New Arctic program and is studying the interactions and feedbacks within permafrost-agroecosystems by co-producing knowledge with Alaskan and Siberian farmers. To better understand permafrost-agroecosystems, Permafrost Grown is using a combination of a sensor-based observational data network; characterizing permafrost using boreholes and geophysics; testing permafrost mitigation strategies using on-farm agricultural experiments; using dendrogeomorphology to time permafrost thaw using leaning trees; and using unmanned arial vehicle (UAV) based remote sensing to monitor plant health throughout the growing season (Figure 6), as well as to monitor ground surface subsidence and snow depth. We are focusing on in-the-ground farming to directly assess the interactions and feedbacks within permafrost-agroecosystems and are planning to study several farm sites in the Tanana Valley near Fairbanks, Alaska and one in Bethel, Alaska that either grow vegetables, peonies, and/or raise livestock (Figure 7). Moreover, we are interested in the legacy impacts of land cleared 100 to 300 years ago that was initially used for agriculture but has since been either abandoned or converted to a different land use

with sites, including a golf course, a satellite downlink facility, and a migratory waterfowl refuge. Furthermore, we are collaborating with the Melnikov Permafrost Institute based in Yakutsk, Russia, to conduct a knowledge exchange with Siberian farmers and researchers.

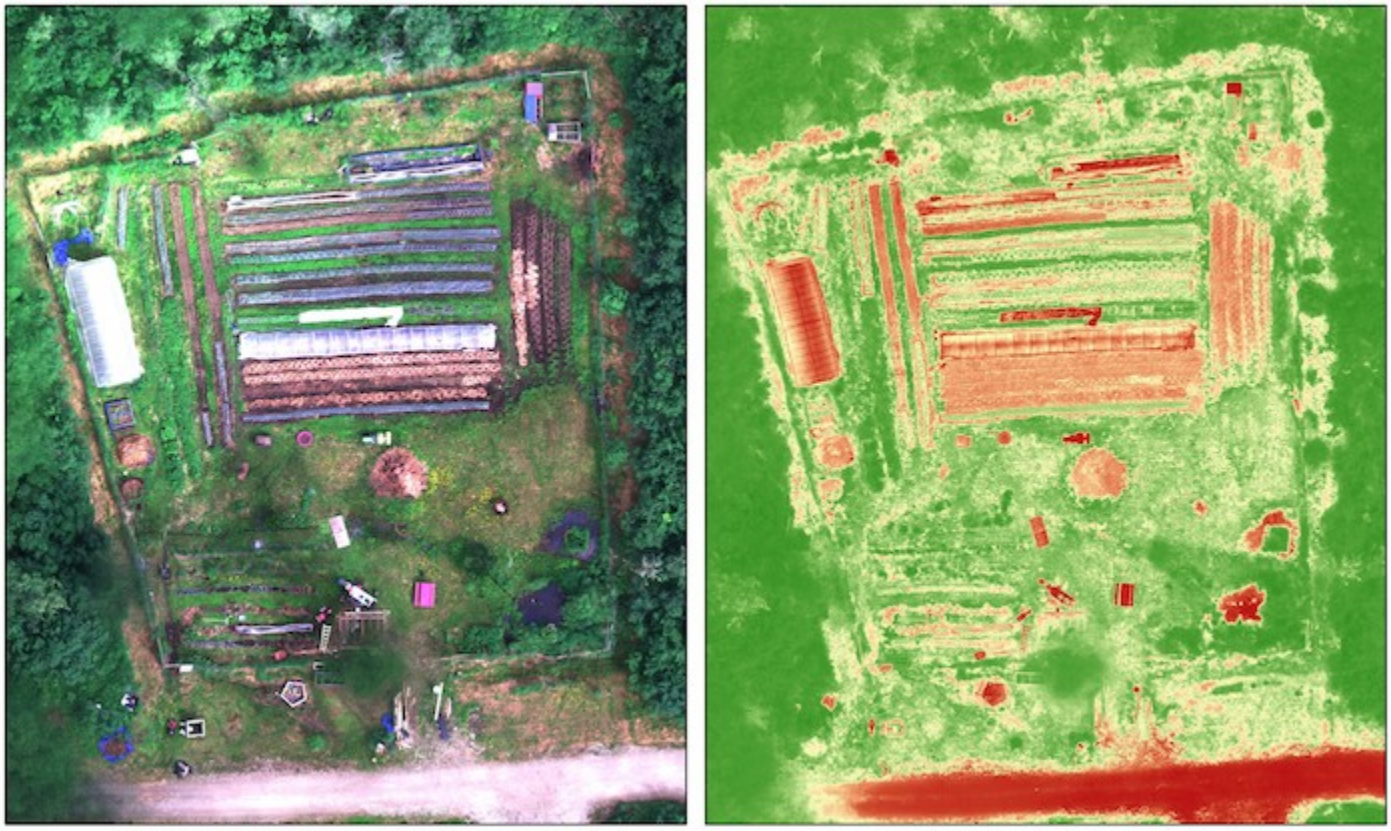

Figure 6. Images using an unmanned arial vehicle (UAV) of a farm with permafrost soils in the Fairbanks, Alaska. The image on the left is a visible image composite and the image on the right is a normalized vegetation index image that denotes green as healthy vegetation, yellow as less productive vegetation and red for either dead vegetation or non-vegetation land cover. Conducting these surveys throughout the growing season will allow us to identify areas with less productive vegetation that can be further investigated for permafrost conditions. Images courtesy of Melissa Ward Jones.

Figure 7. Three examples of Permafrost Grown project study sites. Sites are focused on in-the-ground farming and include vegetables, peonies, and livestock. Photos are all taken at different farm sites within the Fairbanks area. Left image shows Principal Investigator (PI) Melissa Ward Jones holding a cooler filled with recently harvested Kohlrabi; middle image shows her two-year old daughter, Lillian, holding a bloomed peony flower;

and right image shows co-PI Glenna Gannon with a dairy cow. Photo on left courtesy of Benjamin Jones, middle photos courtesy of Jill Russell, and photo on right courtesy of Melissa Ward Jones.

Permafrost Grown will also evaluate the socioeconomic trade-offs of intensifying permafrost-agroecosystems that will contribute to the development of decision-making tools for farmers through planned outputs including best practice guides, and guides with mitigation strategies for agriculture activities in permafrost-affected soils. Planned outreach and educational activities will engage both farmers and the public to raise awareness of permafrost-agroecosystems. These activities include annual workshops and "Permafrost Grown" days at the Fairbanks Farmer's Market, new interpretative signage in Fairbanks, as well as establishing the first UAF Toolik Field Station Community Garden and supporting the Family Farmers Program in Anaktuvuk Pass created and run by Gardens in the Arctic.

An improved understanding of the permafrost-agroecosystem as a coupled social-ecological system will help guide sustainable and adaptable cultivation and development practices. Moreover, understanding the impacts of permafrost-cultivation feedbacks on agricultural systems benefits high-latitude communities by improving food security and economic resiliency.

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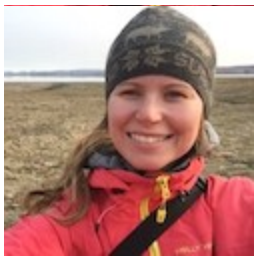
About the Authors



Melissa K. Ward Jones (UAF) – Melissa Ward Jones is a permafrost geomorphologist and a Postdoctoral Fellow in the Institute of Northern Engineering at the University of Alaska Fairbanks and is leading the Permafrost Grown project. She is interested in the causes, consequences, and significance of geomorphic change and applying her knowledge of permafrost to sustainability issues. She has conducted fieldwork on Axel Heiberg and Ellesmere Islands, Canada, Svalbard, Norway, and throughout Alaska, USA.

Benjamin M. Jones (UAF) – Benjamin M. Jones is a Research Professor in the Institute of Northern Engineering at the University of Alaska Fairbanks. His research focuses on Arctic and sub-Arctic systems and combines the use of GIS and remote sensing techniques with field observations and laboratory analyses to better understand the causes and consequences of landscape change, processes, and feedbacks in northern high-latitude environments across a multitude of spatial and temporal scales. For the Permafrost Grown project, he will work with farmers on environmental sensor observation network development and deployment, multi-season remote sensing with UAVs, and assessing landscape changes using historical remote sensing datasets.

Tobias Schwoerer (UAF) – Tobias Schwoerer is a Research Assistant Professor of Natural Resource Economics in the International Arctic Research Center. His work centers around the human dimensions of sustainability where he is most interested in actionable research that informs public policy and private decision making. For the Permafrost Grown Project, he will work with partner farmers to illuminate trade-offs related to permafrost mitigation and come up with co-produced decision support tools.

Mikhail Kanevskiy (UAF) – Mikhail Kanevskiy is a Research Assistant Professor in the Institute of Northern Engineering at the University of Alaska Fairbanks. He studies structure and properties of permafrost, permafrost-related geological hazards, and engineering and environmental problems in the areas of ice-rich permafrost. He has performed fieldwork in various parts of Siberia, Alaska, and northern Canada.

Glenna Gannon (UAF) - Glenna Gannon is a Research and Extension Assistant Professor of Sustainable Food Systems in the Institute of Agriculture, Natural Resources, and Extension. Her work focuses on the sustainable development of high-latitude food production and human dimensions of northern food systems. For the Permafrost Grown project, she will work with partner-producers to develop on-farm agricultural experiments aimed at answering permafrost-related questions and develop education and outreach materials based on research findings.

Jill and Dave Russell (Boreal Peonies) - Jill and Dave Russell are the owners of Boreal Peonies, a family run, 40-acre peonies farm established in 2012 in Two Rivers, Alaska. The farm serves both as a scientific research station that serves the Alaska Peonies Growers Association and the Alaska peonies industry, and sells large cut peonies flowers to florists and wholesalers worldwide. In the off season, Jill and Dave are Teaching Professors at Miami University in Oxford, Ohio.

Iris Sutton (Ice Wedge Art and Farm) - Iris Sutton is the owner of Ice Wedge Art and Farm, established in 2012 and is located in Fairbanks, AK. The farm grows vegetables, raises goats and chickens. Iris grew up both in rural and urban Alaska and enjoys the outdoors, an inspiration for her artwork that explores Alaska's unique wildlife and landscapes.

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From Svalbard to the Classroom—Adventures of a PolarTREC Alum

By: Mark Goldner, Science Teacher at Heath K-8 Elementary School in Brookline, Massachusetts

Growing up as a suburban kid near Boston, I never imagined spending a summer doing Arctic field research. But here I am, having been lucky enough to spend two summers with Dr. Julie Brigham-Grette (UMASS Amherst) studying the effects of climate change on the meltwater plumes of glacier systems in Kongsfjord, Svalbard at 79°N latitude.

My first research experience with Dr. Brigham-Grette was as a PolarTREC teacher in 2011. That summer, our group, co-led by Dr. Brigham-Grette and Dr. Ross Powell (NIU) and funded by the National Science Foundation, included a variety of oceanography measurements and sediment coring and collection methods.

In July 2021, our team included Dr. Brigham-Grette and two students—PhD candidate, Kelly Mckeon (Woods Hole/MIT) and undergraduate, Xander Kirshen (UMASS Amherst). Funded by the National Geographic Explorers Program, we spent three weeks collecting oceanography and bathymetry data, along with drone video to better understand the dynamics of the glacier meltwater system and to document the dramatic effects that climate change is having on these magnificent Svalbard glaciers. My participation was funded by grants from the Brookline Education Foundation and the National Education Association, and PolarTREC graciously allowed me to use their blogging platform and provided support for a live Zoom presentation while we were in the field.

By the end of the school year this past June, consumed with the seemingly impossible challenges that came with pandemic teaching, I was completely exhausted. With almost no break, we were off to the Arctic a few days later. We had a ten-day COVID quarantine in Oslo, Norway, then flew up to Longyearbyen in Svalbard, and finally traveled to Ny Ålesund, an international research station, which can hold up to around 150 scientists.

Figure 1. The research team (Kelly Mckeon, Julie Brigham-Grette, Xander Kirshen, Mark Goldner) in front of the Roald Amundsen statue in the cute little research station of Ny Ålesund. The team paid our respects to the stern-faced Amundsen every day! Photo courtesy of Mark Goldner.

Despite my exhaustion from the year, and as intense as the field work was, I came out of the experience totally rejuvenated! What a treat for me to be entirely immersed in science for almost a month—and under the tutelage of the amazing Dr. Brigham-Grette. I have learned so much from Julie over the past ten years, from her deep knowledge about glacial geology to her extensive field experiences.

While in the midst of the mundane process of data collection, I was reminded of how messy and unpredictable field work can be. Whether it was as serious as spending days trying to get the bathymetry setup working properly, as uncomfortable as dressing improperly for a long, cold, and rainy day out on the fjord, or as silly as being attacked by the local terns, nothing ever quite goes along as planned. Flexibility and patience are essential traits to bring to the work.

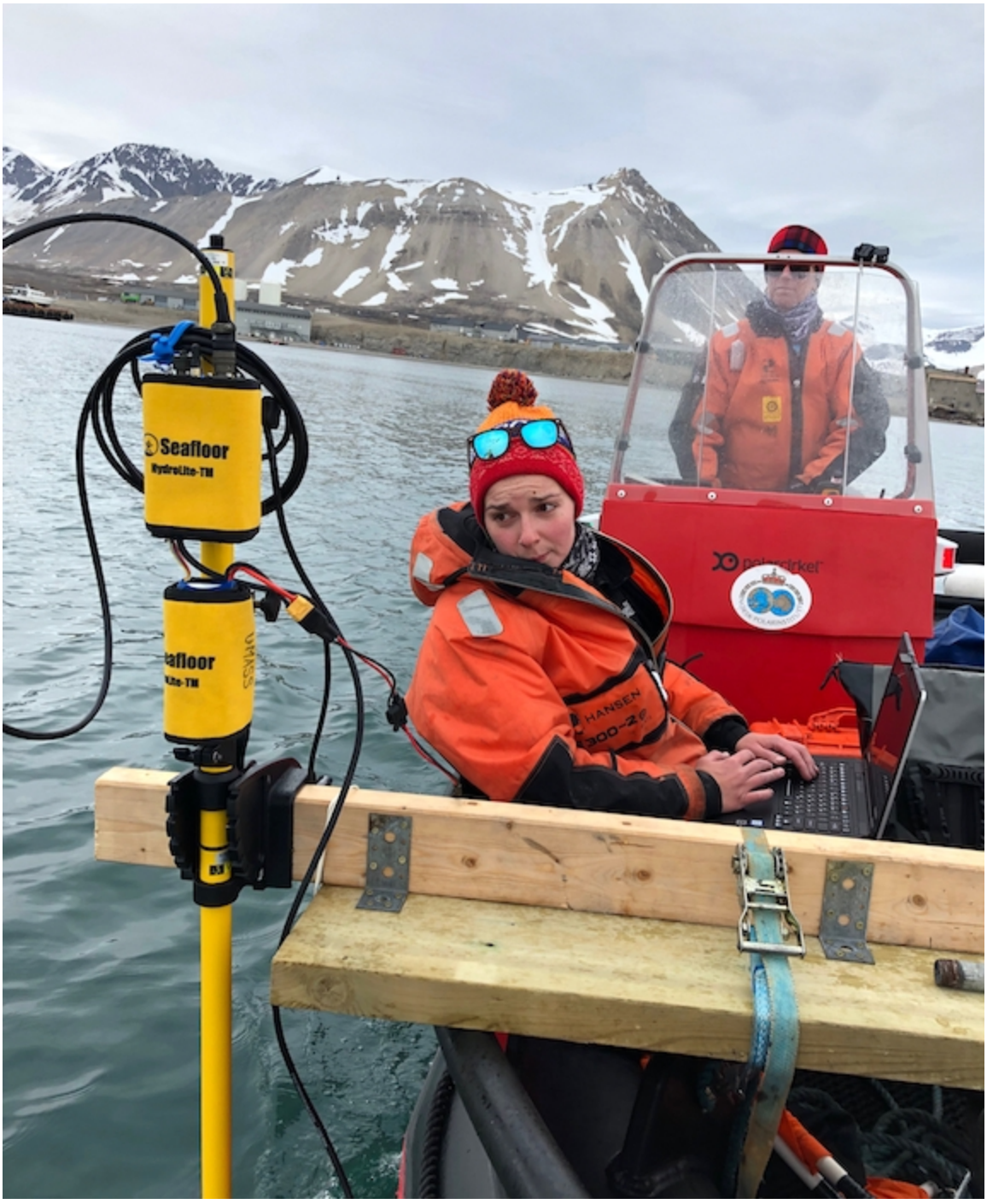

Figure 2. PhD student Kelly Mckeon troubleshooting our bathymetry equipment. Dr. Julie Brigham-Grette is driving the boat. Photo courtesy of Mark Goldner.

Dr. Brigham-Grette plans to compile the data we collected this summer and add it to the growing body of data she has amassed over the past two decades (having first studied this area in 1995), along with data collected by other researchers in the area. Studying the sub-glacial "plumbing system" is important to understanding how glaciers are responding, not just to a warming atmosphere, but to a warming ocean.

An important aspect of our work this summer was to collect drone video footage along and above the glacier face. Getting that close to the glacier helps us gain insight into how sediment plumes behave as they exit the glacier. In addition, having this footage provides dramatic visual imagery that can be used to share with the

general public as we communicate about the effects of the climate crisis.

Flying the drone was a wonderful (if at times, slightly hair-raising) experience as I was able to take what were essentially virtual tours of these amazing glaciers. It also gave me the opportunity to document features of recently de-glaciated areas, which I plan to use in my own teaching of the glacial history of New England.

Figure 3. Mark flying the drone above the Kongsbreen Glacier. A sediment plume is visible coming off the glacier. Photo courtesy of Mark Goldner.

Being able to do a research project like this is, for many teachers, an experience of a lifetime. But I was able to return and participate twice! One of the important aspects of my return was my first-hand witness to the devastating retreat of the glaciers. I was able to document the ten-year retreat of over 1.7km of the faces of the Kronebreen and Kongsvegen Glaciers as well as the thinning of these glaciers.

Figure 4. A view looking at Collethøgda Mountain. It's notable that the glacier face was at the tip of the peninsula visible in the right side of the image, and that that was almost 2km away from the current glacier face. Photo courtesy of Mark Goldner.

I have a responsibility to make topics like climate change and geology accessible to young people. My field experiences bring these topics alive for my students. Having had these field research experiences, my students see me not just as a science teacher, but as a bona fide scientist in my own right. I can talk confidently about the process of science. When I show them images of glacial retreat, they are from my own first-hand account (not just a picture found on a web image search) brought alive further by my own emotional response. I think this has enormous intangible results in terms of students' heightened enthusiasm for, and interest in, science.

Giving students a flavor of the actual field work is also important to me. Following my 2011 experience, every year I have my students do their own sediment coring at a local pond to see if we can detect any evidence of climate change. This year I will also bring in some of our recent CTD data as part of a data visualization exercise.

Figure 5. Mark's students coring sediment at a local pond. This is one of the ways that Mark has brought his Arctic research into his curriculum, which has increased interest and enthusiasm for science among his students. Photo courtesy of Mark Goldner.

Ideally, science instruction should be a hands-on, immersive experience. What better way to impart our enthusiasm for authentic instruction than to participate in hands-on immersive field experiences ourselves!

Figure 6. Our research team in front of the Kronebreen glacier in July 2021 (photo taken from drone). Photo courtesy of Mark Goldner.

For more information, see:

- Mark Goldner's PolarTREC blog from this summer's research field work (https://www.polartrec.com/expeditions/high-arctic-change-2021)
- Video clips of drone footage and other video clips from the summer field work (https://www.youtube.com/playlist?list=PL3dbSwL6VFzivGdldRyFx7osv2B-pgB9q)
- Sediment Coring Activities (https://docs.google.com/document/d/1AmvTxC7u1SuM14u3g3NJL0EnZWg6o4b04AWneiVdqMw/)

About the Author

Mark Goldner teaches 7th and 8th grade science at the Heath K-8 Elementary School in Brookline, Massachusetts, and he has been teaching middle and high school science for the past 29 years. He has led extensive professional development work for teachers around science and literacy, and is co-author of the book, "The Stories of Science." Mark has participated in multiple polar research experiences through PolarTREC, Alaska Geographic, the Canadian Wildlife Federation, and the ARMADA project.

Engaging Rural and Alaska Native Undergraduates and Youth in Arctic STEM: Workshop Outcomes

By: Janet Warburton, Project Manager, Arctic Research Consortium of the US

The Arctic is undergoing rapid and significant changes. These changes require communities to be aware, informed, and involved to be able to address complex environmental, economic, and social challenges with their associated Arctic science, technology, engineering, and mathematics (STEM) needs. These challenges require a diverse workforce with different backgrounds, perspectives, and knowledge to develop responses to new and emerging issues. In particular, there is a greater need for better representation of rural and Alaska Native undergraduate students in STEM programs to ensure a more diverse Arctic STEM workforce.

To address this issue, the virtual workshop Engaging Rural and Alaska Native Undergraduates and Youth in Arctic STEM (https://www.arcus.org/meetings/2021/arctic-youth-stem) was held from 13–15 April 2021. The goal of the workshop was to bring together rural and Alaska Native undergraduates and youth, federal agency representatives, researchers on Arctic STEM projects, Indigenous faculty and staff, those from the private sector, and rural Alaska community members to discuss the gaps, challenges, opportunities, and successful practices to increase and support the representation of rural and Alaska Native undergraduates and youth in STEM education and career pathways (Figure 1).

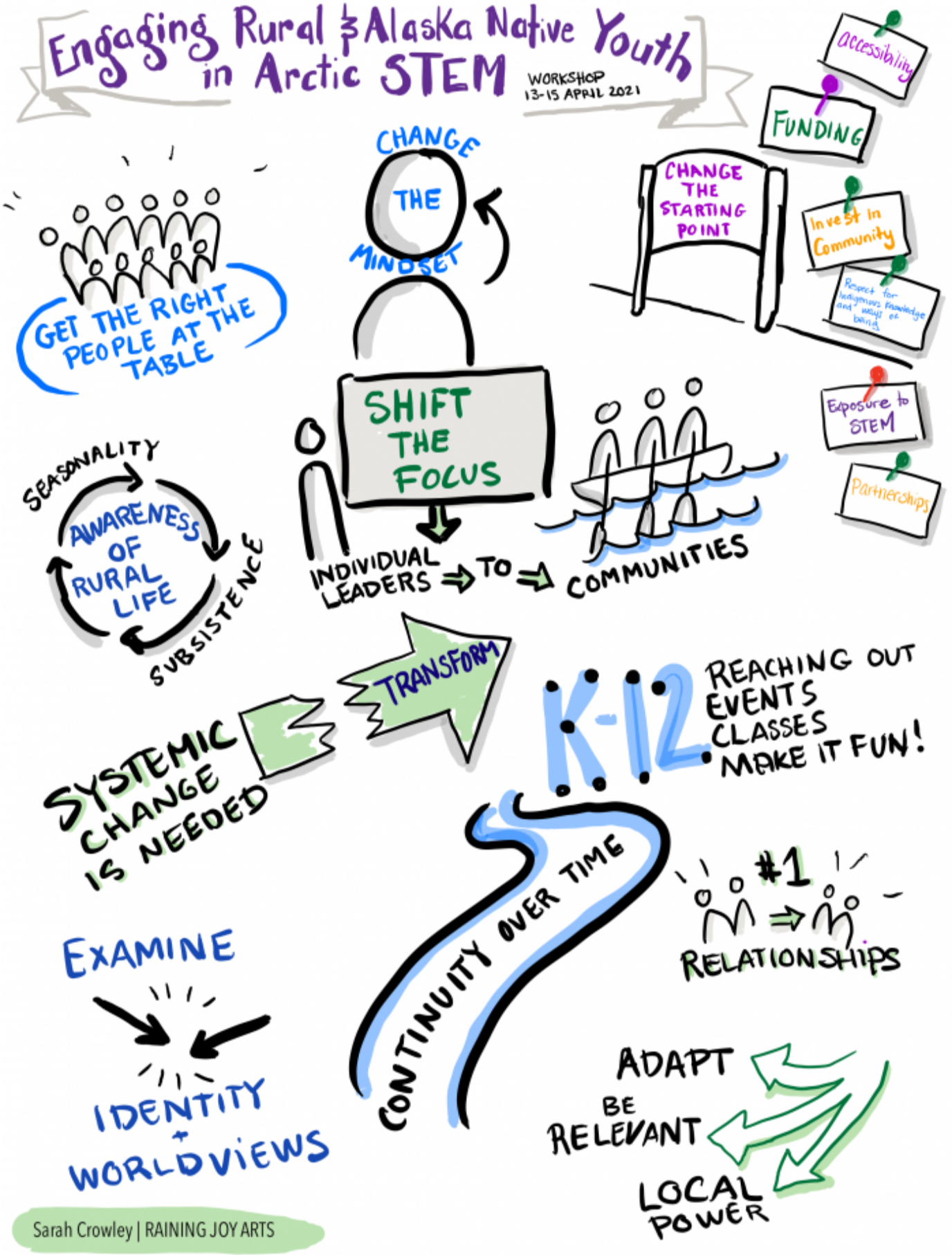

Figure 1. Graphic from the Engaging Rural and Alaska Native Undergraduates and Youth in Arctic STEM workshop, created by Sarah Crowley, Raining Joy Arts.

(https://www.arcus.org/files/article/images/figure_1_graphic_stemreport.png)

The workshop was an initiative of the Interagency Arctic Research and Policy Committee (IARPC) Arctic STEM Education Working Group and was hosted by the Arctic Research Consortium of the US (ARCUS) with funding from the National Science Foundation (NSF PLR 1304316 and PLR 1928794). The International Arctic Research Center at the University of Alaska Fairbanks (IARC) was subcontracted to provide support for the planning and execution of the workshop. A series of Listen and Learn Sessions were held before the workshop to set foundational themes and draft recommendations to be discussed and refined during the workshop.

Seventy-three participants attended the three-day workshop, which included a series of plenary sessions and smaller breakout sessions addressing two guiding questions: (1) What can be done to increase rural and Alaska Native undergraduate and youth participation in existing Arctic STEM programs? and (2) What can programs do differently or how can programs adapt to support student engagement?

By the end of the workshop, a nonprioritized list of recommendations was created to respond to these questions. For the preparation of the report, recommendations were synthesized and sorted into seven thematic areas. Below, the full list of recommendations follows each theme.

Theme One: Increase Early Outreach and Exposure to STEM

- Create more preparatory programs that address regional needs and diverse approaches.
- Engage more with high-school freshmen and younger students; existing programs mostly target sophomores and juniors.
- Increase personal engagement and communication. Pay more attention to how we are actually reaching and communicating with students.
- Integrate research into courses in the K–12 system; incorporate citizen science. Make courses relevant to place and culture.
- Time outreach activities appropriately throughout the year, being sensitive to subsistence and/or yearly events already occurring in communities.

Theme Two: Define STEM broadly and inclusively to capture a wider group of students

- Use a broader definition of science and STEM. Be more holistic and have social sciences and humanities integrated. Do not just focus on STEM fields on their own.
- Avoid gatekeeping in science. Make sure an inclusive definition of science is used so that social science and Indigenous knowledge are not excluded. (Gatekeeping is defined as limiting access.)

- Encourage finding ways to integrate STEM identities and Indigenous identities.
- Help—and create programs for—students who do not have a high grade-point average. They need an entry point.
- Encourage students in a variety of programs besides just in STEM. Include the social sciences so that some blending can occur for those with similar interests.
- Consider the needs of nontraditional students.

Theme Three: Redefine how program objectives and success are measured to ensure they are relevant to students and communities

- Make sure scientists, researchers, and STEM program leaders ask themselves:
- What is the purpose of what we are doing? What are the intended and actual outcomes? What do we see students doing, and where do we see them going, after? What are their opportunities and desires, and needs in communities, and how can we align them better?
- Skills needed to conduct scientific work are varied; make sure that the skills students gain are applicable to other aspects of their lives.
- Shift away from individualistic thinking and more toward communal/community-based thinking.

Theme Four: Draw on partnerships with multiple sectors and organizations

- Create more partnerships with industries.
- Work more with existing programs, including the Rural Alaska Honors Institute (RAHI), Alaska Native Science and Engineering Program (ANSEP) and Upward Bound. Continuity in and across programs is important.
- Create a website repository of available programs across Alaska (not just University of Alaska) for educators and students, so that programs are easier to access.
- Encourage better collaboration among STEM programs and organizing entities (e.g., partner with programs or organizations that work with Indigenous youth) from many institutions and not just one institution.
- Work with local Alaska Natives and Native organizations (nonprofit and for-profit) to get better input early on in designing and/or maintaining available programs or grants.
- Help agencies and organizations that work in Alaska but are not based here get an Alaska perspective.

Theme Five: Shift power to students and communities

- Move power to the communities by engaging and involving them early in program design, program recruitment, and making funding decisions.

- Make sure the right people are at the table. If needed, slow down the process to make sure the right people are there. Plan carefully to include extra time that may be needed. This might require challenging federal agencies to institute change in this area.
- Change the starting point of projects so that students, along with communities, drive what projects look like.

Theme Six: Remove hurdles to participation, including structural and systemic hurdles

- Include more thought about and discussion around systemic issues.
- Provide more internet access and bandwidth in communities.
- Incentivize programs so that students want to and are able to participate. Provide livable wages.

Theme Seven: Respect and include Indigenous knowledge and ways of being

- Make relevancy a primary goal and make sure diverse worldviews are considered.
- Be aware of and work flexibly around seasonal subsistence activities and timing, so that students have the capacity to participate in these activities.

A draft of this workshop report was submitted to the steering committee, workshop participants, and broader community members for review and to solicit any additional input before publication. Comments and feedback were incorporated, and the final report has been posted on the ARCUS website (https://www.arcus.org/meetings/2021/arctic-youth-stem), shared publicly, and submitted to the IARPC Arctic STEM Education Working Group (https://www.iarpccollaborations.org/teams/Arctic-STEM-Education-Working-Group), which will look at how the recommendations and highlights can be distilled into actionable items. The IARPC Arctic STEM Education Working Group works to connect STEM education organizations that leverage Arctic science and includes both federal and nonfederal members. The IARPC 2022–2026 Arctic Research Plan (https://www.iarpccollaborations.org/arctic-research-plan-2022-2026.html) includes STEM education as a foundational activity. The outcomes in this workshop report will be useful for federal planning.

The workshop was an initiative of the Interagency Arctic Research and Policy Committee (IARPC) Arctic STEM Education Working Group and was hosted by the Arctic Research Consortium of the US (ARCUS) with funding from the National Science Foundation (NSF PLR 1304316 and PLR 1928794).

Questions about the workshop or the report can be directed to Janet Warburton at warburton@arcus.org.

About the Author

Janet Warburton joined ARCUS in October 2000. Her primary focus as Project Manager is developing and implementing education related projects that help ARCUS meet its mission. For over a decade, she has administered ARCUS' signature education program, PolarTREC - Teachers and Researchers Exploring and Collaborating. She is also currently working The Arctic in the Classroom, a program that focuses on citizen science projects in the Arctic. She is currently ARCUS' representative for University of the Arctic.

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NSF Awards Grants to Early-Career Polar Investigators

Editors: ARCUS Staff

The National Science Foundation (NSF) Office of Polar Programs (OPP) has awarded $3.8 million to early-career scientists as part of the OPP Postdoctoral Research Fellowship (PRF) Program. This is the first year of funding for the Postdoctoral Research Fellowship Program.

The program encourages new investigators who have not previously worked in polar regions and/or innovative techniques that have not previously been applied to polar science into polar research. Additionally, the OPP-PRF aims to support beginning investigators with experiences that will establish them in positions of leadership in the scientific community.

Postdoctoral Research Fellowship provide opportunities for early-career scientists, including social scientists, to accomplish one or more of the following goals:

- Expand their work across traditional disciplinary lines.
- Develop new partnerships connecting the polar regions and/or non-polar research communities.
- Provide entry to researchers who have traditionally had limited access to polar research resources, sites, and facilities.

NSF has awarded 13 grants as part of the Postdoctoral Research Fellowship Program, with seven representing the Arctic research community and six representing the Antarctic research community. These include:

Submesoscale Fjord Variability and Its Influence on Glacial Melt

Abstract Award # 2138790 (https://www.nsf.gov/awardsearch/showAward?AWD_ID=2138790&HistoricalAwards=false)

Principal Investigator: Ken Zhao, Oregon State University.

Revealing the Genomic Underpinnings of Polar Bear Physiological Adaptations to the Arctic

Abstract Award # 2138649 (https://www.nsf.gov/awardsearch/showAward?AWD_ID=2138649&HistoricalAwards=false)

Principal Investigator: Blair Perry, Washington State University.

Investigating 2.5k Years of Human History and Atmospheric Transport in Greenland Ice Using High-

Resolution Lead Isotopic Records

Abstract Award #2138782 (https://www.nsf.gov/awardsearch/showAward?AWD_ID=2138782&HistoricalAwards=false)

Principal Investigator: Sophia Wensman, Nevada System of Higher Education, Desert Research Institute

Freeze-thaw Effect on Biogeochemistry and Nutrient Cycling in Arctic Soils

Abstract Award #2138937 (https://www.nsf.gov/awardsearch/showAward?AWD_ID=2138937&HistoricalAwards=false)

Principal Investigator: Erin Rooney, University of Tennessee Knoxville

Assessing the Relationship Among Fire, Temperature, and Precipitation in the Arctic During the Pleistocene

Abstract Award #2138893 (https://www.nsf.gov/awardsearch/showAward?AWD_ID=2138893&HistoricalAwards=false)

Principal Investigator: Emily Tibbett, University of Massachusetts Amherst

Investigating the Effects of Late Holocene Climate Change on Polar Bears

Abstract Award #2139044 (https://www.nsf.gov/awardsearch/showAward?AWD_ID=2139044&HistoricalAwards=false)

Principal Investigator: Lillian Parker, University of Oklahoma Norman Campus

Using Passive Acoustic Monitoring of Bowhead Whales to Identify Biotic and Abiotic Drivers and Timing of Migration

Abstract Award #2138801 (https://www.nsf.gov/awardsearch/showAward?AWD_ID=2138801&HistoricalAwards=false)

Principal Investigator: Angela Szesciorka, Oregon State University

Organic Matter Export, Processes, and Transformations Drive Carbon Cycling Patterns in the Arctic Ocean

Abstract Award #2138584 (https://www.nsf.gov/awardsearch/showAward?AWD_ID=2138584&HistoricalAwards=false)

Principal Investigator: Jumanah Hamdi, Louisiana Universities Marine Corsortium

Calving, Icebergs, and Climate

Abstract Award #2139002 (https://www.nsf.gov/awardsearch/showAward?AWD_ID=2139002&HistoricalAwards=false)

Principal Investigator: Alexander Huth, Princeton University

Investigating the Influence of Ocean Temperature on Antarctic Ice Sheet Evolution During the Early

to Middle Pleistocene

Abstract Award #2139051 (https://www.nsf.gov/awardsearch/showAward?AWD_ID=2139051&HistoricalAwards=false)

Principal Investigator: Michelle Guitard, Lamont-Doherty Earth Observatory at Columbia University

High-resolution Nested Antarctic Ice Sheet Modeling to Reconcile Marine and Terrestrial Geologic Data

Abstract Award #2138556 (https://www.nsf.gov/awardsearch/showAward?AWD_ID=2138556&HistoricalAwards=false)

Principal Investigator: Anna Ruth Halberstadt, Berkeley Geochronology Center

The Role of Southern Ocean Iron Limited Diatoms in Modulating Copper Speciation

Abstract Award #2138217 (https://www.nsf.gov/awardsearch/showAward?AWD_ID=2138217&HistoricalAwards=false)

Principal Investigator: Angel Ruacho, University of Washington

Pygoscelis Penguin Response to Potential Prey Retention Along the West Antarctic Peninsula

Abstract Award #2138277 (https://www.nsf.gov/awardsearch/showAward?AWD_ID=2138277&HistoricalAwards=false)

Principal Investigator: Katherine Hudson, Stony Brook University

To learn more about the grantees and their projects, visit the OPP Postdoctoral Research Fellowship awardees page (https://www.nsf.gov/geo/opp/postdoc_awardees2021.jsp).

Learn more about future opportunities on the NSF solicitation webpage (https://beta.nsf.gov/funding/opportunities/office-polar-programs-postdoctoral-research-fellowships-opp-prf).

An Introduction to Polar Cyberinfrastructure at the National Science Foundation

By: Allen Pope Polar, Cyberinfrastructure Program Director, Office of Polar Programs, National Science Foundation

What do you think of when you hear the term, "Polar Cyberinfrastructure?" Whatever you thought of, worry not, because even experts agree that, "cyberinfrastructure is a word commonly used, but lacking a single, precise definition" (Stewart et al., 2010) (http://dsc.soic.indiana.edu/publications/fp109a-stewart.pdf).

Breaking down the jargony mouthful, we have three parts:

1. Polar—"relating to the North or South Pole"
2. Cyber—"relating to or characteristic of the culture of computers, information technology, and virtual reality"
3. Infrastructure—"the basic physical and organizational structures and facilities needed for the operation of a society or enterprise"

Stewart et al. (2010) continue to cite a broad definition that, "Cyberinfrastructure consists of computational systems, data and information management, advanced instruments, visualization environments, and people, all linked together by software and advanced networks to improve scholarly productivity and enable knowledge breakthroughs and discoveries not otherwise possible." This definition includes interoperability and collaboration as key features of cyberinfrastructure, including a range of technologies which are connected together to facilitate a full range of scientific activities. Other aspects of cyberinfrastructure, or CI, highlighted by Atkins et al. (2003) (https://repository.arizona.edu/bitstream/handle/10150/106224/report.pdf?sequence=1&isAllowed=y) and "What is Cyberinfrastructure?" (https://cnx.org/contents/NSJb9NWz@1/What-Is-Cyberinfrastructure) include sharing of common resources, as well as lowering the barriers to entry to use the cyberinfrastructure itself. In addition to technical aspects, it is important to recognize that cyberinfrastructure includes human aspects such as training, exchanges, and community organizations.

Polar Cyberinfrastructure (Polar CI) brings the above systems and technologies to bear on Arctic and Antarctic applications. Polar CI is, and should be, embedded in the way polar scientists work, supporting the full range of polar research requirements and goals. At the National Science Foundation (NSF) Office of

Polar Programs (OPP), Polar CI has alternated between having a dedicated program officer and being shared among those with other duties.

Figure 1. Principal Investigator Jessie Creamean prepares for a podcast interview in Utqiaġvik. Creamean's research is part of a multi-year effort to determine whether ice nucleating particles (INPs) from permafrost make their way into the Arctic atmosphere via lateral hydrologic transport. To do this, her team collects samples along coastal water, lakes, and the Elson Lagoon. Photo courtesy of Thomas Hill.

Today, Polar CI is included in the main Arctic Research Opportunities (https://www.nsf.gov/pubs/2021/nsf21526/nsf21526.htm) solicitation. Through this solicitation, the Polar CI program considers proposals that promote effective collaboration between polar and cyberinfrastructure researchers and aims to support proposals that provide significant benefit to the polar research community. This benefit could be realized in a variety of ways, spanning the full breadth of cyberinfrastructure.

The Polar CI program also helps build collaborations between OPP and the NSF Computer and Information Science and Engineering (CISE) (https://www.nsf.gov/dir/index.jsp?org=CISE), Office of Advanced Cyberinfrastructure (OAC) (https://www.nsf.gov/cise/oac/about.jsp), aiming to incubate and encourage polar submissions to relevant solicitations across NSF. There are several potential solicitations that might be of particular interest to polar research. The Cyberinfrastructure for Sustaining Scientific Innovation (CSSI) (https://beta.nsf.gov/funding/opportunities/cyberinfrastructure-sustained-scientific-innovation-cssi) program emphasizes addressing scientific community needs to enable new science, as well as the Training-based

Workforce Development for Advanced Cyberinfrastructure (CyberTraining) (https://beta.nsf.gov/funding/opportunities/training-based-workforce-development-advanced-cyberinfrastructure) program, which facilitates a range of different types of data and computing-related training for CI professionals and CI users—which could include Arctic researchers or residents! Data-focused researchers might also be interested in exploring a range of opportunities available through NSF's Harnessing the Data Revolution (HDR) initiative.

NSF, through OAC, also sponsors a range of computing and training resources related to high performance computing (e.g., XSEDE (https://www.xsede.org/)), cloud computing (e.g., CloudBank (https://www.cloudbank.org/)), and distributed computing (e.g., PATh (https://path-cc.io/about/)). Some or all of these may be available to Arctic researchers, depending on needs, applications, and funding situation.

As a tentpole of the Polar Cyberinfrastructure program, the interdisciplinary Arctic Data Center (ADC) (https://arcticdata.io/) is the primary data and software repository for NSF-funded Arctic research. The ADC provides data management tools, training, outreach, customizable data portals, and other research community support services.

The Polar CI program also supports the Polar Geospatial Center (PGC) (https://www.pgc.umn.edu/), which provides a range of freely available datasets like the Arctic Digital Elevation Model, aerial photography, and maps, as well as training and materials for building geospatial data skills. PGC also provides high-resolution satellite data, tasking, and support for NSF-funded Arctic researchers.

In addition to these large initiatives, the Polar CI program supports more focused activities, services, workshops, and research projects at a wide range of different sizes and scopes! You can read more about the current (https://www.nsf.gov/awardsearch/advancedSearchResult?PIId=&PIFirstName=&PILastName=&PIOrganization=&PIState=&PIZip=&PICountry=&ProgOrganization=&ProgEleCode=5407&BooleanElement=All&ProgRefCode=&BooleanRef=All&Program=&ProgOfficer=&Keyword=&AwardNumberOperator=&AwardAmount=&AwardInstrument=&ActiveAwards=true&OriginalAwardDateOperator=&StartDateOperator=&ExpDateOperator=) and past (https://www.nsf.gov/awardsearch/advancedSearchResult?PIId=&PIFirstName=&PILastName=&PIOrganization=&PIState=&PIZip=&PICountry=&ProgOrganization=&ProgEleCode=5407&BooleanElement=All&ProgRefCode=&BooleanRef=All&Program=&ProgOfficer=&Keyword=&AwardNumberOperator=&AwardAmount=&AwardInstrument=&ExpiredAwards=true&OriginalAwardDateOperator=&StartDateOperator=&ExpDateOperator=) Polar CI portfolio in the NSF award search.

In the Dear Colleague Letter: Supporting Data and Sample Reuse in Polar Research (https://www.nsf.gov/pubs/2021/nsf21041/nsf21041.jsp), OPP also encourages submission of proposals that leverage existing data, physical and non-physical samples, facilitate the reuse of existing data, and projects that leverage and

make publicly available data or samples that are currently unavailable or inaccessible (i.e., data rescue and reuse).

As you can see, Polar Cyberinfrastructure cuts across many disciplinary boundaries, facilitating and potentially transforming how Arctic knowledge is built. The NSF Arctic research community is encouraged to explore the opportunities included above to think about how cyberinfrastructure can help build understanding of the changing Arctic. As always, you are encouraged to reach out to your NSF program officer(s) to talk more about your great ideas!

For more information, see:

- Polar Cyberinfrastructure Webinar Page (https://www.iarpccollaborations.org/members/events/21809)
- Polar Cyberinfrastructure Webinar Recording (https://www.youtube.com/watch?v=1gmYYCSHMBk)
- NSF GEO Cyberinfrastructure Information (https://www.nsf.gov/geo/geo-ci/index.jsp)

Or contact Allen Pope, NSF apope@nsf.gov and @PopePolar

About the Author

Allen Pope joined the Office of Polar Programs as the new Program Director for Polar Cyberinfrastructure in September 2020. Prior to NSF, Allen served as the Executive Secretary of the International Arctic Science Committee. Allen is also a glaciologist and remote sensing scientist—most recently tracking lakes on the surface of the Antarctic and Greenland Ice Sheets, studying ultra-cold surface temperatures in Antarctica, tracking ice-shelf velocities and fractures, contributing to a glacier inventory of the Mongolian Altai, and researching and teaching on the undergraduate-focused Juneau Icefield Research Program.

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Global Climate-Fragility Risks Associated with Arctic Change

By: Marisol Maddox, Arctic Analyst, the Wilson Center Polar Institute

The Wilson Center (https://www.wilsoncenter.org/) was chartered by Congress in 1968 as the official, living memorial to President Woodrow Wilson. It serves as a key, non-partisan policy forum for tackling global issues through independent research and open dialogue to inform actionable ideas for the policy community. The Polar Institute of The Wilson Center was formed in 2017 and has become a premier forum for discussion, policy analysis, and expertise on issues pertaining to the Arctic and Antarctic.

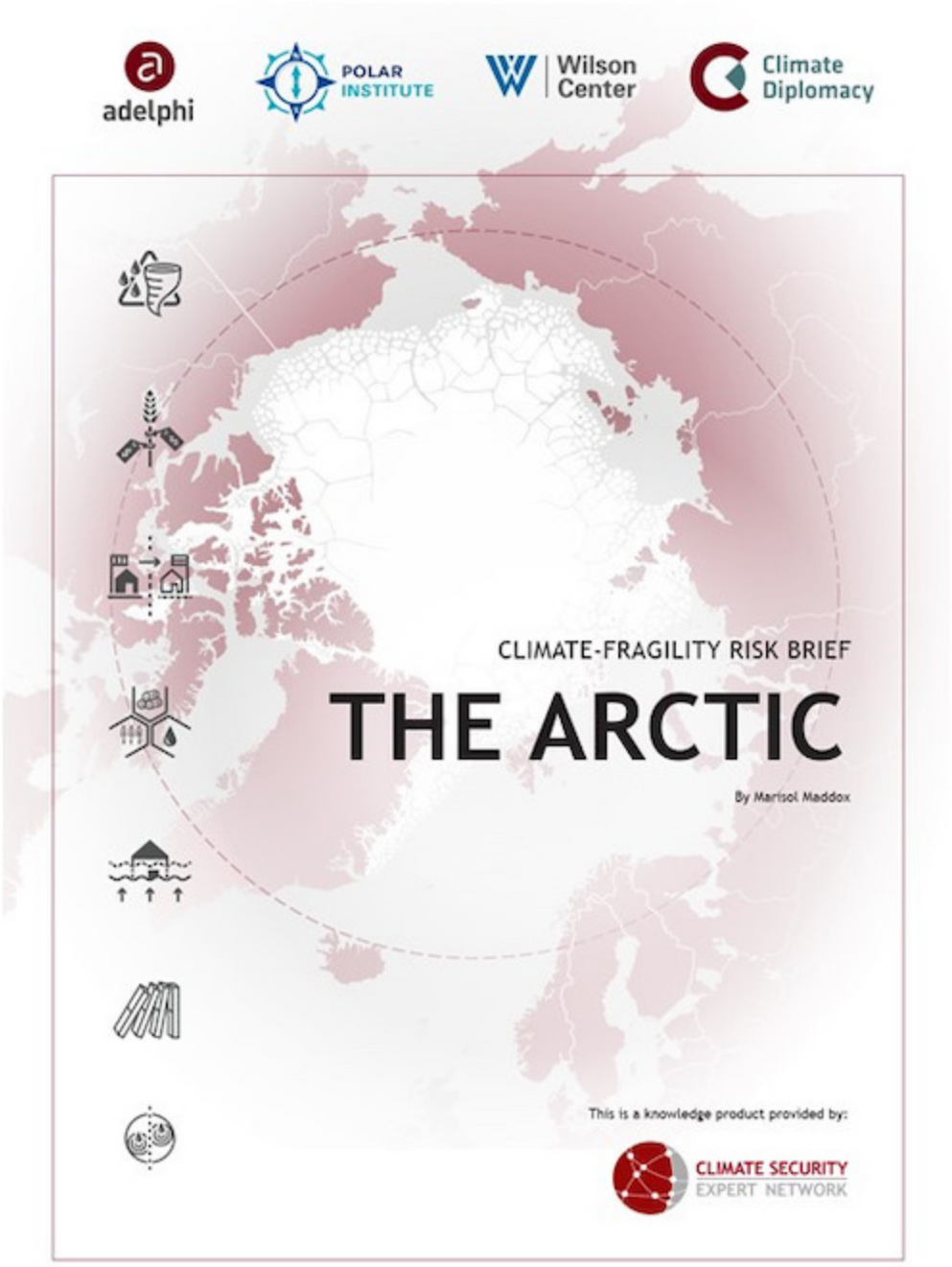

Figure 1. Cover image of the Climate-Fragility Risk Brief: The Arctic, published by the Climate Security Expert Network with support from the German Federal Foreign Office. Image copyright rests with © adelphi.

During the summer of 2021, I authored the Climate-Fragility Risk Brief: The Arctic (https://www.adelphi.de/en/publication/climate-fragility-risk-brief-arctic) as part of a Polar Institute (https://www.wilsoncenter.org/program/polar-institute) collaboration with the Berlin-based think tank, adelphi (https://www.adelphi.de/en), and their Climate Security Expert Network (CSEN) (https://climate-security-expert-network.org/). Climate change is one of several "actorless threats," which will increasingly shape the global threat to the environment and challenge stability. The term, actorless threats, referring to the lack a proximate causal actor, is useful because of the implications it has for the evolution in thinking necessary for policy, security,

and intelligence communities to properly frame our changing reality, where significant threats are developing in the form of something other than a state or non-state actor.

These risks are demonstrative of the fact that actorless threats, like climate change, will increasingly influence global stability, both directly as well as indirectly through the ways that state and non-state actors respond to them. For instance, certain geoengineering technologies are relatively inexpensive and accessible, so could potentially be deployed by a wealthy individual. The risks are profound whether or not the intentions are benevolent.

The Arctic is warming three times faster than the global rate of change. Several global climate tipping points are directly linked to changes in the Arctic, namely, the stability of the Greenland ice sheet, the stability of permafrost, and the strength of the Atlantic Meridional Overturning Circulation (AMOC), which is a giant ocean conveyor belt that contains the Gulf Stream.

There is about seven meters worth of global sea level currently locked up in the Greenland ice sheet, and it is melting from the top down and the bottom up. Research has demonstrated the global climate impacts of diminishing land-based ice from Greenland, such as the established connection between Greenland's ice melt and a "drastic decrease" in west African monsoon precipitation, which impacts the fragile Sahel region of Africa. The gravitational pull of the Greenland ice sheet means its melt has direct implications for the US Eastern Seaboard (Bartelme 2021).

Over 80% of Alaska and 60% of the Russian Federation are underlaid by permafrost and there are significant concerns about implications for critical infrastructure as well as for permafrost's contributions to further warming. When permafrost thaws, it releases methane—an extremely potent greenhouse gas—as well as carbon dioxide. It is estimated there are around 60 billion tons of methane and 560 billion tons of carbon trapped in subsea permafrost, sediment, and soils. Permafrost is also concerning as a source of novel pathogens (ancient viruses, fungi, bacteria), as well as radon and mercury, which are both pertinent to public health. New research takes a novel approach in beginning to catalog a list of biogeochemical impacts of permafrost thaw, making it clear that the implications of Arctic cryosphere degradation are profound (Miner et al. 2021).

The AMOC is the weakest it has been in over 1,000 years due to the freshening and warming of the Arctic Ocean. Increased rainfall, coupled with greater melting of ice, adds significant amounts of freshwater to the ocean. This reduces the salinity and density of the ocean water, which combine with the temperature increase to inhibit the sinking and circulation of AMOC— hence it slows down. If this trend continues and combines with a period of reduced solar activity due to natural variability, the result could be decades-long mega-droughts in central Europe.

It is unclear whether it is possible to overshoot thresholds, by how much and for how long, and still remain safe. There is additional risk that triggering one tipping point may cause other tipping points 'thresholds to be crossed in a domino effect. It is also clear that particularly when it comes to the cryosphere, it is important to limit warming to 1.5°C because once glaciers, ice sheets, and permafrost are gone it "will be essentially permanent on human timescales, and catastrophic for humanity"(ICCI 2021).

The accelerated rate of warming in the Arctic also creates geopolitical and human security risks. China is seeking to establish itself as a stakeholder in the Arctic to gain access and influence, while Russia is increasing its military capabilities and aggressive posturing in the region leading to threat of security dilemma dynamics with neighbors and NATO. Increased access and new commercial opportunities come with a growing risk of opportunistic transnational crime and illicit financial flows, while policy and emergency response mechanisms lag behind the fast-changing reality.

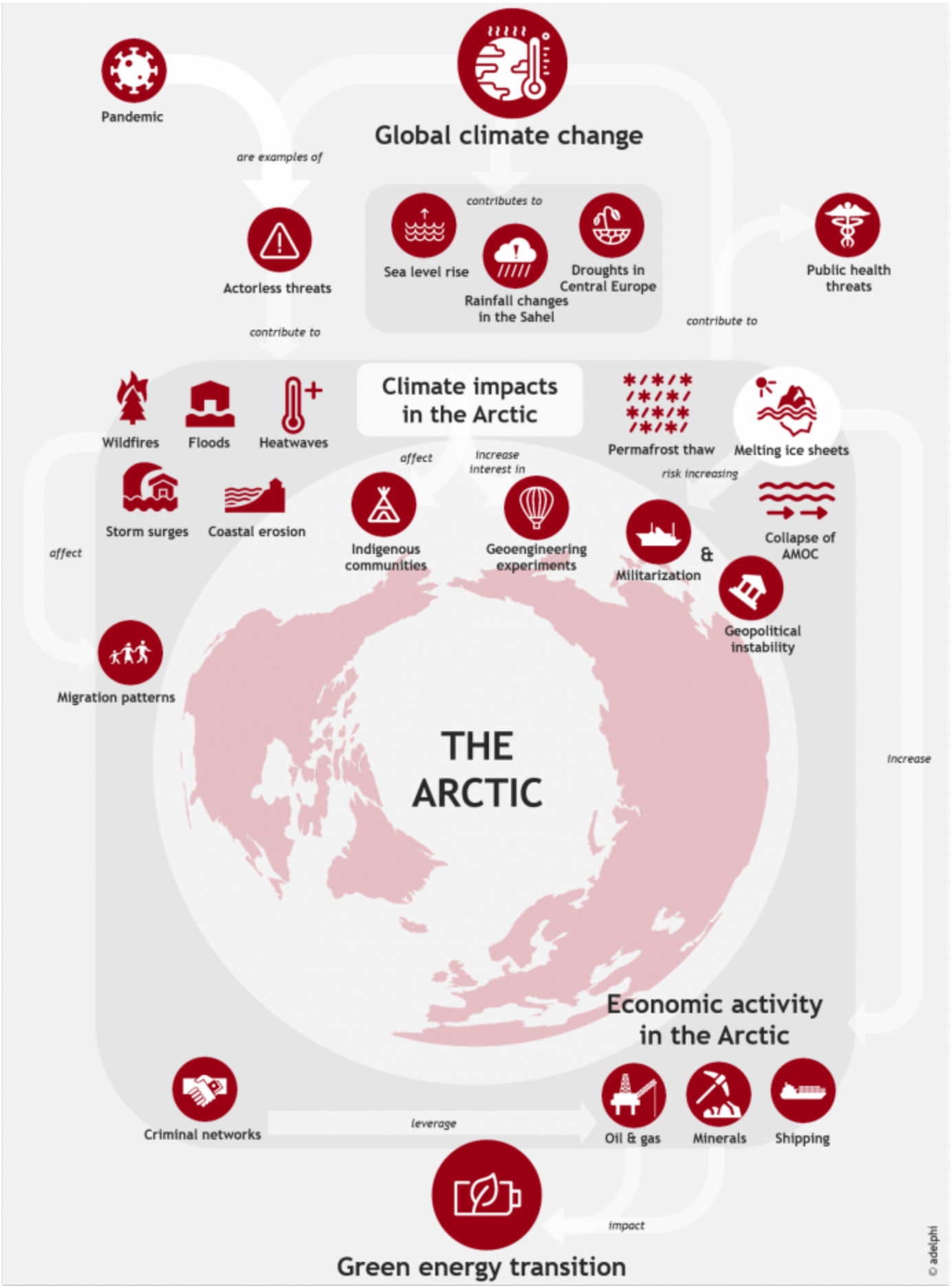

Figure 2. Infographic display of stressors to the Arctic system and entry-points for action from the policy community based on a Risk Brief

The CSEN risk brief includes several entry-points for action from the policy community, including the need for urgent global action to catalyze emissions reduction efforts and increase carbon sequestration, with an emphasis on nature-based solutions that also seek to support biodiversity and Indigenous communities. Multilateral Arctic military dialogue must be renewed to reduce risk of escalation or misinterpretation. Governance structures should be appropriately adapted to the new Arctic reality to prevent gaps, and the integrity of sustainable development should be upheld through actively limiting opportunities for bad actors to exploit new opportunities, such as fraud in carbon credit markets.

Figure 3. Photo of trekkers climbing snow filled mountains from Entry Points to Reduce Climate-Fragility Risks discussion in Climate-Fragility Risk Brief. Photo courtesy of S&B Vonlanthen.

A more involved cultural paradigm shift will be necessary as part of the longer-term work to address the root causes of climate change. At the heart of this matter is the falsehood that humans are somehow separate from nature, as if it does not exist within us, and that it is necessary for humans to dominate nature in order to survive. Nothing could be further from the truth. This illusory falsehood is at the philosophical foundation of many policy approaches that have led to the structural challenges we are confronted with today, and needs to be addressed. Indigenous Knowledge must be at the core of our approach toward seeking solutions. To effectively confront these new risks, it is crucial to balance boldness and urgency of action with humility and acknowledgement of the profound nature of the larger work that must be done in order to be successful.

For further information, please download the Climate-Fragility Risk Brief: The Arctic (https://climate-

security-expert-network.org/sites/climate-security-expert-network.org/files/documents/csen_risk_brief_arctic.pdf) and the accompanying Factsheet (https://climate-security-expert-network.org/sites/climate-security-expert-network.org/files/documents/csen_factsheet_arctic.pdf).

About the Author

Marisol Maddox is an Arctic analyst at the Polar Institute of the Woodrow Wilson International Center for Scholars and a non-resident research fellow at the Center for Climate and Security. Her research interests include the security and geopolitical implications of actorless threats such as climate change and biodiversity loss, as well as international collaboration opportunities, with a regional focus on the Arctic.

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President Biden Appoints New USARC Chair and Commissioners

By: Cheryl Rosa, US Arctic Research Commission Deputy Director

On 24 September 2021, President Biden (appointed) (https://www.whitehouse.gov/briefing-room/statements-releases/2021/09/24/president-biden-appoints-commissioners-of-u-s-arctic-research-commission) commissioners to the US Arctic Research Commission and designated a new chair. These appointments coincide with other Arctic-related actions (https://www.whitehouse.gov/ostp/news-updates/2021/09/24/biden-harris-administration-brings-arctic-policy-to-the-forefront-with-reactivated-steering-committee-new-slate-of-research-commissioners) announced by the White House Office of Science and Technology Policy.

Mr. David Kennedy (https://www.arctic.gov/david-kennedy), appointed by President Trump in December 2020, and designated chair by President Biden in March 2021, was reappointed to a second term on the commission, but not as chair, as Kennedy had originally requested that role on an interim basis.

The newly designated chair is Alaskan, Dr. Michael Sfraga, the founding director of the Polar Institute (https://www.wilsoncenter.org/program/polar-institute) and the director of the Global Risk and Resilience Program at the Woodrow Wilson International Center for Scholars in Washington, DC. Dr. Sfraga previously served the University of Alaska, for over thirty years, in various academic, administrative, and executive positions, including vice chancellor, associate vice president, faculty member, department chair, and associate dean.

The five new commissioners are:

- Dr. Michael Sfraga (https://www.arctic.gov/mike-sfraga) of Fairbanks, Alaska
- Ms. Elizabeth Qaulluq Cravalho (https://www.arctic.gov/elizabeth-cravalho) of Kotzebue, Alaska
- Dr. Mark Myers (https://www.arctic.gov/mark-meyers) of Anchorage, Alaska
- Dr. Jacqueline Richter-Menge (https://www.arctic.gov/jacqueline-richter-menge) of Lyme, New Hampshire
- Ms. Deborah Vo (https://www.arctic.gov/deborah-vo) of Anchorage, Alaska

A vacancy currently exists on the commission for a representative from the research community, as former commissioner Major General Randy ("Church") Kee, USAF (ret.) resigned his position, effective 10 September 2021, to accept the federal position of Senior Advisor, Arctic Security Affairs, in the US Department of Defense (DoD). He will assist with establishing the Ted Stevens Center for Arctic Security Studies (https://www.defense.gov/News/Releases/Release/Article/2651852/the-department-of-defense-announces-establishment-of-arctic-regional-center), the DoD's sixth and newest regional center.

In an ex officio non-voting capacity, Dr. Sethuraman Panchanathan, the Director of the National Science Foundation, remains the eighth and final member of the commission. Dr. Sfraga, who will serve on the commission in one of the four research slots, will remain a senior member of the Polar Institute, where he will focus his scholarship and public speaking on Arctic policy.

In response to the appointment, Sfraga said, "I am grateful to President Biden for selecting me to serve in this important position. As the Arctic region grows in global importance, the commission will play a consequential role in informing and shaping US Arctic research efforts and policies. The commission, along with international partners, will help meet the challenges presented by a region undergoing rapid change. I look forward to working with my fellow commissioners and staff to advance this important mission. I thank David Kennedy for his leadership as chair, and I am pleased that we will continue to have the benefit of his expertise moving forward."

Ms. Cravalho, who served on the Alaska Arctic Policy Commission, will hold one of the two slots reserved for representatives from private industry. She is the Vice President of Lands at the NANA Regional Corporation, an Alaska Native Corporation owned by the Iñupiat people of northwest Alaska.

Dr. Myers, a geologist appointed by President George W. Bush as the 14th director of the US Geological Survey, and who has worked for the State of Alaska in a variety of positions, is currently a private contractor and is the other industry representative.

Dr. Richter-Menge, an expert in Arctic sea ice, is serving a second term as a research representative, as she was previously appointed to the USARC in 2016 by President Obama.

Ms. Vo, a Program Officer at the Rasmuson Foundation and a former Special Assistant for Rural Affairs to Senator Lisa Murkowski, is the commission's new Indigenous representative.

The USARC's mission is to develop and recommend US Arctic research policy to the President and Congress and to build cooperative links in Arctic research within the federal government, with Arctic residents, the State of Alaska, researchers, and international partners. Visit the USARC website (https://www.arctic.gov/) for more information on our duties and how to connect via our Daily Arctic Update or our social media accounts.

About the Author

Cheryl Rosa, Deputy Director and Anchorage-based Alaska Director of the United States Arctic Research Commission (USARC), is trained as a wildlife veterinarian and wildlife biologist and has worked with subsistence communities on the North Slope and in the Russian Far East on a wide range of studies involving wildlife health and zoonotic disease, marine mammal stranding response, subsistence food safety, and oil spill/offshore discharge research. She is a member of the International Whaling Commission's Scientific Committee, as well as numerous other federal and non-federal boards and steering committees. Presently, she is involved in running USARC's Alaska Rural Water and Sanitation Working Group, the Arctic Renewable Energy Working Group, and the Arctic Mental Health Working Group.

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Building Bridges between Research and Community

By: Anna-Sofie Skjervedal, Head of Secretariat, International Arctic Hub in Nuuk, Greenland

During 2021, an area as big as Sweden and Norway combined melted from the Greenlandic Ice Sheet. Researchers worldwide visit Greenland to study these extreme weather conditions and socioeconomic effects. Meanwhile, politicians struggle to navigate an ocean of information, while locals try to adapt new realities, with everyone strongly depending on each other to adapt. The International Arctic Hub (https://naalakkersuisut.gl/en/Naalakkersuisut/Departments/IKTIN/International-Arktisk-Hub) is here to create a bridge between knowledge and action.

The year 2021 became a record year in regard to ice melting from the Greenlandic Ice Sheet. According to National Snow and Ice Data Center (NSIDC) (http://nsidc.org/greenland-today/), the melt extent peaked at 872,000 square kilometers (337,000 square miles) on 14 August, melting an area as big as Sweden and Norway combined. In all the years we have had satellite observations, this scale of melt was only matched in 2012. Meanwhile, new studies from the Intergovernmental Panel on Climate Change (IPCC) (https://www.ipcc.ch/) state that within 30 years the Arctic will experience the first ice-free conditions during summertime.

Greenland is the Center of Attention

The changing climate has undoubtedly increased international attention to Greenland, where much important scientific knowledge is conducted. However, much of this knowledge is never absorbed into society. That is one of the reasons why the governments of both Denmark and Greenland decided to finance the International Arctic Hub (https://naalakkersuisut.gl/en/Naalakkersuisut/Departments/IKTIN/International-Arktisk-Hub) locally anchored in Nuuk, Greenland, concentrating on building bridges between science and the community.

"We are trying to prevent what we call 'fly in-fly out' conditions. So many different researchers come to Greenland to conduct their research, collect data, and discovering ways to approach various topics and solutions. The researchers often have so little time, and many are uncertain as to how to approach, for instance, local community engagement or how to disseminate their valuable data," says Anna-Sofie Skjervedal, Head of Secretariat, International Arctic Hub (Arctic Hub) in Nuuk, Greenland.

At the same time, coming to Greenland is not easy, as the infrastructure and logistics are difficult and expensive. Further, many of the researchers coming to Greenland do not have a local network.

Figure 1: International Arctic Hub staff in Nuuk, pictured from left to right are Nicoline Larsen, Communications Officer; Anna-Sofie Skjervedal, Head of Secretariat; and Jula Maegaard-Hoffmann, Project Manager. Photo courtesy of Christian Sølbeck.

The Arctic Hub will be a one-door entry point to research in Greenland, and a forum for information and inspiration on how to navigate matters like this. The aim is that Arctic Hub can help smooth the initial process and facilitate communication and dialogue across disciplines and Arctic research stakeholders.

Local anchorage of knowledge is key to sustainable development, and there is much to gain for both researchers and society if researchers put more effort into disseminating their findings. A primary function

of Arctic Hub is, therefore, to contribute to making knowledge from research in and around Greenland more visible and more easily accessible, and in that way, to support society at large.

As a first step, Arctic Hub focuses on disseminating knowledge from research conducted in and around Greenland to a broader audience through video and popular scientific articles. Arctic Hub also arranges workshops, providing tips and tools for communicating research to, for instance, the Greenlandic media or a specific Greenlandic audience. Another way Arctic Hub contributes to strengthen the link between research and society is by facilitating events that encourage dialogue beyond research, across research and education, business and industry, from citizens to politicians, as well as across national boundaries.

> "It is so important that we now have a forum of sharing knowledge and connecting people. We are very excited to be part that collaboration." Anna-Sofie Skjervedal, Head of Secretariat, International Arctic Hub (Arctic Hub) in Nuuk, Greenland.

Combining Expertise

Arctic Hub is a new secretariat established as a Danish-Greenlandic collaboration. The Danish Finance Act annually contributes three million Danish kroner, and the Greenlandic Finance Act contributes 750,000 Danish kroner a year from 2019–2022. Arctic Hub has a Board consisting of eight members; four Danish members and four Greenlandic members. The secretariat is administrated through the Greenland Institute of Natural Resources.

For more information, see the International Arctic Hub (https://naalakkersuisut.gl/en/Naalakkersuisut/Departments/IKTIN/International-Arktisk-Hub) or follow #ArcticHub at LinkedIn and on Facebook. Or, contact the International Arctic Hub via email (info@arctichub.gl), or by mail: International Arctic Hub; Pikialaarfik, 1.floor; Kivioq 2, 3905 Nuussuaq; Greenland.

About the Author

Anna-Sofie Skjervedal is Head of Secretariat at the newly established International Arctic Hub (Arctic Hub) in Nuuk, Greenland. (Photo is courtesy of Christian Sølbeck.) Anna-Sofie holds a PhD from Ilisimatusarfik (University of Greenland) and Aalborg University, in which she focused on meaningful youth engaging through visual means and social media (Towards Meaningful Youth Engagement: Breaking the Frame of the Current Public Participation Practice in Greenland, 2018). As prior head advisor in public participation, she has also overseen public participation strategy development—and implementation at the Municipality of Sermersooq in Nuuk, Greenland. Moreover, Anna-Sofie is part of the steering committee of the Greenland Science Week, a multidisciplinary science event for networking and outreach. To read more, see Greenland Science Week (https://scienceweek.gl/) and #greenlandscienceweek2021.

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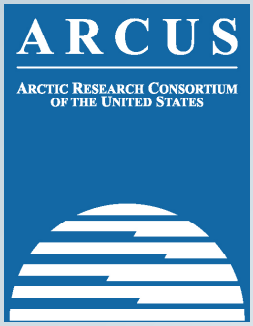

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