

Facilitating increased engagement between the research communities of Greenland and the U.S.

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NAALAKKERSUISUT
GOVERNMENT OF GREENLAND



Institute of
Arctic Studies
at Dartmouth



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EXECUTIVE SUMMARY

The Greenland and U.S. research communities invest substantial resources towards understanding global processes, environmental change, and social-cultural issues in Greenland. As the need for this research intensifies along with the rate of Arctic change, both research communities seek new and stronger bilateral collaborations that leverage resources and expertise held by researchers, stakeholders, and community members. The production of new knowledge through these collaborations along with increased community engagement and student education will place the U.S. and Greenland at the cutting edge of Arctic research. It will strengthen U.S.-Greenland relations and prepare a future generation for taking on the challenge of navigating the new Arctic.

A two-day workshop was held 27-28 August 2018 at Pinngortitaleriffik (Greenland Institute of Natural Resources, GINR), in Nuuk, Greenland, where diverse participants from the U.S. (19) and Greenland (29) research communities explored possibilities for strengthening U.S.-Greenland collaborations. Participants set priorities for future work and funding related to: Research & Co-Production of Research, Public Outreach, and Education & Student Training. This workshop report captures many thoughtful, creative, and overwhelmingly enthusiastic ideas and recommendations for improving the way that the U.S. and Greenland researchers collaborate on important Arctic projects.

The key finding from the workshop was that U.S.-Greenland collaborations will strengthen if researchers work together intentionally and continuously. This includes starting collaborations early to co-define project questions and objectives and allowing adequate time to develop trusted partnerships with defined roles. The report contains specific ideas, mechanisms, and contacts that we hope will be helpful to U.S. and Greenland researchers as they consider the following recommendations in their future work:

- Host workshops, symposia, and scholar exchanges year-round that bring researchers together in person
- U.S. universities with significant research presence in Greenland should pursue self-funding for workshops and student and scholar exchanges
- Use online networks and websites to describe research projects based in Greenland and seek collaborations
- Co-develop research priorities, codes of conduct and best practices for collaboration and research co-production
- Engage potential research partners and Greenland communities early and often during research
- Make public outreach and training of U.S. and Greenland students an explicit goal of all research projects

Research in Greenland is of substantial relevance to Greenland society and will continue to shape our understanding of global processes and rapid Arctic change. The representatives of the U.S. and Greenland research communities present at the Nuuk workshop acknowledged that we can do better research by working together, considering more diverse perspectives as we conduct our research, articulating the benefits of research to Greenland society, and training the next generation in a collaborative framework. We are excited that the workshop has already led to the development of joint proposals, revised project plans related to education and outreach, and plans for future events that will emphasize the growth and potential of U.S.-Greenland collaborations on Arctic research. We hope that this report is helpful to the broader Arctic research community and will help funding agencies understand the opportunities and challenges of interdisciplinary and international collaborative research in Greenland.

INTRODUCTION

Background

Greenland is an important research site for scientists from around the world. As the Arctic warms at twice the rate of the rest of the world, the Greenland Ice Sheet is discharging significant amounts of freshwater to the oceans. This makes Greenland a critical research site for understanding feedbacks to the climate system and sea level rise. The Greenland Ice Sheet also contains essential information for understanding Earth's past and present climate. It serves as a pristine and remote laboratory for astronomy and astrophysics research and year-round observations of climatic and atmospheric variables. Greenland's social-ecological and coupled human-natural tundra ecosystems are also bellwethers of climate-driven social, cultural, environmental, and ecological change. Greenland is rich in historical, cultural and sociological information that can contribute to how human beings and the communities they live in thrive and adapt to environmental conditions. With recognition of the importance of research in these and other disciplines, institutions in the U.S. and Greenland sponsor a significant amount of scientific research in Greenland (Appendix A).

There is significant interest from the U.S. and Greenland research communities in working together to address questions related to global processes, environmental change, and social response. Greenland's policy is to promote the development of its society with a strong and sound international research program based on shared objectives. Greenland's Parliament Act no. 5 of 29 November 2013 addresses research consultancy and the allocation of research funding. The Act emphasizes coordination and prioritization of research efforts and enhancing Greenland's participation in international cooperative research initiatives. Most work by Greenland researchers has direct relevance to society and is located almost exclusively along de-glaciated coastal areas on issues related to natural resources. In contrast, most U.S. researchers, particularly natural and physical scientists, are based on the ice sheet or in remote field camps away from population centers. They collect data and then depart, having had little, if any, contact with Greenland scientists and communities. The U.S. institutions that fund this research include the *National Science Foundation (NSF)*, the *National Aeronautics and Space Administration (NASA)*, the *National Institutes of Health (NIH)*, the *National Oceanic and Atmospheric Administration (NOAA)*, the *Smithsonian Institution (SI)*, and the *Smithsonian Astrophysical Observatory (SAO)*.

Examples of successful collaborations exist, especially between Greenland researchers and U.S. social scientists who are working to understand the vast cultural and societal changes that are taking place in Greenland as a result of colonialization, modernization, globalization, and climate change (Appendix B). If natural and physical scientists wish to engage with communities on research and outreach, they must cultivate the skills and expertise held by social scientists. These include understanding and overcoming language barriers, cultural competency, and training in the ethical conduct of research with human subjects. These steps will make U.S. research in Greenland less of a unilateral, foreign pursuit that it is invisible to the public and can resolve questions and concerns that local citizens have regarding U.S. scientific presence in Greenland.

Both research communities seek a network and other mechanisms for sharing interests and ideas, co-developing research questions, and learning about existing research infrastructure and institutions. Collaborative efforts will help produce research and knowledge that is relevant to and communicated with communities and key stakeholders in Greenland. Working on collaborative research endeavors with students through education exchanges and training, with particular emphasis on civic collaboration, will prepare a future generation for working in this updated framework. The Greenland-U.S. relationship will strengthen if projects are tailored to meet the needs of local communities and Greenland citizens can better understand U.S. scientific presence in Greenland. This is especially important given that Greenland is still in the process of emerging from its colonial past.

Developing new approaches to Arctic research, through cooperation with scientists, communities, and stakeholders in Greenland, is a unique opportunity to contribute to “Navigating the New Arctic,” one of the *National Science Foundation’s* 10 Big Ideas. A research framework for Greenland that involves: 1) co-production by members of the U.S. and Greenland research communities, and 2) increased community engagement and student education, will place the U.S. and Greenland at the cutting edge of Arctic research. This will lead to significant advancements in understanding Earth systems and processes; cultural and social determinants of health, well-being, adaptation and survival in Greenlandic communities; and a critical examination of the ecological and economic impacts of rapid Arctic change.

Workshop Objectives and Overview

The two-day workshop was held 27-28 August 2018 at Pinngortitaleriffik, the Greenland Institute of Natural Resources, in Nuuk, Greenland. Participants were from the U.S. (19) and Greenland (29) and represented diverse backgrounds, disciplines, institutions, and government agencies. Collectively this group represents an initial U.S.-Greenland research network and is a valuable resource for points of contact (Appendix C). The group was enthusiastic about working together and optimistic that future research co-led by scientists from Greenland and the U.S. would be mutually beneficial. Participants agreed that more can be done by individuals, institutions, and funding agencies to overcome barriers for implementation of joint projects.

To explore future possibilities, participants learned about research organization and infrastructure in Greenland, participated in interactive panels and discussed how to develop and facilitate successful collaborations. In addition to structured meetings, participants interacted during an outreach event at Katuaq and during communal meals with local foods from Greenland.

The overarching goal of the workshop was to set priorities for future work and funding. The following questions were considered:

- *Research and Co-produced Research: How can we increase U.S.-Greenland collaborations on research projects in Greenland? What are the mechanisms through which scientists find collaborators in Greenland or the U.S.? What funding can be provided in support of joint projects? What infrastructure or processes would support increased and high-quality collaborations?*
- *Public Outreach: What are the best practices for researchers to approach community outreach? What institutions or infrastructure in Greenland can help support community outreach? How can the U.S. and Greenland work to improve community relations?*
- *Education and Student Training: What are the existing frameworks in support of U.S.-Greenland student exchange and training? Through what pathways can a Greenland student receive research/scientific training in the U.S. and vice versa? What training will help prepare future generations for collaborative work?*

Schedule

Monday 27 August: Day 1 of Workshop

08.30 – 10.30 Research Organization and Infrastructure

Participants were welcomed by Minister Vivian Motzfeldt and then learned about research organization and infrastructure in Greenland and the U.S. through a series of presentations.

11.00 – 12.30 Co-Production: Knowledge and Research

A panel of six experts from Greenland and the U.S. shared experiences with co-producing knowledge and research. A Q & A allowed time for all workshop participants to consider how they could adopt a co-production model in their own work.

15.00 – 17.30 Public Outreach Event at Katuaq

This feature event was opened with remarks by U.S. Ambassador to Denmark Carla Sands. Following her remarks, researchers from the U.S. and Greenland shared science with the local community at Katuaq, Nuuk's Cultural Center. The format included scientific posters, hands-on displays, and presentations. This event was followed by a reception hosted by Naalakkersuisut.

Tuesday 28 August: Day 2 of Workshop

08.30 – 09.30 The roles of Arctic Universities in Community Engagement and Education

University leaders from Greenland and the U.S. led a discussion about the role of institutions in facilitating engagement with communities (research, education and outreach).

10.00 – 12.30 Participant Contributions: Outreach, Education, and Co-Production

Workshop participants from Greenland and the U.S. gave brief presentations about projects related to the workshop topics.

13.30 – 17.30 Breakout sessions and meeting wrap-up

These forward-thinking sessions solicited participant input to frame the workshop report, including recommendations and priorities for future work. Day 2 concluded with a group dinner hosted by Dartmouth.

RECOMMENDATIONS FOR INCREASED U.S.-GREENLAND COLLABORATIONS

Research

A primary goal of the Nuuk workshop was discussing ways to increase and maintain high quality U.S.-Greenland collaborative projects, especially in the natural sciences. The group identified solutions for increasing collaborative work (Figure 1), with recognition that social scientists, and to some extent, biologists, have successfully completed co-produced research.

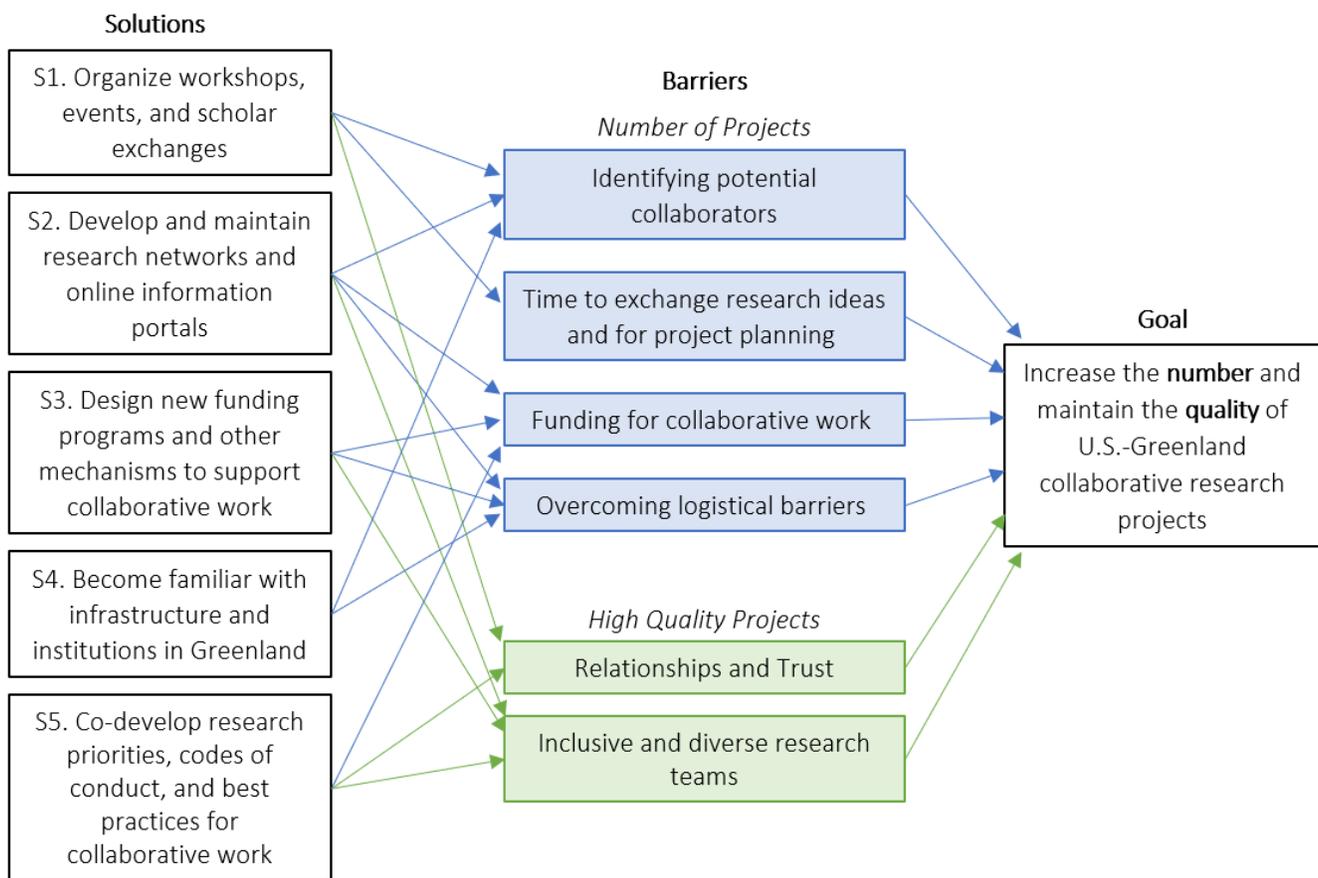


Figure 1. This diagram outlines the core barriers to successful collaborations. Five solutions (S1 – S5) are provided, many of which support multiple drivers of successful collaborations.

S1. Organize workshops, events, and scholar exchanges

The number one discussed solution for increasing and improving U.S.-Greenland research collaborations was to develop opportunities for face-to-face meetings. Individual connections at meetings, especially if they can be at regular intervals (e.g., annual or biennial), are effective at advancing collaborative work. Greenland workshop

participants noted that they often provide letters of collaboration after an initial phone or e-mail contact but that there is often no follow-up. U.S. researchers note that they have had difficulty finding and getting responses from researchers in Greenland within their discipline. In person meetings are great for initial introductions, advancing ideas, defining project roles and funding allocations, and building relationships and trust, essential elements of successful collaborative projects (Figure 1).

Some specific recommendations:

- *Host workshops in Greenland* - It is expensive and time consuming to travel to meetings from Greenland and Greenland researchers may have less flexibility in their schedule and fewer resources for travel. This is also true for Greenland students who may have difficulty in traveling to foreign venues due to travel costs and family obligations.
- *Organize and lead sessions at international meetings that feature research in Greenland*- Researchers often travel to national and international conferences to present about their work in Greenland. These conferences offer the opportunity to lead interdisciplinary sessions/symposia that feature research from particular areas of Greenland (e.g., AGU session about research around Kangerlussuaq or the Greenland Ecosystem Monitoring program sites) or focused on particular topic areas (e.g., the Greenland Ice Sheet). These events may attract a diverse group of researchers who could also participate in side meetings in advance of or after the main conference event. Organizers of these sessions should ensure that invitations are sent to researchers from Greenland to keep them connected to the broader research community.
- *Workshops and sessions should include diverse representation*- Include academic and government researchers with representation from the diverse communities in the U.S. and Greenland, early-career to senior researchers, students, and balance participants by gender. Interdisciplinary workshops that include stakeholders are essential for developing collaborations that produce a novel understanding of the Arctic as a system and identifying research priorities. This will help to leverage resources among different countries, research groups, agencies, and communities for better science (e.g., combining large-scale aircraft surveys with land- and ocean-based ground-truthing).
- *Develop scholar exchanges*- Short-term fellowships and teaching opportunities in Greenland for U.S. researchers, and vice versa, will create time for project planning, building relationships, and working with students. These can be planned year-round and could occur during the academic year (approximately September through May) because the summer months, when U.S. researchers are in Greenland, are quite busy with field work and holiday schedules. For exchanges based in Greenland, there is also the potential for visits to and project planning with local communities.

S2. Develop and maintain research networks and online information portals

The use of listservs and networking-focused websites can facilitate introductions to potential collaborators from different disciplines, agencies, and institutions (Figure 1). Interested stakeholder groups and community members should be encouraged to participate in these online networks. These websites can also provide information about ongoing projects, funding, logistics, and infrastructure. This is important for increasing the transparency of research in Greenland and so that researchers are aware of the breadth of research and research locations. These should be an initial starting point for any researcher wanting to embark on a new project in Greenland. The following four websites provide information about ongoing research in Greenland:

1. Isaaffik: The Arctic Gateway (www.isaaffik.org): Anyone engaged with Arctic research, education, infrastructure, and logistics may join Isaaffik, a web platform in support of research and collaboration.
2. Interagency Arctic Research Policy Committee (IARPC) Collaborations (www.iarpccollaborations.org): This U.S.-based website brings together scientists from Federal, State, academic, NGO, industry, indigenous and international organizations to share their work and team up to solve complex Arctic issues.
3. Arctic Research Mapping Application (www.armac.org): This interactive web map, designed for funding agencies, logistics planners, research investigators, students, and others, shows information about hundreds of projects around the Arctic.
4. The U.S. National Science Foundation's Arctic Data Center (<https://arcticdata.io/>): U.S. researchers are required to submit their data here within two years of collection, or by the end of the award, whichever comes first.

Some specific recommendations:

- Make it a requirement for U.S. researchers to register their Greenland projects at Isaaffik- Knowledge about who is where and doing what would be helpful in sharing logistics, data, and ideas, which seeds collaborations, reduces costs, and increases efficiency. This also is highly relevant to Greenland Search & Rescue, who would be able to see projects within Issaaffik.
- Create and maintain a listserv of U.S. and Greenland researchers interested in collaborations- The base of this group is the 2018 Nuuk workshop participants (Appendix C) but anyone interested in collaborations could join this listserv that could be a starting point for collaboration on ideas, projects, announcing new publications, and requests for assistance.
- Use online platforms to host webinars, post funding opportunities as well as share data, reports, and publications associated with Greenland research projects- These platforms provide potential for organizing project information and outcomes in an easily-accessible format.

S3. Design new funding programs and mechanisms to support collaborative work

Workshop participants repeatedly stressed the importance of funding mechanisms for collaborative work (Figure 1). Participants discussed how funding from the U.S. or Greenland could be used to support time and effort of foreign researchers. Participants offered the following ideas for funding and development:

- Develop pooled funding sources (across countries, agencies, institutions) that require or incentivize full participation by researchers from Greenland and the U.S.
- Government agencies and institutions in Greenland should develop a mechanism to give government researchers release time for participating in research and outreach beyond government mandates
- Ensure U.S. support for collaborative work by budgeting for sub-awards that support time and resources from local Greenland research organizations
- Organize a research coordination network that could support longer-term projects
- Develop a research hub (see S4) that includes facilities for U.S., Greenland, and international researchers to set up collaborative research spaces

S4. Become familiar with infrastructure and institutions in Greenland

One significant outcome for the U.S. workshop participants was learning about the various agencies and organizations in Greenland that support research (Appendix A). This is an essential starting point for identifying facilities and collaborators.

Briefly described at the workshop was an **International Arctic Science Hub** to be located in Nuuk. The Ministry of Higher Education and Science in Denmark and the Ministry of Industry, Energy, and Research of Naalakkersuisut are working to establish the hub to facilitate Arctic research on behalf of the Kingdom of Denmark. The headquarters will be placed in Nuuk with satellite hubs around the Kingdom of Denmark. The hub will serve as a main access point for researchers interested in collaborations. Ideally, each major town or settlement in Greenland will have a point of contact for researchers to connect with partners/students/researchers in Greenland.

S5. Co-develop research priorities, codes of conduct, and best practices for collaborative work

Future workshops can lead to the development of joint U.S.-Greenland statements of research priorities, codes of conduct, and collaborative research best practices (Figure 1). These statements and the workshops themselves will build relationships among collaborators and lead to high-quality future projects.

- *Research Priorities*- U.S. research in Greenland is driven by a diverse academic research community whereas Greenland research is mandated by the government to be relevant to society and is often directed at natural resource management and extractive industries. These are not mutually exclusive. Participants recommended development of joint research priorities and a requirement for U.S. researchers to consider how their work is relevant to and of benefit to Greenland society. This would make it easier for Greenland researchers to participate in U.S.-funded projects.
- *Codes of Conduct and Best Practices*- Communication from start to finish is essential for equal and successful partnerships. Idea and hypothesis generation should involve researchers from the U.S. and Greenland and stakeholders/institutions in Greenland (e.g., local communities, Inuit Circumpolar Council (ICC), Ilisimatusarfik, the Hunter and Fisher Association (KNAPK)). Methods should be jointly developed. Resources should be pooled to overcome logistical issues (e.g., community members doing field sampling, institutions doing lab work). All research participants should discuss how to share results and be involved with some aspect of dissemination (outreach, reports, publications, and presentations).

Co-Produced Research

The research community and the political system in Greenland are particularly concerned with the involvement of Indigenous and local knowledge in research and the development of communities in Greenland. There is a large push for research that directly benefits and involves society, and it is important for researchers to engage in issues that are of importance to Greenland society. U.S. researchers, particularly natural and physical scientists, often arrive in Greenland with project ideas that were developed without direct engagement with communities or potential colleagues in Greenland.

True co-production of knowledge means working together from the very beginning, formulating research questions together and collaboratively determining how to proceed to answer them. A priority is identifying overlapping interests and concerns, and strengthening the involvement of fishers, hunters, and other stakeholders interested in the documentation and management of natural resources (e.g., see PISUNA in Appendix B).

The preliminary work for co-production requires creating opportunities for people to develop relationships that will lead to collaboration. Researchers must build formal and informal networks and connect with local researchers and community members. The most important element of this is time. Participants suggested that it takes at least a year to year-and-a-half to build capacity, find research contacts, and develop trust and relationships that are essential for collaborations. Ideally this happens during proposal development. Participants also suggested that time and funding for developing collaborations should be built into proposals, despite the short funding cycles (3-5 years) of U.S. research projects.

Multiple groups have a role in building capacity for co-production of research:

1. *The research community in Greenland* is relatively small and could be nurtured by developing a research pipeline to inspire and train young people from Greenland to become independent researchers in Greenland. This is one goal of the Joint Science Education Project. Growing this community is important because Greenland researchers have huge demands on their time for international collaborations and community outreach.
2. *Educators (teachers, professors) in Greenland and the U.S.* must be trained to teach and embrace models of co-production of knowledge and to provide opportunities for students to meet and listen to Greenland communities before they begin their work. An open question is if and how to involve Greenland and U.S. teachers in the co-production of knowledge beyond training students. U.S. researchers, who are often professors who mentor students, should embrace co-production and emphasize its importance to research in Greenland.
3. *The general public in Greenland* may lack an understanding of what research is and what benefits it can bring them. Thus, they may not be in a good position to formulate questions in collaboration with researchers. This is an important area where Greenland researchers can build public understanding and support for long-term collaborations with U.S. and international scientists. There is also no obvious mechanism for gathering information from the public, especially given the presence of language barriers. One proposed solution is inviting people from Greenland to attend scientific meetings, where they can learn about research and give input about community interests and needs. One example is the Ilulissat Climate Days meeting that took place 2-5 June 2015 and involved both scientists and stakeholders in discussions on cryosphere changes and their effects on the Greenland environment and society. For these events to be successful, funding must be available to support the participation of Greenland community members. Even if the meeting takes place in Greenland, travel costs can be prohibitive.

Public Outreach

People in Greenland are often aware of foreign researchers working in local field stations or as they transit through to more remote field camps. However, there is often little interaction among community members and researchers unless this is part of the funded work. In some instances, community members have expressed frustration at the influx of foreign researchers who have significant impacts on local resources such as housing. Participants recounted interactions with community members who questioned the need for researchers to be in Greenland as the direct benefits are not apparent.

All agree that there is room for significant improvement with regards to public outreach. Ideas offered by Greenland participants were particularly valuable and appreciated because of their understanding of the nuances of communication and best practices for outreach in Greenland communities.

General recommendations:

- Public outreach should be prioritized as an explicit goal of all projects conducted in Greenland regardless of funding source
- Resources (time and money) should be allocated to outreach
- Researchers should emphasize the benefits of research to Greenland society beyond global impacts (e.g., enhanced education and training opportunities, improved infrastructure, improved natural resource use and management)
- Think of outreach as a conversation with the public rather than a one-sided presentation. Researchers should try to respond to requests from Greenlanders for information or action on questions that the Greenlanders raise
- Use Greenlandic names to refer to major equipment installations
- If possible, partner with a Greenland scientist or translator to overcome language barriers - one participant noted that more Greenland citizens ask questions when presentations are in Greenlandic
- The International Arctic Hub in Nuuk could facilitate outreach in communities, especially if there is a dedicated person to coordinate and facilitate community outreach and assist with translations

Specific recommendations for reaching the Greenland public:

- *Radio and Local Advertising*- Seek interest from Kalaallit Nunaata Radio (KNR) and Sermitsiaq, the print media outlet (sermitsiaq.ag). Both broadcast nationally and are ubiquitous ways for the public to learn about news and events in Greenland. These venues are a significant way to advertise science outreach events, as is using local flyers in bus stops and Nuuk Ugeavis, the free newspaper in Nuuk. One exciting idea from the workshop is to connect researchers with Ilisimatusarfik journalism students, who can collaboratively work to convey information about research and results to the public through radio stories and written articles for the local free newspaper in Nuuk.
- *Social Media*- Researchers use Twitter for science communication and outreach, however, in Greenland, Facebook (and Instagram, secondarily) is the best way to reach the public. Posting events on Facebook and tagging colleagues or friends in Greenland is a fast way to spread awareness of research projects and outreach events.

Opportunities for Outreach in Greenland:

Online

Every town in Greenland has a computer with 4G internet that is available to anyone living in or near that town. A well-known website that is regularly maintained within Greenland, freely available, and that already has a lot of other information on it should have a tab created for “Outreach”. Someone clicking on that tab would be able to see science outreach film clips and science classroom activities that are crafted to be easily understood by a Greenland citizen. Isaaffik (www.Isaaffik.org) is already widely known, recognized, and regularly maintained. Outreach materials could include:

- Science videos and podcasts: 5-7 minute brief, interesting podcasts about science results that are relevant to the citizens of Greenland. If possible, each podcast should be in multiple languages, including English and Greenlandic. The podcast should be posted on YouTube, linked on Isaaffik, and could also be linked to the official YouTube channel of Ilisimatusarfik. When the research is a partnership between scientists from other nations and Greenland community-scientists, both the local and the international scientist should be included within the footage and in the design of the video or podcast
- Science lessons for classrooms in Greenland: The lessons should be pedagogically sound (e.g. follow guidance in the U.S. National Science Standards), easily understood, use materials readily available in remote communities*, and should be accompanied by a teacher’s guide to help the local teacher be prepared to use the material in his/her classroom. *Some materials, including paper-handouts and posters, may need to be sent to communities because access to printing is very limited in the smallest communities. Also, there needs to be an avenue to connect local teachers to these materials (perhaps through the Ministry of Education in Greenland and the Institute of Learning at Ilisimatusarfik).
- Visualizations of projects and their data: NASA has amazing visualizations, freely available at the NASA Science Visualization Studio (SVS): svs.gsfc.nasa.gov

Greenland Science Week in Nuuk

There has been a polar research day every year in Denmark that Greenland researchers attend, and, excitingly, this event is moving to Nuuk and is scheduled for 2-5 December 2019 as “Greenland Science Week”. This and future events will be a significant venue to showcase research by Greenland and international scientists. It may also be worth exploring satellite versions in smaller towns with at least one researcher from each the U.S. and Greenland in attendance. Participants suggested a good model for this event is the annual Culture Night in Nuuk, when most businesses and institutions are open to the public and host various displays, exhibitions, and activities. This has included the Greenland Institute of Natural Resources hands-on display and the Greenland National Museum and Archive exhibit and history quiz game, which are well attended in part because bus services are free during this period to encourage residents to attend. If U.S. researchers are unable to travel to partake in this important event, they could design and provide the materials for hands-on activities to partners at research institutions in Greenland. For part of the Nuuk workshop, we hosted such an event at Katuaq (see Insert below).

Outreach in towns where field work is conducted

Scientists coming to Greenland should work with local scientists well before their arrival to organize an event at a local venue (e.g., airport, community center in Pituffik/Qaanaaq), which would then occur while the visiting scientist is in town. One possible format is having the scientist briefly talk about a research topic, allowing a lot of time to answer questions from the audience about their talk or on a range of scientific topics suggested by attendees. One currently implemented outreach event occurs at the Kangerlussuaq airport each summer during the Joint Science Education Project. Students put together displays and hands-on activities and because the teams include students from the U.S., Denmark, and Greenland, they can share their science projects and answer questions in Greenlandic, Danish, and English.

Greenland National Museum and Archives

The Greenland National Museum and Archives is tasked with protecting, preserving and disseminating information on the entirety of Greenland’s cultural history and intangible heritage. From a management standpoint, this is a daunting task as the sheer size of Greenland presents incredible logistical challenges to accessing remote parts of the country. The National Museum also holds an obligation to perform research and disseminate information on new discoveries related to Greenland’s natural history. Therefore, the National Museum has a standing interest in promoting and participating in collaborative projects that bridge the natural and social sciences and can combine cultural resource management (i.e. heritage & archaeology) with environmental/climate science. The National museum lacks funds, exhibition space and expertise in the natural history of Greenland and would like to incorporate more natural history and science into their larger public outreach efforts and in the process help scientists make their discoveries more accessible. As there is not a lot of space in the museum for full exhibitions, the Museum has offered to post videos and develop new virtual platforms on the museum’s website and Facebook page and possibly KNR that help promote scientific literacy and general interest in local scientific research. Again, the target audience would be both local and international, with translations provided in Greenlandic, Danish and English.

Public outreach event at Katuaq

As part of the workshop, researchers from the U.S. and Greenland set up hands-on exhibits and shared science with the community at a two-hour event at Katuaq, Nuuk’s Cultural Center. This feature event was opened with remarks by U.S. Ambassador to Denmark Carla Sands. Following her remarks, researchers from the U.S. and Greenland used various formats for communication. Some participants elected to prepare a five-minute presentation describing their project and research for the general public. The talks included a personal dimension, i.e., ensuring to introduce yourself, your background, and tell a little bit about your story of being a researcher in Greenland. We displayed over ten posters that described various projects in Greenland led by U.S. and/or Greenland researchers and we had a collection of hands-on exhibits featuring photographs, videos, scientific equipment, and field samples.

Photos by Bo Gregersen (left, center) and Lauren Culler (right).

Exploring Science in Greenland
U.S. and Greenland partnerships

Presentations and Exhibits by Scientists from Greenland and the U.S.

MONDAY 27. AUGUST 2018
15.00 - 17.00 at KATUAQ
FREE ENTRY
Activities for Children

NAALAKKERSUUT
GOVERNMENT OF GREENLAND

NIS
NUNAKTSINI ILIUMATSUNERIS
SUNNERSUQATIGIT

DARTMOUTH

KATUAQ

NSI



Education

Participants discussed how to educate and train the next generation of Greenland and U.S. researchers. Greenland researchers indicated a need for students and interns with basic scientific training as well as with technical skills such as remote sensing and GIS (geographic information systems). U.S. and Greenland students can be prepared for collaborative work if it's emphasized in their training.

Specific recommendations include:

Develop greater access to STEM resources and courses in Greenland -

- Greenland schools want more science materials (education modules, lesson plans, textbooks etc.) in Kalaallisut (Greenlandic), especially inquiry-driven materials. Researchers and Embassy Science Fellows could work with the publishing house in Nuuk, with teachers, the teachers' college, and the Ministry of Education to develop science materials in Kalaallisut.
- Participants were excited about the idea of developing and leading research-based science courses and a possible science degree at Ilisimatusarfik. More visiting lecturers from the U.S. offering lectures or short courses at Ilisimatusarfik would be helpful in broadening the curriculum and adding English coursework.
- Ph.D. courses combined with a workshop in Greenland is another way to train and engage the next generation in research and build networks. For example, from 2-9 October 2019, Ilisimatusarfik will host the Ph.D. course "Community based health research – methods and strategies." As part of that course, students will develop presentations to give at NUNAMED 2019, a conference on Greenlandic health and medicine (5-7 October 2019, www.nunamed.org).
- Continue to implement summer school programs that include Greenland students. A successful model is the U.S. NSF- and Naalakkersuisut-funded Joint Science Education Project (see *Insert* below) but other courses should be developed (e.g., a course focused on holistic management of natural resources in rapidly changing environments) including for students of all age groups.
- Online Courses and online certificate programs, such as those offered by the University of Alaska-Fairbanks might be another avenue for Greenland students to access coursework. While this would not lead to completed degrees, the students could transfer some of these credits into Ilisimatusarfik degree programs.

Develop and encourage student exchanges or mechanism for Greenland students to study in the United States and vice versa- The education of Greenland researchers in Denmark has built a strong base of collaboration. An equivalent pathway in the U.S. would facilitate U.S.-Greenland collaborations. There is also desire for greater access for Greenland students to study in the U.S., with U.S. government support in acknowledgement of Greenland's engagement with the U.S. for research and security missions. U.S. hosts could have students participate in labs as visiting researchers without having to enroll and pay tuition. U.S. universities with a large funding effort in Greenland should pursue self-funding their student and faculty exchange programs. Even at very modest scale, these efforts will be impactful in building reciprocal relationship. For example, each year since 2009 the Institute of Arctic Studies has funded a student from Ilisimatusarfik to spend a term at Dartmouth and this relationship has grown where recently Dartmouth students can now spend a term at Ilisimatusarfik.

Connect Indigenous U.S. and Greenland undergraduates- This would aid Greenland students in identifying with science to a greater degree and introduce U.S. Indigenous students to the research collaborations operating in Greenland. This would produce greater interest and access to Arctic physical and social sciences among Indigenous students.

Provide training for teachers- The U.S. Embassy in Copenhagen, Naalakkersuisut, and Ilisimatusarfik are recruiting an Embassy Science Fellow to work with the teachers' college in Greenland to identify their interests and needs, some of which include creating hands-on materials and inquiry-based field teaching, and how to teach science to different age groups. An example from the U.S. is the NSF-funded School of Ice Project that trains educators about teaching polar science. Other programs that focused on hydrology, geology, biology, etc. would also be appreciated. This would also provide more English instruction, which could help Greenland students connect with the broader scientific community.

The Joint Science Education Project (JSEP)

JSEP is a U.S.-Greenland collaboration funded by the U.S. National Science Foundation and Naalakkersuisut. Each summer since 2009, high school students from Greenland, Denmark, and the U.S. travel to Greenland to study rapid environmental change. The program is based in tundra ecosystems around Kangerlussuaq and on the Greenland Ice Sheet at research sites such as the U.S. Summit Camp or the Danish East Greenland Ice Core Project (EGRIP). Throughout the program, students work in the field alongside scientists and graduate students to get hands-on experience in interdisciplinary field research and the process of science beyond what most classrooms can offer. Students complete inquiry-driven projects that they then present at an outreach event the airport in Kangerlussuaq where they reach hundreds of people traveling to, from, and around Greenland. Giving the students a voice to share their discoveries is an important step for preparing them as future leaders. Built in to the program is intentional cultural sharing- the educators & students host a U.S. night, Denmark night, & Greenland night. This fosters open and creative multicultural research teams that represent the future of U.S.-Greenland research. Importantly, JSEP also gets Greenland students engaged in research and onto the Greenland Ice Sheet, a massive part of the Greenland landscape that is largely inaccessible to Greenland students and the public. *Photos by Lars Demant-Poort.*



CONCLUDING REMARKS BY AUTHORS

We are overwhelmingly appreciative of the efforts of our esteemed colleagues at this workshop for openly and enthusiastically discussing opportunities and actions to enhance U.S.-Greenland research collaborations. Naalakkersuisut (the Government of Greenland) and our many partners in Nuuk offered an excellent environment and venue for our dialogue and network building. It was apparent to all that this workshop was a watershed event in identifying pathways for joint long-term productive relationships and programs. We have done our best to capture the dialogue and recommendations made by the participants and take responsibility for any omissions.

We hope that this report and the specific recommendations are helpful to the broader research communities and to stakeholders in Greenland. We hope the report will also help U.S. funding agencies understand the opportunities and challenges facing interdisciplinary and international collaborative research in Greenland. From this workshop we have an emerging network of institutions, centers, and researchers who can share their perspectives and knowledge of how to better conduct and share research with Greenland and the public.

We wish to thank the following for their direct support of this workshop: Naalakkersuisut (the Government of Greenland), the U.S. National Science Foundation (award #1837806 to L.E. Culler and R.A. Virginia); Pinngortitaleriffik (the Greenland Institute of Natural Resources) for meeting space and their active participation; Kalaallit Nunaanni Ilisimatusarnermut Siunnersuisoqatigiit (the Greenland Research Council); the National Aeronautics and Space Administration (NASA); the Smithsonian Astrophysical Observatory (SAO), and CH2MHill Polar Services. We thank all participants for their willingness to be in Nuuk and dedicate their time to this important workshop.

Research is about science, knowledge, and understanding, all of which are impossible without people. We are confident that our workshop has brought about new and stronger partnerships among the Greenland and U.S. research communities, connections that are critical for addressing urgent scientific issues related to rapid rates of Arctic change and its impacts on Greenland and global society.

APPENDICES

Appendix A - Greenland and U.S. Research

An overview of the extent of research in Greenland funded by the U.S. and Greenland.

Greenland

The Greenland Research Council, a national and independent organization, promotes and strengthens research that is rooted in and benefits Greenland. In Greenland, over 100 projects since 2016 have been conducted by Greenland institutions such as Asiaq, Pinngortitaleriffik, and Ilisimatusarfik (Table A1). Most of these projects are location along the coastal areas (Figure A1). Danish agencies and institutions have supported a similar amount of research projects in Greenland.

Pinngortitaleriffik, Greenland’s Institute of Natural Resources, has office and laboratory facilities in Nuuk that are home to the Department of Fish and Shellfish, the Department of Birds and Mammals, and the Department of Environment and Mineral Resources. The Greenland Climate Research Centre is embedded in Pinngortitaleriffik and conducts research about the effects of climate change on the Arctic environment and Greenlandic society. Pinngortitaleriffik also has an established field station in Niaqornat. Greenland also maintains the Kobbefjord Research Station outside of Nuuk and the Zackenberg Research Station, which is owned by the Government of Greenland but run by Aarhus University (Denmark). The Arctic Station in Qeqertarsuaq is maintained by the University of Copenhagen. The Government of Greenland maintains and runs the Kangerlussuaq International Science Support (KISS) building in Kangerlussuaq, which provides accommodations and laboratory space for international scientists.

Table A1. A list of the major organizations and institutions in Greenland that support and conduct research.

- [Asiaq Greenland Survey](#)
- [Center for Arktisk Teknologi \(ARTEK\)](#)
- [Dronning Ingrid's Hospital i Nuuk \(SANA\)](#)
- [Geological Survey of Denmark and Greenland – GEUS, Nuuk Office](#)
- [Greenland National Museum & Archives](#)
- [Greenland Representation in D.C.](#)
- [Greenland Research Council](#)
- [Ilisimatusarfik – University of Greenland](#)
 - [Greenland Centre for Health Resources](#)
 - [Greenland Perspective](#)
- [Inerisaavik \(Pædagogisk Center\)](#)
- [Ministry of Industry, Energy and Research](#)
- [Ministry of Fisheries, Hunting & Agriculture](#)
- [Ministry of Mineral Resources and Labour](#)
- [Mineral License and Safety Authority](#)
- [Pinngortitaleriffik – Greenland Institute of Natural Resources](#)
 - [Greenland Climate Research Centre](#)
- [Statistics Greenland](#)



Figure A1. The locations and numbers of Greenland-funded projects since 2016. Green nodes indicate there is one project at site location. Map generated on 4/30/2019, for updates, visit: www.isaafik.org.

United States

In any given year, 250-300 U.S. researchers travel to Greenland as part of approximately 50 different projects. There are about 100 project locations (Figure A2), however, many are semi-autonomous instruments. The U.S. National Science Foundation's Research Support and Logistics (RSL) program coordinates support of NSF-funded research as well as research funded by other government agencies. RSL, whenever possible, relies on local Greenland infrastructure and resources (e.g., Air Greenland, Royal Arctic Shipping, Mittarfeqarfiit, KISS). The U.S. built and maintains Summit Station, the only high altitude, high latitude, inland, year-round observing station in the Arctic.

U.S. research in Greenland is funded by government agencies such as the [National Science Foundation](#), the [National Aeronautics and Space Administration \(NASA\)](#), the [National Institutes of Health \(NIH\)](#), the [National Oceanic and Atmospheric Administration \(NOAA\)](#), and the [Smithsonian Astrophysical Observatory \(SAO\)](#). These entities fund projects that are led by principal investigators at public and private universities and non-governmental organizations (far too many to list here). The research spans many disciplines and covers many remote parts of Greenland (Figure A2). The NSF RSL works work the U.S. Air Force and the U.S. Air National Guard to provide transportation to/from and around Greenland research sites. A logistics contractor, currently CH2MHill Polar Services, helps cover the unique logistics needs for each project.

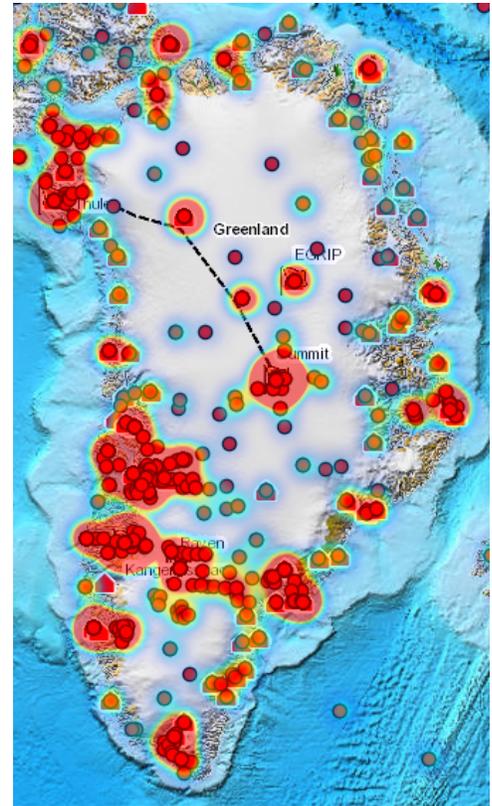


Figure A2. The locations of U.S.-supported field-based research in Greenland since 1999. Map generated on 04/30/2019, for updates, visit: [ARMAP.org](#).

Appendix B - Examples of Co-Produced Research

Three examples of U.S.-Greenland collaborative projects.

Example 1: Piniakkanik sumiiffinni nalunaarsuineq (PISUNA)

PISUNA (<http://www.pisuna.org>) is a project that involves local people in the documentation and management of the environment and living resources in Greenland. The Nordic Council Environment Prize in 2018 was awarded to the Natural Resource Council of Attu, West Greenland, who is tasked with collecting information and observations from fishers and hunters in the community. The award recognized the value of the local council in documenting the marine environment and proposing new ways of managing it. The PISUNA project has worked with the NSF-supported Exchange for Local Observations and Knowledge of the Arctic (ELOKA, <https://eloka-arctic.org/pisuna-net/en>) and the University of Alaska Fairbanks' Alaska Arctic Observatory and Knowledge Hub (A-OK, <https://arctic-aok.org/>) to jointly develop a database and interface for sharing community-based observations that can help inform management of marine living resources (<https://eloka-arctic.org/pisuna-net/en>). The exchange of information and best practices between the project in Alaska and that in Greenland, along with involvement from the ground up of the ELOKA data management experts resulted in a co-produced tool that further empowers local Greenland fishers and hunters to share observations amongst themselves for better resource management.

Example 2: The Rockwell Kent and Early Twentieth Century Greenland Project

This collaborative study combines visual, historical and anthropological methodologies to approach how social, cultural and environmental changes and continuities are constructed and experienced in Greenland. The project started with the work of Rockwell Kent, an American artist and writer, who resided in Greenland in the early 1930s and produced an extensive collection of photographs, art, and literature about his time in the country. Prior to the start of research, the PI and Co-PIs (2 from U.S. institutions and 2 from Ilisimatusarfik) visited the study communities of Illorsuit, Sisimiut, Nuuk, and Uummannaq, discussed the project, displayed Kent's art and photographic works and gathered community feedback which was incorporated into the research design. In the later research stage, Kent's work served as a starting point to engage communities and discuss how social, cultural and environmental changes as well as continuities with the past are understood and defined. Interviews were conducted with community members focusing on the transitions they have experienced in their own lives and in the life of their town/city. Community members were also asked about their knowledge of Kent and his work related to Greenland. In an effort to engage youth in this research and incorporate their perspectives into the project, photographic workshops were carried out with the aid of local schools in 2017/2018 in each of the study communities. During the 1-2 week workshops, the researchers with the aid of local teachers met with students and presented a brief history of photography, lessons in basic photographic techniques and



Photo: Denis Defibaugh

provided students with cameras. Students were asked to take photos of their families, communities, hopes and dreams and keep a photo journal. Participants produced over 1000 photographs during the workshops. After initial analysis, part of the research team returned to each of the study communities in late 2018 and met with workshop participants again to examine their photos and write captions which will be used in a book of the student photos. The researchers have efforted to incorporate students into the various stages of research, thus the ability to return to study communities and meet with workshop participants has been essential. All participants will receive their photos on a USB drive and a copy of the photobook and the proceeds from any sales of the book will be donated to a children's charity in Greenland. The incorporation of youth with the aid of local schools and teachers was an indispensable component of this research allowing for a glimpse into how young people in Greenland see their own time, their social lives and their hopes and dreams for the future. The visual is crucial, not only for how we culturally construct our world, but for what we see, how we see, what it means to us, and how it affects us.

Example 3: Population Dynamics in Greenland: A Multi-component Mixed-methods Study of the Dynamics of Pregnancy in Greenland (PDG)

PDG examined how decisions regarding conception, pregnancy and parenthood are shaped by multiple interacting constraints and influences in Kullorsuaq, an indigenous, predominantly youthful, northern community in Greenland undergoing economic and environmental changes. PDG was a community based participatory research study (CBPR). The study's theoretical framework combined ecological systems theory with traditional knowledge to investigate the complexity of factors that create the context in which people in Kullorsuaq make reproductive decisions. Data collection strategies included semi structured in-depth interviews and ethnographic methods. There were three overarching PDG findings. First, CBPR is an effective method to engage community members in the Arctic. Second, the positionality of the research team within the community creates a psycho-social-emotional relationship between research team members and community members. Third, reproductive health in Kullorsuaq is influenced by an interplay of cultural, social, economic, and environmental factors in the community as well as within the large context of Greenland's political, social service, and health care system. Improving reproductive health outcomes in Kullorsuaq requires a multi-faceted approach. At an individual level culturally relevant sexual and reproductive health education and skill building that addresses communicating about sex, birth control and pregnancy with sex partners and within families and strategies for developing and maintaining healthy intimate relationships is need. At the family level interventions are required that support clear boundaries and expectations within families related to having and raising children. At the community level social norms grounded in pro-cultural beliefs and practices that promote respectful relationships between individuals, couples, and families are warranted. At a political systems level development in the infrastructure that establish culturally relevant educational, social and health care services that are based on the needs of people in Kullorsuaq and Greenlanders are necessary.

Appendix C - Participant List

Greenland

Mikkel Høegh Bojesen is a Remote Sensing and GIS analyst at Asiaq, Nuuk, where he works on research and development projects, producing topographic maps and mapping of natural resources. He has also been very involved in the Arctic DEM initiative, assisting in the improvement of the Greenland portion, in collaboration with the Polar Geospatial Center, University of Minnesota. Before coming to Asiaq, Mikkel worked eight years at the University of Copenhagen, conducting research and teaching on topics related to GIS, spatial multi criteria decision making and natural resource management, mainly within agriculture. He earned his PhD in Environmental and Natural Resource Economics and has an educational background in forest management also from the University of Copenhagen.

Lars Demant-Poort has lived in Greenland since 2002, working in science education. He has served as a public-school teacher, consultant of science and now as an Assistant Professor of Science Education at the University of Greenland. During the past six years, his research in science education at the public-school level has been centered around three major topics of interest: structural conditions for students' science learning and interest development; how nature and the outdoors is part of teaching; and, student experience of science teaching.

Klaus Georg Hansen is a PhD in planning, social anthropology and Greenlandic culture and language. He currently serves as the Head of the Interior Division for the Government of Greenland. His research topics include colonial history of Greenland, kayak dizziness, demography in the Arctic, and large-scale industrial development in the Arctic. Communication and outreach have always been of high priority, as Dr. Hansen has focused on communication to and with a broad audience as well as with scientific communities through conference papers, scientific articles, public presentations, newspaper articles, radio, and film. He has previously held positions in Greenland as the head of the national library, head of Sisimiut Museum, head of division of national spatial planning, head of faculty at Ilisimatusarfik, and deputy director at Nordregio (Sweden). Currently, Dr. Hansen is involved in two USA lead research projects: ASUS (societal sustainability in the Arctic) and Arctic PIRE (sustainably cities in the Arctic).

Hans Husyan Harmsen is an Archaeologist and Curator at the Greenland National Museum and Archives in Nuuk, Greenland. He completed his PhD from the University at Buffalo's Department of Anthropology in 2017 with a focus on exploring prehistoric human responses to environmental change along the southeast coast of Sri Lanka and has participated in NSF-funded archaeological projects in Kamchatka and the Aleutian Islands. He is the former Associate Director of the University at Buffalo's Social Systems GIS Laboratory and still connected to UB's Department of Anthropology as a Research Assistant Professor. Over the past two years he has been involved as a research partner in the REMAINS of Greenland project, exploring the effects of a shifting climate on the preservation of archaeological deposits in West Greenland and the consequent challenges to protecting and preserving Greenland's cultural heritage.

Julie Hollis is the Head of Department of Geology in the Ministry of Mineral Resources, Government of Greenland. Julie is a geologist with fifteen years' experience in Australia and Greenland, managing regional geoscience projects focused on producing new geological maps. The focus of her and the Department of Geology's work is to promote exploration investment by delivering geoscience data and advice. Julie received her BSc in Geology from the University of Sydney and PhD from the University of Edinburgh. She has worked as a postdoctoral researcher and for three different geological survey organizations in Australia and Denmark before starting with the Ministry of Mineral Resources in Greenland almost four years ago.

Lene Kielsen Holm is Research Scientist and Project Leader in the Climate and Society Research Group at the Greenland Climate Research Centre. She is an anthropologist who has worked on environmental and Indigenous Peoples issues for the past 20 years and has led several projects significant to the Inuit in Greenland and other Inuit regions of the Arctic. She has been advocating for the inclusion of the Indigenous Peoples knowledge in research throughout the Arctic.

Thomas Juul-Pedersen has been involved in Arctic research for the past 17 years and holds a PhD degree in Arctic marine biology. He works as a research scientist and education coordinator at the Greenland Climate Research Centre, at the Greenland Institute of Natural Resources, studying Arctic marine ecosystems and the effects of climate change. Thomas has been managing and participating in two ongoing marine monitoring programs since 2008 and has spent more than a year in the field onboard scientific research vessels and at various field camps. He also teaches and coordinates natural science education at the Greenland Institute of Natural Resources. Thomas lives and works permanently in Nuuk, Greenland. Before coming to Greenland, Thomas did a PhD in Canada working with the high-Arctic marine ecosystems. He collaborates with many institutions outside Greenland, often presenting and promoting research in Greenland at meetings, workshops and in different international working groups.

Kirsty Langley is a Researcher in the fields of climate and cryosphere within the Greenland Ecosystem Monitoring Program. She has been based at Asiaq, Nuuk, since 2015, working on remote sensing projects focused on hydrology, climate and the environment. Diverse projects span topics from characterization of coastal environments to ice-marginal lakes, rock glaciers and peripheral glaciers. She has a PhD in Geophysics and Glaciology from the University of Oslo, a MSc in Geophysics from the University of Iceland and a BSc in Geophysics from University College London.

Mítdlârak Lennert is a PhD fellow at the Institute of Social Science, Economics and Journalism, University of Greenland. Her research interests are in the area of education policy and developmental evaluation. She is currently researching the reform processes in the Greenlandic education system. Specifically, Mítdlârak is interested in what type of data and information are gathered and used in the different levels of management in the education system – the Self-government, the municipalities and the public schools – with a focus on management forms and their evaluation and monitoring processes. The main objective of her Ph.D. project is to analyze the Greenland education governance system and how the central level design, organize and steer education systems across complex multilevel governance arrangements. In governing educational systems, she aims to access how the central and the decentralized levels interact and communicate and how this affects trust, cooperation and negotiation of conflicts.

Nette Levermann is the Head of Section, Ministry of Fisheries, Hunting and Agriculture.

Sten Lund is the lead GL coordinator for the Nuuk workshop. He has been Research Coordinator since 2014 at the Government of Greenland. He is educated M.Sc. in Public Administration. Sten is responsible for managing research legislation in Greenland, coordinating research initiatives, thereby ensuring the realization of Naalakkersuisut's objectives in research policy. Coordinate contact between authorities and the research community. Providing and managing dissemination with a view to anchoring research for the benefit of Greenlandic society. Sten has solid knowledge of the political system's development in Greenland and is often used as a political expert in the Greenlandic media.

Arnajaaq Lyngø is Secretary for the Greenland Research Council. The Greenland Research Council works to promote and strengthen Greenlandic research, which is rooted in and benefits Greenland. In her position, Arnajaaq disseminates PhD and postdoc projects, communicates statistics on all the projects the Council funds, and reports when projects wholly or partially are finished. She also disseminates research strategies of

Greenland's research institutions. Arnajaaq earned a Masters in Social Sciences from Ilisimatusarfik, University of Greenland in 2017.

Christian Koch Madsen is an archaeologist and postdoctoral researcher at the Greenland National Museum & Archives / National Museum of Denmark. During the last 15 years, he has worked with Greenland's archaeology and cultural heritage by participating in and directing both research and cultural resource management projects. In his own research, Christian has specialized in the landscape and settlement archaeology of Greenland's medieval Norse settlements, although his current position allows him to work in numerous ways with all of Greenland's history. Some of these projects have been made possible only by NSF-funding, not at least through the international research cooperative of the North Atlantic Biocultural Organization (NABO). Continuous regional research investment as that sustained by NABO for more than a decade is one of the strongest tools for providing new perspectives on complex human-ecodynamics in the Arctic through deep local knowledge and local friendships.

Eva Mätzler is a researcher and head of Remote Sensing at Asiaq Greenland Survey. She is a geologist from the University of Berne in Switzerland and has worked at Asiaq since 2008. She is involved in research projects focused on climate and environment, specifically on topics such as ice-marginal lakes, permafrost degradation, hazard assessments and coastal studies.

Kirstine Eiby Møller is a curator in the Greenland National Museum and Archives with specialization in intangible cultural heritage and the UNESCO convention for the Safeguarding of the Intangible Cultural Heritage. She has a background in archaeology and holds a MA in Sustainable Heritage Management. She is interested in the way heritage renegotiates histories, memories, identities and emotions as articulated in policies and practices. More specifically, her work examines how intangible heritage practices undergoes changes, revitalization or are intentionally forgotten. She is currently a guest lecturer at Ilisimatusarfik, the University of Greenland, and teaches the undergraduate course "The history of Greenland and didactics of history".

Gert Mulvad is a MD, GP, Doctor h.c., at the Greenland Center for Health Research, Ilisimatusarfik, University of Greenland. He is also a family physician at the Centre for Primary Health Care in Nuuk, Greenland. He has been working in Nuuk since 1986. His areas of research include traditional food risks/benefits and family health. He serves on many committees involved in health care delivery, research and education in Greenland and is Chair of the Greenland Institute of Natural Resources. He received a Doctor PhD honoris causa in 2015 from Ilisimatusarfik, University of Greenland. Internationally, he is active in AMAP Human Health working group, Committee for Inuit Circumpolar Health, Chair of the Arctic Health and well-being network under the University of the Arctic.

Josephine Nymand is the co-lead GL coordinator for the Nuuk workshop, she is a biologist and holds a PhD in wildlife population biology and an MSc in petrel breeding biology from the University of Copenhagen. She is presently chair of the Greenland Research Council, to which she was appointed in 2017. Josephine is also head of the Department of Environment and Mineral Resources at the Greenland Institute of Natural Resources (GINR). Josephine is native to Greenland and has been engaged in research topics related to Greenland since she was an undergraduate student at the University of Copenhagen. Applied science has always been an important aspect of her work. Since 2007, Josephine has worked as a scientist at GINR, monitoring the effects of climate change on terrestrial ecosystems, assessing the impact of caribou grazing on vegetation, and giving management advice to the Greenland Government about the sustainable use of caribou and muskoxen. Before working at GINR, Josephine spent several years working at the Danish National Environmental Research Institute (now Danish Centre for Environment and Energy). Josephine has hands-on experience with incorporating local knowledge and

traditional use of resources into oil spill sensitivity atlases. Presently, Josephine is lead scientist in the group advising the Government of Greenland on environmental issues related to the extractive industry.

Allan Olsen is a research coordinator at Greenland Perspective working out of Ilisimatusarfik, the University of Greenland in Nuuk. He focuses on anchoring science about Greenland in the Greenlandic science community to contribute to building up competence and capacity of the Greenlandic research institutions in collaboration with local and international partners. He also focuses on activating research into the Greenlandic society, connecting research projects with the Greenlandic society, business community and authorities. Allan is currently facilitating an agricultural research network in Greenland with a report expected in 2019, initiating a research collaboration looking into the Greenlandic labour market and heads the organizing committee behind the upcoming Greenland Week of Science & Polar Researcher Day conference in December 2019. Allan is an MSc in Social Science from the University of Aarhus.

Hans Kristian Olsen is the AS Research Coordinator at Ilisimatusarfik - The University of Greenland and former CEO of NUNAOIL A/S, the National Oil Company of Greenland. He has experience in petroleum and mineral exploration as a geologist and as president and vice president in private companies and at the Bureau of Minerals and Petroleum in Greenland. He received a M. Sc. in geology from the University of Aarhus, Denmark in 1988, a Diploma of Management from Aarhus Business College, Denmark in 2002, and an MBA from the University of Aalborg, Denmark in 2014.

Martin Olsen is Head of Department for Hydrology, Climate and Environment at Asiaq Greenland Survey, where he has been employed since 2017. His department is responsible for the Climate Basis activities under the Greenland Ecosystem Monitoring Program, as well as the Greenlandic National Weather Observations Network and the Hydrological Observations Network for hydropower potentials on the West coast of Greenland. He holds a Ph.D. in Environmental Science, an M.S. in Environmental Biology and Geography and a B.S. in Environmental Biology from the Roskilde University.

Qupanuk Olsen is the Head of the Inspection and Technical department at the Mineral License and Safety Authority, The Ministry of Mineral Resources, Labour and the Interior, Government of Greenland. The Inspection and Technical department issues permission to field activities for mineral exploration and exploitation in Greenland. One of the main tasks in her department is to ensure that the exploitation of minerals in Greenland is carried out properly in terms of health and safety. Qupanuk has a Master of Engineering Science (Mining) from Western Australian School of Mines, Curtin University. She is the first and only mining engineer from Greenland currently. With her background and knowledge in the mineral and mining industry she has an overview of all mineral activities in Greenland. Qupanuk is a great proponent for Greenlandic young people to study in mining.

Jette Rygaard is head of department and associate professor in the Department of Language, Literature and Media at Ilisimatusarfik (University of Greenland). Her interests include literary and media theory, feminist theory, cultural studies, visual anthropology, sensory ethnography and photography. She has lived and worked in Greenland for over 25 years and conducted a variety of research projects in communities throughout the country. She has worked extensively with youth in Greenland and is currently a Co-PI on the National Science Foundation funded project entitled, *Rockwell Kent and Early 1930s Greenland*.

Simon Thaarup is a Geologist at the Geological Survey of Denmark and Greenland's (GEUS) office in Nuuk. He has done geological fieldwork in several different geological settings in West Greenland, e.g. mapping the zinc and lead potential in the Ummannaq-Upernavik district, ground truthing hyper spectral imagery in the Kangerlussuaq area, and investigating the gold potential in Godthåbsfjorden. He is co-author on a geological guidebook for tourist and locals describing the geology in Godthåbsfjorden. Simon is responsible for GEUS' involvement in the

EU funded project UpDeep, which aims to identify and prioritize exploration targets, using low environmental impact exploration techniques. Simon holds a MSc in Geology (2015) from Aarhus University.

Kisser Thorsøe is Chief Advisor, Head of Office at the Geological Survey of Denmark and Greenland (GEUS), Nuuk. She has been in charge of GEUS' office in Nuuk since 2013. Kisser has broad experience within human resources and economy, and project management and administration of EU funded research projects. Furthermore, she has strong experience in fieldwork planning and logistics in Greenland. She holds a MSc in Physical Geography (2002) from the University of Copenhagen, Denmark and a diploma in leadership (2012) from the Business Academy Aarhus, Denmark.

United States

Alden Adolph is an Assistant Professor of Physics at St. Olaf College in Northfield, Minnesota. She is interested in structural, optical, and thermal properties of snow, especially as they relate to snow albedo, the temperature of snow and near-surface air, and snow melt processes. Her work involves local projects to study seasonal snow (in New Hampshire as a graduate student and now in Minnesota) and projects in Greenland to investigate snow processes on the ice sheet. As a professor at a small liberal arts college, she is keenly interested in the intersection of high impact research and undergraduate education. Alden received her B.A., B.E., and Ph.D. from the Thayer School of Engineering at Dartmouth College where her thesis work focused on physical properties of snow and firn.

Mary R. Albert is Professor of Engineering at the Thayer School of Engineering at Dartmouth College. She is also Executive Director of the U.S. Ice Drilling Program Office. At Dartmouth she teaches classes on climate change and engineering, and also she and her graduate students conduct research on climate change in two ways: understanding evidence of past climate change using ice cores from the polar ice sheets, and also preparing adaptation and mitigation strategies that will be needed for current climate change. She has led and participated in many research expeditions on both the Greenland and Antarctic Ice Sheets. Dr. Albert earned her B.S. in Mathematics from Penn State University, a B.E. in Engineering Sciences from Dartmouth, and a Ph.D. in Applied Mechanics and Engineering Sciences in 1991 from the University of California, San Diego.

Kelly Brunt is an Associate Research Scientist with the University of Maryland Earth System Science Interdisciplinary Center and the NASA Cryospheric Sciences Laboratory. She obtained a B.S. and an M.S. in Geology from Syracuse University and the University of Montana, respectively. She received her Ph.D. in Geophysics from the University of Chicago in 2008, modeling ice-shelf flow and the connection between ice shelves and the ocean. As a postdoctoral scholar at Scripps Institution of Oceanography, she worked on Ice, Cloud, and land Elevation Satellite (ICESat) laser altimetry data. Dr. Brunt is currently part of the ICESat-2 mission (scheduled to launch in 2018) and is working on post-launch calibration and validation of the satellite elevation data.

Zoe Courville is a research mechanical engineer with the US Army Corps of Engineers Cold Regions Research and Engineering Laboratory in Hanover, NH. She received her masters and doctorate degrees from the Thayer School of Engineering at Dartmouth College. She has worked in Greenland for the last fifteen years on a variety of science and engineering projects at Summit Station in the middle of the ice sheet, the Danish drilling camp NEEM, and Thule Air Force Base, including two traverses across the ice sheet to Summit Station. For the past seven years, she has worked as a member of the Science Coordination Office for Summit Station to help facilitate science for the research community and advise the US National Science Foundation with regards to station management and resources.

Lauren E. Culler is the lead U.S. coordinator for the Nuuk workshop. She is a Research Assistant Professor of Environmental Studies at Dartmouth and has conducted scientific research in Greenland since 2009. She co-leads the NSF-funded Joint Science Education Project in Greenland and the Joint Antarctic School Expedition in Antarctica. Her research is focused on how tundra food webs are impacted by warming temperatures and hydrologic change and she is known in Greenland for her work on Arctic mosquitoes. Lauren is co-lead of the Network for Arthropods of the Tundra (NeAT), a University of the Arctic thematic network. She has a Ph.D. in Ecology from Dartmouth, a M.S. in Entomology and a B.S. in Biology from the University of Maryland.

Denis Defibaugh is a tenured professor at Rochester Institute of Technology and chair of the Advertising Photography Program. Denis has participation in over 30 solo exhibitions in galleries, museums, and cultural centers. His recent work *Afterlives of Natural History* was exhibited in Arles, France during Fotofest and featured in Smithsonian.com. The work *Family Ties do not Die, The Day of the Dead in Oaxaca, Mexico* has been displayed in museums and cultural centers including three exhibitions in Texas and numerous shows in San Francisco, Miami, Rochester, Buffalo, Kansas, Colorado and Montana. These photographs were published by TCU Press in his first book, *The Day of the Dead*. His documentary and travel photographs earned a Fulbright-Hays Travel/Study Grant to Mexico, and most recently a National Science Foundation award to produce the *Rockwell Kent and Early 1930's Greenland, A Comparative View of Environmental, Social and Cultural Change in Contemporary Greenland*.

Hajo Eicken is Professor of Geophysics and Director of the International Arctic Research Center at the University of Alaska Fairbanks. His research focuses on sea ice geophysics, Arctic coastal processes, and their importance for human activities and ecosystems. In Alaska he has helped lead efforts to advance collaborative research with Indigenous knowledge holders and to enhance use of scientific data by Arctic communities and government agencies. This work draws on a number of different approaches, including participatory scenarios and community-based monitoring. For more than a decade, he has worked with colleagues to establish a sea-ice observatory at Utqiagvik/Pt. Barrow. Other collaborative efforts include his involvement in launching the Sea Ice for Walrus Outlook (SIWO) and contributions to the Alaska Native Tribal Health Consortium's Local Environmental Observer Network.

Bo Gregersen is a Danish national and serves as Scientific Affairs Specialist in the Regional Environment, Science, Technology and Health Office at the U.S. Embassy in Copenhagen, Denmark. His office covers the Nordic, Baltic, and Western European regions.

Lenore A. Grenoble is the John Matthews Manly Distinguished Service Professor in the Department of Linguistics at the University of Chicago. Her research focuses on the study of contact linguistics, language shift and vitality, and language documentation, and the study of language practices as contextually and culturally situated. She is currently studying the impact of urbanization, cultural and climate change in the Arctic, with fieldwork in Greenland, Norway, and the Sakha Republic in the Russian Federation. She is a member of the American Academy of Arts and Sciences and her current projects are supported by the National Science Foundation's program in Documenting Endangered Languages, the Fulbright Arctic Chair Norway, and the Guggenheim Foundation. She received her PhD from the University of California, Berkeley.

Jay T. Johnson is Professor and Associate Chair of Geography and Atmospheric Science at the University of Kansas where he also directs the Center for Indigenous Research, Science, and Technology. His research focuses on Indigenous peoples' cultural survival, particularly in the areas of resource management, political activism at the national and international levels, and the philosophies and politics of place that underpin the drive for cultural survival. Much of his work is comparative in nature but has focused predominately on New Zealand, the Pacific, and North America. He is the co-author along with, Soren C. Larsen of the University of Missouri, of *Being*

Together in Place: Indigenous Coexistence in a More Than Human World, published by the University of Minnesota Press in 2017.

Ellen Martin is a Professor in the Department of Geological Sciences at the University of Florida and the Co-Director of the Florida Climate Institute. Her research on paleoceanography and paleoclimatology uses the geochemistry of deep-sea sediment to reconstruct past climate conditions and understand climate sensitivity. Her work in Greenland focuses on studying the chemistry of glacial and nonglacial waters to understand how fluxes from glacial and nonglacial landscapes are transported to the ocean, how these fluxes may vary as the ice sheet retreats, how these variations may impact future climate, and how resulting marine sedimentary records can be used to interpret past ice sheet dynamics. She is a University of Florida Term Professor and a Fellow of the Geological Society of America.

Jon Martin is Professor of Geological Sciences at the University of Florida. His research interests center on water chemistry, hydrology, and hydrogeology, particularly related to flow of groundwater, interactions between surface water and groundwater, magnitudes of solute fluxes to coastal zones and greenhouse gas exchange with the atmosphere. In Greenland, his research interest focuses on evaluating how nutrient and gas fluxes differ between watersheds that are connected to the ice sheet, and thus drain predominately meltwater, and watersheds that are separated from the ice sheet, and thus drain only annual precipitation and permafrost meltwaters. Specifically, he is interested in how chemical reactions of watersheds in these two distinct landscapes differ as a result of exposure age following the retreat of the ice sheet since the Last Glacial maximum.

Jennifer Mercer is the Arctic Research Support and Logistics Program Manager at the National Science Foundation. She has a broad scientific background with extensive field experience and logistics management in both the Arctic and Antarctica. Dr. Mercer has also managed NSF's Arctic Observing Network (AON) program and currently co-leads the Interagency Arctic Research Policy Committee's (IARPC) Atmosphere team and is Chair of the International Forum of Arctic Research Operators. She was the 2017 Embassy Science Fellow at the U.S. Embassy in Denmark.

Nimesh Patel is a radio astronomer working with the Smithsonian Astrophysical Observatory's Submillimeter Array (SMA) project since 1994. His research interests include astrochemistry, evolved stars, star-formation and astrophysical masers. Prior to joining SAO, Dr. Patel was a postdoctoral research fellow at the University of Massachusetts, Five College Radio Astronomy Department, during 1991-1994. He obtained his Ph.D. in Physics from the Indian Institute of Science in 1990. Dr. Patel has been involved with various instrumentation projects and has participated in the development of the SMA since its early construction phase, in Massachusetts and in Hawaii. Since 2012, Dr. Patel has been working on the Greenland Telescope project. Addressing big questions in astronomy will require construction of large telescopes, to be built by the next generation of young engineers, physicists and astronomers. He is contributing to the development of such a talent pool through his efforts in education and outreach, as an instructor for the laboratory undergraduate research course at Harvard, a mentor to high-school and undergraduate students, and participant in public outreach science festivals. Dr. Patel became a naturalized US citizen in 2002 and is a member of the American Astronomical Society, the International Astronomical Union, and the International Union of Radio Sciences.

Elizabeth Rink conducts community based participatory research (CBPR) with Indigenous communities in Montana, Greenland and Finland to address the socio-ecological determinants of reproductive health. Her research focuses on the extent to which colonialism, historical loss and trauma, structural violence and climate change impact reproductive health disparities in Indigenous communities. As faculty at Montana State University in Bozeman, Montana, Dr. Rink is a researcher with the Center of American Indian and Rural Health Equity and a research mentor in the Montana – Alaska American Indian/Alaska Native Center for Clinical and Translational

Research. Her research has received funding from the US Office of Population Affairs, the National Science Foundation and the National Institute of Health. For the past 12 years Dr. Rink has collaborated with Dr. Gitte Alder Reimer at Ilisimatusarfik to conduct CBPR with Greenlandic communities to reduce reproductive health disparities. Currently Dr. Rink is a scholar with the Fulbright Arctic Initiative Program 2018-2019.

Cynthia Suchman is Program Director for Arctic Natural Sciences (ANS) at the National Science Foundation. Her scientific background is in biological oceanography and she worked for several years in the Division of Ocean Sciences prior to moving to the Office of Polar Programs in 2016. She has interest and experience in managing interdisciplinary and interagency programs within NSF as well as regional funding organizations in Virginia and Alaska.

Kirsty Tinto is an Associate Research Scientist at Lamont-Doherty Earth Observatory of Columbia University. Her research interests consider how the underlying landscape and geology influence the flow of ice sheets. She has been involved in large-scale airborne geophysics campaigns in both the Arctic and Antarctic for nearly a decade, including Operation IceBridge, Oceans Melting Greenland and the development of the IcePod instrument suite. She has an undergraduate degree in Earth Sciences from Oxford University, England, and a PhD in Geophysics from Otago University, New Zealand.

Susan Vanek, a sociocultural anthropology PhD student at Binghamton University (SUNY), is in the final stages of her dissertation work on state sponsored development in Greenland. Her initial 12 months of fieldwork in the communities of Nuuk, Maniitsoq and Tasiilaq, Greenland was funded by an International Dissertation Research Fellowship from the Social Science Research Council, with additional fieldwork supported provided by a Doctoral Dissertation Improvement Grant from the National Science Foundation and an American-Scandinavian Foundation Fellowship. She has presented papers stemming from her dissertation research at the American Anthropological Association's Annual Meetings, the International Congress of Arctic Social Science and during four summer schools in Norway, Sweden, Russia, and most recently at the Vienna Arctic Summer School in Austria in the summer of 2016. She is currently a Co-PI on the National Science Foundation funded project entitled, *Rockwell Kent and Early 1930s Greenland*. She has conducted research in Greenland for 6 years.

Ross Virginia is the co-lead U.S. coordinator for the Nuuk workshop. He is the Myers Family Professor of Environmental Science at Dartmouth College where he also directs the Institute of Arctic Studies. His research is focused on climate change impacts on the biodiversity and nutrient cycles of soil ecosystems in the Arctic and Antarctic. Dr. Virginia is a Distinguished Co-Lead Scholar for the Fulbright Arctic Initiative and is a Global Fellow for the Polar Initiative at Woodrow Wilson Center for International Scholars where he works on polar science and policy issues. He directs the U.S. contributions to the Joint Science Education Project in Greenland and is a member of the Board of Governors for Ilisimatusarfik (University of Greenland) and the University of the Arctic. He holds a M.S. and Ph.D. in Ecology from the University of California, Davis and a B.S. in Biology from the State University of New York, Syracuse.

Jeff Welker is a Professor in Arctic Ecology and Biogeochemistry and is the Inaugural UArctic Research Chair with a joint appointment between the University of Oulu, Finland and the University of Alaska, Anchorage. Dr. Welker has been using observational and experimental studies at Thule, NW Greenland since 2003 as part of the Biocomplexity and AON ITEX programs. His research teams have discovered that: a) polar semi-deserts that are warmer and wetter will become stronger C sinks; b) ancient permafrost C is leaking into the modern atmosphere and being discharged into the Arctic Ocean; c) moisture sources exhibit distinct water vapor isotopic signatures when they are from either the ice sheet or the open water of Baffin Bay; and, d) sea birds provide a record of Arctic Ocean food webs. Future studies will continue to monitor the Arctic water isotope cycle in conjunction with measurements at Nord, in Arctic Finland and aboard the Polarstern icebreaker as part of MOSAiC.