WEATHER & SOCIETY

MARCH 8-10 2022

Online Workshop
(Focus on Inuit Nunangat)

WORKSHOP REPORT
October 2022
WEATHER AND SOCIETY IN INUIT NUNANGAT:
USER NEEDS, SERVICE PROVIDER EFFORTS, AND OPPORTUNITIES FOR THE FUTURE

Proceedings of the Weather and Society online workshop focused on Inuit Nunangat
March 8-10, 2022

Detailed workshop agenda and recorded presentations available at:
https://straightupnorth.ca/march2022-presentations/

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Photos by: Gita Ljubicic
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Workshop Overview

Introduction
In March 2022, community members, northern/Inuit organizations, researchers, and service providers living and working across Inuit Nunangat (Inuit homelands in Canada) came together for a virtual (online) workshop. This was the first workshop of its kind, with a focus on tailoring environmental services to better meet Inuit community needs. Our goal in the workshop was to learn from diverse experiences, and develop new connections, in order to be able to improve environmental programs and services in support of safe travel (Box 1).

Why we organized this workshop

- To bring together community members, northern/Inuit organizations, researchers, and service providers
- To learn from diverse experiences, and develop new connections, to tailor environmental services to better meet Inuit community needs
- To discuss community priorities and needs for environmental information
- To consider barriers and opportunities to access, provide, share and use environmental information
- To explore training, monitoring, and funding to meet community needs.

What we did
The workshop involved three half-days of meetings online using Zoom (See Appendix 1, workshop agenda). Each day focused on a different aspect of tailoring environmental services to meet Inuit community needs, including:

- **Day 1** – User needs and community services;
- **Day 2** – Service providers and efforts to tailor services; and,
- **Day 3** – Opportunities for training, monitoring, and funding.

Each day began with an opening from Gita Ljubicic. This was followed by videos from the Aqqiumavvik Society and Ittaq Heritage and Research Centre to ground our discussions in Inuit knowledge, values, and connections to the land. Each session was three hours long, broken into two parts with a break in between.

Each part of the workshop started with short (10 minute) presentations (Table 1, and see Appendix 2, presentation descriptions). Speakers were affiliated with 14 organizations including community-monitoring groups, Hunters and Trappers Organizations, federal agencies, universities, and others across Canada and in Alaska, USA (See Appendix 3, list of organization links and resources). Formal presentations were followed by small group discussions in breakout rooms. Each breakout discussion was facilitated by a member of the StraightUpNorth research team. At the end of the day facilitators summarized key points from breakout discussions, and Gita Ljubicic provided closing remarks.

All workshop sessions were recorded in Zoom. Presentations are publicly available. Breakout group recordings were only used for the purposes of summarizing discussions and preparing this report. Mentimeter was also used as a tool throughout the workshop to get feedback from the whole group, to stimulate discussion in breakout groups, and to enable participants to share comments in an anonymous way.
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Natalie Carter |
| Weather and ice on SIKU: Services and tools | Becky Segal  
Andrew Arreak |
| SmartICE real-time monitoring and mapping - Sikumik Qaujimajjuti | Andrew Arreak  
Leanne Beaulieu  
Rex Holwell  
Lynn Moorman  
Becky Segal  
Katherine Wilson |
| Harvest and environmental monitoring with InReach | John Bryan Idlout  
Stephan Schott  
Emmelie Paquette |
| **DAY 2 - Service providers and efforts to tailor services** |
| Understanding and responding to changing sea ice and weather conditions in northern communities | David Atkinson  
Laura Eerkes-Medrano  
Adrienne Tivy  
Armel Castellan  
Sara Hoffman |
| C-CORE’s Floe Edge Monitoring Service | John Bennett |
| A community weather station network in Cambridge Bay, NU | Brent Else |
| The Meteorological Service of Canada: Review of products and services with a focus on the North | Armel Castellan  
Tom Zagon  
Kristine Confalone |
| **DAY 3 - Opportunities for training, monitoring & funding** |
| Getting more from Windy.com and other apps | Rick Thoman |
| Environmental monitoring with Cryologger weather stations | Derek Mueller  
Adam Garbo |
| SIKU supporting community monitoring projects | Christina MacDonald |
Workshop Overview (continued)

Workshop participants
A total of 120 participants registered for the workshop, including representatives from land users, service providers, Northern/Inuit research organizations, Inuit Organization/Associations/Corporations, federal and territorial governments, universities, non-governmental organizations, industry, and colleges from across Canada, and some international (See Appendix 4, list of registered workshop participants). Many participants had experience across different sectors and roles (See Appendix 5, perspectives and experiences of registered workshop participants).

During the opening session on Day 1, participants were invited to share if they considered themselves: an environmental information user, a service provider, both, or neither. Of the 45 who responded using Mentimeter, we learned there was lot of overlap with participants being both users and providers of environmental information (Figure 1). Many also contribute to service development, and some were attending the workshop just to learn.

Throughout this report we include quotes from workshop participants that help to provide examples in particular contexts. Quotes are summarized as closely as possible to the original comment and are not attributed to individuals for privacy reasons.

"The challenge is not so much the technology rather it’s people talking with one another and commitments to sharing data, managing access, making sure we’re responsive to the needs."

Figure 1 - Workshop Participant Roles

![Figure 1 - Workshop Participant Roles](image_url)

(45 participants responded, and could select multiple roles)
Main concerns for safe travel in communities across Inuit Nunangat

Across all breakout groups in Day 1, some common themes emerged related to concerns for travel safety in Inuit Nunangat communities, including:

1. Rapidly changing conditions
2. Difficult/dangerous conditions (Table 2)
3. Lack of knowledge/experience
4. Need for more monitoring and information sharing; and,
5. Lack of community-relevant products/tools (Figure 2).

There are many complex factors to consider in relation to travel safety, and these will be different in different communities and regions, as well as based on different levels of personal knowledge and experience (See Appendix 6, details on concerns for travel safety).
"I feel in my community like I am the only one who needs to multiply because I am doing 11 jobs right now because no one is doing them. Being a contractor for Environment Canada and having an interest in hunter and camper safety many have died going through the ice in spring trying to get home. Ice thickness science is what really interests me."

During breakout group discussions several commonly observed environmental changes were discussed that have implications for travel safety, including:

1. Unpredictable environmental conditions
2. Quantity and texture of snow
3. Ice thickness and timing of freeze up
4. Wind
5. Visibility
6. Rain and clouds
7. Permafrost (See Appendix 7, details on observed changes).
Sources of environmental information relied on to make travel decisions

Workshop participants identified a wide range of sources of information that are relied on to make decisions about travel safety. These included services provided by government, industry, Inuit and northern organizations, and independent services, as well as community sharing of observations and warnings (Figure 3).

“Trying to address getting good real-time ice condition information in terminology that is specific to local conditions is difficult because it varies between seasons and locations. Bringing together different sources of information in an integrated way is a challenge...people get their information from so many different sources like: each other, friends, piece of paper posted somewhere, an app. Making sure the tools can actually bring together as much information as possible into one spot is one of the challenges.”

Figure 3
Awareness and use of Inuit-led environmental monitoring programs

Breakout group facilitators presented workshop participants with a list of Inuit-led programs, including: 1) SmartICE; 2) SIKU; 3) Clyde River Weather Station Network; 4) Ujjiqsuiniq; 5) Inuvialuit CBMP (Community-Based Monitoring Program); 6) Imalirjiit; and, 7) eNUK. Participants were then invited to indicate which programs they had heard of, as well as which programs they have actually used (Figure 4).

SmartICE and SIKU are the programs that participants have heard of and used the most. Fewer participants had heard of the Clyde River Weather Network and Inuvialuit CBMP, and only a fraction had used them. Very few participants had heard of the other Inuit-led programs and only 1 or 2 participants had used them. Given this, discussions in most groups focused on SmartICE and SIKU (See Appendix 8, details on SmartICE and SIKU discussions).

Participants noted that SIKU is the platform (app) that hosts SmartICE monitoring information, which includes the trails taken with the SmartQAMUTIK and the associated ice thickness measurements. In addition, a wide range of environmental information can be posted using the SIKU app such as hunting stories, observations of animals or ice conditions, harvesting of berries/plants/eggs/animal materials, research monitoring data, and Indigenous terminology. Participants appreciated that SIKU continues to be developed to accommodate various needs and projects. Some questions also came up related to data access controls in SIKU, which may be tied to membership in specific projects or communities.

"In the north, [we should not be] pretending to know what is needed, rather let products and services development be user-led; User-led products/services development, user-centred design - allows for uptake, feedback, and better chance for success that accounts for the diversity of user-needs."

Figure 4 - Inuit-led programs

(41 participants responded, and could select multiple programs)
Participants were also invited to share about other environmental monitoring programs they are aware of and/or are using in their community or region. In the process, we learned about a wide range of programs that included other Inuit- (Box 2) and Indigenous-led (Box 3) programs, as well as some led by government, universities, and other groups (Box 4).

**BOX 2 - OTHER INUIT-LED PROGRAMS**

- Arctic UAV Nunavut-based Professional Aerial Drone Imagery
- Harvest study in Gjoa Haven and Taloyoak using inReach devices
- Environmental monitoring in Clyde River using inReach devices
- Weather stations in Arctic Bay
- Hydroblock marine seabed mapping in Arviat
- Harvest monitoring using Nunavut Wildlife Management Board app SMART collect
- Community freezer programs in Nunatsiavut

**BOX 3 - OTHER INDIGENOUS-LED PROGRAMS**

- Indigenous Climate Hub
- Cree Trappers’ Association Wildlife app
- Indigenous community-based climate monitoring projects (funded by CIRNAC)

**BOX 4 - OTHER ENVIRONMENTAL MONITORING INFORMATION USED**

- CoCoRaHS (Community Collaborative Rain Hail and Snow)
- Aurora forecast
- Aurora watch
- Winter road monitoring programs
- Wildfire smoke monitoring programs
- Canadian Ice Service and McGill monitoring in Nain
- Environment and Climate Change Canada and University of Victoria working with local weather monitors in the Inuvialuit Settlement Region
- Nunatsiavut mapping with the Firelight Group

As discussions highlighted, one product or information source cannot cover everything. Working together and bringing in different kinds of information is most beneficial.

“SIKU is always intended to be used with a suite of other tools. Going to communities [with a] big beautiful map, talking about the map...SIKU can’t ever replace that kind of experience and all the benefits that emerge over a cup of tea pointing things out on a map. Lots of lines of evidence are needed. One-way solutions are not always needed.”
Principles for safe travel

Some key principals for safe travel emerged in discussions, including:

1. Prepare for travel
2. Develop and share a trip plan
3. Travel with - and learn from - a knowledgeable buddy
4. Develop land, equipment, and survival skills
5. Develop interpretation skills for environmental forecast products and services (Figure 5, and see Appendix 9, details on principles for safe travel)

"[B]ring your essentials because you never know what could happen out there and we are the only ones that are able to provide the solutions for any trouble that may occur out on the land or ice."

"Satellite images and maps are great while in town but when you get out of town then you can’t access updated information. Satellite images and maps help people with planning a trip and [are a] conversation planner. [You can look at images/maps] and reference them and share knowledge with each other. [Maps and images are] grounds for people to talk about conditions and learn from each other, tell stories with safety messages inside of them."
Awareness and use of environmental services

During breakout groups in Day 2, facilitators presented workshop participants with a list of government, industry, or independent environmental services, including: 1) **Weather forecast**; 2) **Marine forecast**; 3) **Ice charts and services**; 4) **Environment and Climate Change Canada (ECCC) Collaborative Monitoring Network**; 5) **Canada Centre for Climate Services (CCCS)**; 6) **C-CORE Floe Edge Service**; 7) **Windy.com**; and, 8) **Tide Tables**. Participants were then invited to indicate which services they had heard of, as well as which services they have actually used (Figure 6).

Weather and marine forecasts, as well as Windy.com and ice charts/services were the environmental services that participants have heard of the most, while it was most common for participants to be using weather forecasts, Windy.com, and tide tables. Fewer participants had heard of the ECCC (Environment and Climate Change Canada) Collaborative Monitoring Network, Canada Centre for Climate Services, and C-CORE's Floe Edge Service (and even less were using these services).

**Figure 6 - Environmental services**

(33 participants responded, and could select multiple services)
Challenges faced by land users, community members, and local organizations in accessing and interpreting online products

Through breakout group discussions a range of challenges were identified by land users, community members, and local organizations that affect how they can access and interpret environmental products and services available online. Key challenges related to internet/cell service, as well as the quantity, quality/access, and frequency/timing of information that is provided.

Internet and cell service
A big challenge faced by land users and community organizations is the cost of internet service. Also noted was insufficient bandwidth and the fact that internet and cell service are often unreliable in Inuit Nunangat (i.e. they tend to cut out at certain times of day). For instance, in Gjoa Haven cell and internet is often unavailable daily from noon to 1pm due to the location of the satellite.

“I have cell service with data and Qiniq internet and both are super slow in Gjoa Haven. Getting online is very slow and not even reliable.”

Another challenge is that cell coverage does not extend to harvesting areas and community members must reply on repeater stations for radios.

“It would increase safety and access to info if new satellite systems enable better coverage with cell, but it is limited for now.”

Quantity of information
Participants noted that there is a lack of data on specific environmental variables of interest, and that existing systems are not capturing relevant information. For example, there are differences between ECCC stations and NAV Canada stations. Another example relates to freshwater systems in Yukon Territory.

“Fresh water systems are relevant to the sorts of travel being done in the Yukon. There are sites that share hydrographic information...often relevant for river travel in the summer; and fewer information points but lake levels can also be relevant. There isn’t any publicly available information that does a good job of forecasting changes in water level, changes in discharges and changes in river conditions. There is lots of local knowledge about what might happen - but you can only access that on Facebook or if you know the right person to ask.”
Quality/access to information
Participants also said that data and products are not precise or accurate enough and, at times, the data quality is unknown. There is also a lack of accessible information sources, which includes some products that require special approvals (or payment) to access. There is not enough monitoring in areas of community interest, and much information is not publicly available. As well, community members need timely access to environmental products for search and rescue purposes, including recent historic data, but they often cannot get access to recent/archived data.

“My community has had problems trying to access past weather information during search and rescue efforts. The weather at the time is critical to know, to extrapolate, to get an idea of where the people might be going if they are lost. Some people not knowing the weather tend to follow the wind or the light and it doesn’t help with navigation. So, [lack of] access to data from a day or two before or at a certain time is a difficulty to a community search and rescue. Would be good to have access to archives or recent data [in an interface like Windy] to see what the weather is and wind particles in graphics – see it presented the same way for a few days after would be good”.

Frequency/timing of information
Often the frequency of product provision does not match community members’ travel needs and patterns. Updates are not regular or frequent enough and there is too much of a gap between updates, so the information is not relevant when people are looking at it. Some products are only available in certain seasons, and not the seasons relevant to community use. For example, marine forecasts are only provided during the marine shipping season, but community members would utilize the forecasts year ‘round if they were available.

“Marine weather forecast is not provided unless there is open water so as soon as there is ice that forecast drops off, but it would still be really useful for Arctic communities.”

Similar comments were made related to the frequency of satellite images, along with noting the challenges of interpreting Synthetic Aperture Radar imagery.

“Satellite imagery hopefully in future will be more frequent but sometimes doesn’t match community travel needs; same with some of Canadian Ice Service products decrease when there is no shipping in the Arctic but that is when communities need that information more.”

“Absolutely, the frequency of satellite images needs to be increased.”
Limitations faced by service providers in responding to diverse community needs

Service providers are investing significant time and effort into responding to diverse community needs. However, they experience ongoing challenges related to limited resources, issues with coordination and communication, and prioritizing the diversity of needs (See Appendix 10, detailed list and examples of barriers faced by service providers).

Limited resources

“Understanding [service providers'] significant time commitments trying to do multiple forecasts per day for the entire Arctic, just a few people.”

Considerable discussion arose about how limited resources (data, personnel, funding) are, and the reasons why they are so limited. Not enough funding is made available to service providers, which limits personnel hiring and infrastructure (weather station) installation and maintenance. Even where monitoring networks exist, they are not necessarily well connected. There is a need for more coordination between government departments, including across federal departments, and between federal and territorial/provincial governments. The result is sparse data coverage because services are focused more in areas with high population density than in large spaces with fewer people, as is the case in Inuit Nunangat. Some participants highlighted that these limitations are the result of systemic racism, colonial policies, and competing governmental priorities.

“Systemic racism. When you look at where the monitoring is happening it’s not always where everybody is. We have to flip things around. It is all south of 60°...It has always been a challenge within government. It is getting better. It has been a long time coming”.

“Weather station distribution reflects a colonial past of Canada, DEW [Distant Early Warning] line, military stations, communities that didn’t exist before. If we really want to address our colonial past, we could start by sorting out some of those very obvious patterns”.

“Budgets. Now we have a lot going on with COVID, a war, when does [environmental monitoring in the North] become a priority? That is always the challenge trying to get these things up high enough in the federal government to make them a priority to get things to happen.”
Coordination and communication
Participants identified that there is a lack of coordination among providers, as well as between providers and regional or community organizations. Community organizations can be overwhelmed with requests which can result in delays and in getting projects “off the ground”. There is also a lack of advertising of available services so potential end users may not be aware that a particular service exists or how to use it. In addition, technical information is difficult to explain in accessible ways. Service providers acknowledged that they need to better understand the most effective way to communicate weather data.

“[There is a] gap between how people actually want to access the data versus how we [service providers] make the data available...we need to simplify tools, need effort from MSC [Meteorological Service of Canada] to have easier ways to digest information, which has not always been at the forefront of the MSC’s services. The MSC does make data available to be pulled into existing apps/tools, and [we need to think of] ways to integrate tools versus having many different platforms...a one-stop-shop. [Right now] you need to know where to go to find what you’re looking for, which is definitely challenging.”

Prioritizing the diversity of needs

“There are so many gaps...[we’re] trying to work with others to fill the gaps, but there are so many applications and users, competing priorities, not enough funds to fill gaps, it’s hard to know where to focus efforts.”

Through our discussions it became clear that service providers experience challenges in understanding community priorities across Inuit Nunangat, which is a large and diverse region in both cultural and geographic terms. The increasing number of community organizations engaged in monitoring, providing local services, and developing their own platforms to share environmental information makes it challenging for providers to:

- know who to partner with,
- tailor services and connect across regions
- respond to diverse needs and prioritize their response (i.e. who to fund/support).

An added challenge is the high turnover of staff/contacts in community organizations, and graduate students in research programs. This makes it difficult to develop and maintain relationships between service providers, community leaders, and academic partners. This is also a challenge for maintaining continuity of trained local personnel who can lead ongoing monitoring activities.
Data management and making the data available to communities, in the format communities want it in, is another challenge. It is difficult for service providers to know what information will be meaningful for residents because demand varies regionally based on geographic location and proximity to the coast. At the same time, service providers must respect that different communities have different data management concerns and processes, so some platforms fit better for one type of interest for data management and others do for something else.

For funders of environmental monitoring programs there are unique challenges when deciding which initiatives to fund. Funders receive many applications, each with unique goals and platforms, and that will address the unique needs of a particular community. It is hard for funders to understand what research is going to have the most impacts and what priorities they should be considering. They strive to manage the balance across different interest groups in different regions. Funders aspire to respectfully support communities in their efforts to identify and address local needs, and help build capacity in communities. At the same time, funders want to maximize the impact funding will have (economies of scale). Sometimes this means smaller or more focused community initiatives may not be funded, and these sorts of decisions are very difficult to make.

“...if you have 10 different proposals from different organizations and all different platforms which one do you fund? 10 different ones? Each addresses unique community needs, has community buy-in and a community engagement piece. [They are] bottom-up developed community initiatives… if we really want to create capacity in communities and make sure community needs are met it has to be bottom up. But do you fund a platform that services 200 people, 300? It is difficult that these platforms are competing to a certain degree. If one tool could serve more people then [we would ideally] fund it. But will that tool actually meet the needs of those specific communities, or will it be too generalized and not really meet anyone’s need?”

Funders and service providers are sensitive to the fact that there are many high priorities across regions and interest groups, and feel like they can never meet all the needs expressed. However, there was a strong message that funders and service providers want to keep receiving feedback on how to make the most of the systems in place, as well as what needs to be changed and improved.

“[We] need to be more transparent about how we make decisions.”
Ways to address community-identified challenges and service provider-identified limitations

“There is this common idea in the meteorological community about a three-legged stool and how you cannot [be missing] any one of the pillars. If you want to serve a community, you need to be able to back it up with monitoring and then obviously modelling is a big piece, and you can’t just have modelling. As sexy as a really beautiful model is, it is nothing and it is obviously imperfect and more so if you don’t have monitoring to ingest into that process. So, in order to get to community, to the public, to emergency management decision makers, you need to have all three of those pieces firing otherwise a three-legged stool can only stand for a very short amount of time and fails.”

Although many challenges were shared from both community and service provider perspectives, there was much optimism and a range of constructive suggestions for how to overcome these challenges (Figure 7, and see Appendix 11, details on addressing challenges).

Figure 7

“"A lot of development and work needs to be done to provide a strong network for climate and weather monitoring."”
Opportunities for Training, Monitoring, and Funding

On Day 3 of the workshop, participants could select from three breakout groups to join, focused on opportunities for: training, monitoring, and funding.

Training ideas to meet community needs

SmartICE representatives facilitated the breakout group discussing training ideas to meet community needs. Common themes that emerged focused on: redefining success, setting up trainees for success, and factors contributing to sustainable programs.

Redefine success
Participants shared challenges and sought advice related to recruiting and retaining community-based research assistants, stating that assistants often moved on in their career to other employment. This meant the recurring need to recruit and train new research assistants. Some participants had experienced this as a challenge and indicator of a lack of success. Others suggested that giving trainees the skills needed to move on to another job should be considered a success. Along with this was the added bonus that now another person who takes their place will have the opportunity to join the team with new insights and experiences to bring to the training.

As part of defining and redefining success it was emphasized that it is important to find out from a trainee point of view what ‘success’ means. This helps to establish a measure of success that is relevant to those involved. You want to avoid the situation where trainers are pushing every piece of information they want to share, and instead aim for training to be continually evolving and improving. By understanding and incorporating different points of view, the program can keep getting better and better over time.

Set up trainees for success
Participants noted the importance of being a good employer and providing northern trainees with all that is needed for success (e.g. pay for internet, provide offices, computers, and other logistical support). Providing extended benefits packages is important, including coverage related to mental health and support for things that are relevant in the north. Part of training is also making sure the workplace is inviting and comfortable, and that employee needs are met (considering needs that may be different from needs in the south).

Meeting often and consistently throughout training was also discussed. Consistency in meeting times for training and troubleshooting as a team has been found to be supportive and result in high quality products. Creating space for trainees to share about challenges, rather than expecting them to be proactive in reaching out about difficulties, was also encouraged.
Factors contributing to sustainable programs
Four key factors were identified that contribute to the sustainability of community-based environmental monitoring programs and increase the likelihood of programs continuing with limited or no outside support, including: co-developing training systems (Box 5); multi-directional training (Box 6); using a Training of Trainers approach (Box 7); and, recruiting motivated, enthusiastic team members (Box 8).

Box 5 - Co-Develop Training
- Sustainable programs involve co-developing training systems with trainees to ensure their relevance and applicability to each trainee (i.e. consider local circumstances and situations).
- Incorporate principles of adult education and Inuit learning stages.
- As an example of this, SmartICE uses four stages: 1) basic literacy; 2) fluency; 3) being capable; and, 4) being critically competent.

Box 6 - Multi-Directional Training
- Training needs to be considered as happening in multiple directions.
- This means that trainees in communities, and trainers such as scientists, are learning from each other.
- Knowledge sharing and learning must be very reciprocal all the time.

Box 7 - Train the Trainers
- A "Training of Trainers approach" means that those with newly acquired and applied skills are trained in such a way that they can then go on to teach others the same skills they themselves have recently learned.
- This helps to make programs sustainable by reducing (or eliminating) the reliance on non-community members for training or long-term success.
- SmartICE has developed a toolkit about their training approach. To learn more visit https://www.youtube.com/watch?v=kVobDezxLT8

Box 8 - Recruit Motivated Team
- For programs to be sustainable, recruitment and retention of local personnel is critical.
- Recruiting people who are motivated, enthusiastic, and have demonstrated a keen interest in this line of work is a priority.
- It also helps if team members are motivated to share information with their community and include community knowledge/input in the work.
- It is important to remember that a specific skill set can be learned quickly by those who are motivated and enthusiastic.
- Once recruited, understanding what keeps team members motivated and engaged is important for retention.
- Some suggested approaches to recruitment include: 1) reaching out to Nunavut Arctic College Environmental Technology Program students and/or graduates; 2) contacting the local Hamlet Office for recommendations; and, 3) seeking feedback from community partners.
- Working through existing networks for support in advertising, interviewing, selecting and hiring community-based researchers was also recommended.
Monitoring and forecasting ideas to meet community needs

Representatives of the Meteorological Service of Canada and Cryologger (Carleton University) facilitated breakout group discussions about improving monitoring and forecasting. Some common themes that emerged were: establishing and connecting more weather stations (**Box 9**), balancing local and broader needs (**Box 10**), and expanding capacity (**Box 11**).

**Box 9 - Establishing and Connecting More Weather Stations**

- More weather monitoring stations are needed beyond community airports to support local forecasting and safety.
- New stations need to be established quickly and effectively connected to broader distribution networks.
- Key considerations:
  - decide what variables to monitor (e.g. temperature, precipitation, wind direction, visibility, etc.)
  - lessons learned from established community weather station networks
  - data stewardship standards
  - metadata collection, documentation and sharing
  - location of stations
  - equipment redundancy and maintenance to ensure reliability and avoid data loss
  - access to monitoring information (streamlining data hubs)
  - sustainable funding for station maintenance.

**Box 10 - Balancing Local and Broader Needs**

- Service providers are considering how to meet local versus broader needs and interests in different but compatible ways.
- Current ECCC initiative involves developing a climate data inventory (historic and projections), which will help to:
  - identify data gaps in northern Canada
  - provide information to support decision-making with regards to use of products.
- Community and forecaster interests/needs both need to be considered in terms of weather station coverage.
- Metadata needs to be relevant and understandable for both community and forecaster decision-making.
- When planning for monitoring, be sure to include community needs to have better support and outcomes from a broader perspective.
- Aligning local monitoring efforts with larger/broader monitoring/forecasting interests is important, but ongoing challenges of how to get information shared more broadly (i.e. connected into ECCC services) are related to funding, personnel, and capacity on both sides.

**Box 11 - Expanding Capacity**

- Building relationships is critical to expand community capacity, which is the only way to move this work forward.
- Training community-based individuals to maintain weather stations and other monitoring equipment contributes to the sustainability of programs, reduces costs (travel of technicians for maintenance), and creates local employment.
- It is important to re-think job requirements to situate within the on-the-ground reality of communities:
  - What is needed on the ground, how can we bridge that gap, and can we hire into that gap?
  - Are there potential opportunities to build equipment locally (i.e. 3D printing, etc.), to facilitate training, and have community residents conducting ongoing maintenance?
- Improve communications and get community feedback to ensure that data/variables/information/dissemination methods are meaningful and useful.
Funding ideas and opportunities for community-based monitoring and climate change projects

In the breakout group session focused on funding, CIRNAC representatives provided an overview of opportunities available for Indigenous-led monitoring, with primary emphasis on the Indigenous Community-Based Monitoring Program (Figure 8) and the Climate Change Preparedness in the North Program (Figure 9, and see Appendix 3, links and other funding resources).

**Figure 8**

**INDIGENOUS COMMUNITY-BASED CLIMATE MONITORING PROGRAM**

**PROGRAM OVERVIEW:**
- Provides $6 million per year announced in Budget 2017
- Funds Indigenous Peoples across Canada to monitor climate and the environmental effects of climate change on traditional lands and waters
- Supports networking, tools, and coordination related to community-based climate monitoring

**PROGRAM OVERVIEW:**
- COMMUNITY-DRIVEN
  - Monitoring initiative led by an Indigenous community or organization
- CAPACITY-BUILDING
  - Incorporates Indigenous knowledge and science
- INCORPORATES INDORENSIVE KNOWLEDGE AND SCIENCE
- Incorporates youth training and/or employment
- Opportunities for youth/elder connection
- Builds long-term community capacity to monitor

**ELIGIBLE PROJECT ACTIVITIES INCLUDE:**
- Community engagement
- Training and hiring of community members
- Purchase and rental of monitoring equipment
- Assessing and managing data
- Monitoring key climate indicators
- Communicating climate monitoring results
- Networking

**Figure 9**

**CLIMATE CHANGE PREPAREDNESS IN THE NORTH PROGRAM**

Supporting Indigenous and northern communities to adapt to climate change

The Climate Change Preparedness in the North program has received $21.4 million from 2016 to 2021 and $24.4 million from 2017 to 2023 in funding for climate change adaptation projects. The program’s primary objective is to provide support to northern communities and organizations & territorial and regional governments to help them adapt to climate change impacts.

**AREAS OF FOCUS:**
- Northern regions (Yukon, Northwest Territories, Nunavut, Nunatsiavut, and Nunavik including Eeyou Istchee and Nunatsiavut communities)
- Climate change adaptation projects which increase Indigenous and northern communities adaptability, resilience and growth
- Priority is given to projects that demonstrate strong Indigenous and/or community leadership, engagement, or partnerships.
**Key Messages from Workshop Discussions**

**Key messages**

During the closing session on the third day, the whole group came together to share reflections on the key messages that stood out from the presentations and discussions throughout the workshop. A wide range of messages were identified from 81 participants who responded (Figure 10). Among these, the strongest messages included:

- collaboration/cooperation
- relationships
- training/capacity building
- community/local leadership
- language
- wind
- sustainability
- data accessibility/sharing.

"[There is] a lot of desire for communities to work together on projects especially around monitoring, [we are] looking for ways to network and community exchanges.”
Collaboration/Cooperation

Many workshop participants shared their interest in, and emphasis on, the benefits of increased connections and cooperation between communities and/or regions. An overarching theme that arose is that food security, travel safety, and the impacts of environmental change are interrelated. It is important to work from/with community-specific Inuit knowledge to understand user needs and recognize the diversity in interest for monitoring within and across communities in Inuit Nunangat. There is value in learning from others through community exchanges and peer-to-peer learning. This could include real-time information sharing between hunters while out on the land.

"We have to be talking more. We are mapping the floe edge every week and others are doing similar work. We need a little bit more cooperation. We are trying to tie a bunch of [information] together but there is so much more to do."

Throughout the week we heard how improving collaboration involves taking into account different needs (and different roles/capacities) at different scales. At the local scale, the priority is engaging community experts and local organizations/programs to understand community interests, and to develop products and visualizations that are relevant according to community uses. At the regional scale, it is important to have people involved in product development who can interpret many different sources of environmental information (including Inuit knowledge), to be able to develop relevant forecasts about weather or climate impacts. There was also interest expressed in establishing learning exchanges with people in other regions (e.g. First Nations in Yukon and NWT, Sami of northern Sweden).

“Gratitude for all the amazing work that has been done. A lot of optimism for so much overlap in some of the things that we’re doing. I am really inspired to read and learn more about these projects because I see so many ways that we could support each other and not create extra work. [We can] integrate into what has already been established as effective and answer some of these questions about where particularly travellers are exposed to avalanche hazard...gaining insights on some observations around the snow conditions and potential for avalanche hazard without having to recreate or start something new. Already use things that have been shown to be useful in the hands of those who use them.”
Relationships
Relationships were highlighted as the foundation of collaboration, and of various other aspects related to understanding and addressing community needs in weather, water, and ice products and services. Many examples were shared in workshop discussions of strong relationships developed over time between community organizations, as well as between community and academic partners, community and government partners, and large complex partnerships with many contributing organizations at various scales. Relationships are at the core of learning, sharing information, and working effectively together.

“We were in Sachs Harbour...the forecast was for very poor visibility so all the flights were going to be cancelled. I asked the locals who we were engaged with at the time, ‘This snow seems pretty bombproof. Is there an amount of wind that will actually drop the visibilities?’ And the answer was categorically ‘no’. So, we picked up the phone together and called [the person in charge at the weather office in Edmonton to explain]...And he appreciated the fact that for miles, for hundreds of miles in the direction of that system there was no new snow...so he was able to change the forecast because of that obvious linkage and that intel and allow for flights to go well into that evening. And it was [overnight] that the visibilities changed. [So] you cannot replace a human, on the ground, telling you what is going to happen when the winds pick up. It’s just a clear example of how much more is possible...”

Training/Capacity-Building
Community organizations, service providers, and researchers all expressed interest around developing training initiatives that can support more cooperative forecasting. This training is also meant to enhance community capacity for local program leadership, and to improve cultural awareness and develop new models for how academic and government researchers work with community partners. Training programs developed by SmartICE were regularly mentioned as examples of innovative and effective cross-cultural training (in person, and remote) that have contributed to community leadership in sea ice monitoring and safety.

"SmartICE training [supports monitoring] to become operational...Trainees are training others in a new cohort – training of trainers approach – co-developing curriculum to train Inuit to interpret satellite imagery. [You] can’t just take something from the south and translate for the region you are going into. [We] had to incorporate Inuit ways of knowing and learning [including Inuit laws and societal values] into the training so it is culturally contextualized. It is important to meet Inuit where they are at in their communities and eliminate the barriers that are well known to limit Inuit from participating in training (e.g. travel to south, English, having to leave family, not in a local context)."
Community/Local Leadership
Successful collaborations, as well as improved services, were closely tied to community engagement and local leadership. Examples were highlighted throughout all presentations of initiatives that were started in communities, and that continue to grow and expand through community-led partnerships. Supporting the capacity, continuity, and funding of local leadership is essential in developing programs and services that address community needs.

“Have not often had chance to have community involvement in our projects before, [we are] adapting work done previously for use in communities. [It was] so good to see all of the lessons learned, Natalie’s presentation about what communities want, these are the same questions I have been asking. Lots of valuable information there we can definitely benefit from.”

Language
Language is closely related to effective communication, and was raised as a key consideration throughout workshop discussions. Language is critical in the clarity and accessibility of products and services developed (i.e. plain, non-technical language). Working between languages (e.g. English, French, Inuktut, and other Indigenous languages) can be a challenge and a learning opportunity. Cultural differences in how language is translated, and how concepts are interpreted, can have a big influence on how well people understand each other, can work together, or can use products created.

"You can be all using the same words but cultural significance or interest differences, meanings are very different. Need a common dictionary, common language, when you have significant cultural challenges, [communication] is a huge challenge."

Wind
Wind was the most commonly referenced of difficult weather conditions, and it was also discussed as the most difficult to forecast. Land users are always interested in the wind strength and direction, as wind affects all modes of travel, creating issues with visibility, rough water, snowpack, and ice breaking up. Windy.com has become very popular for monitoring wind conditions across Inuit Nunangat, but as Rick Thoman explained in his presentation, it is important to understand the limitations of this product. The visualizations are colourful and intuitive, but the global models used to develop Windy.com cannot be interpreted at a local scale without careful validation with 'on the ground' conditions. Land users want more weather stations installed on the land (not just at the community airport), so that they can check weather – and especially wind – on important trails or at common destinations before they travel.

“Once you pass this lake and get over the mountains that area always has high winds coming from the north, so be prepared.”
Sustainability
Sustainability came up in many ways throughout workshop discussions. Priorities for tailoring weather, water, ice, and climate services to community needs require sustainable (i.e. long-term, continuous) funding, forecasting services/products, personnel, and training opportunities (See p. 18 and Appendix 10).

“Funding is project-based and [we] need to get away from that...very colonial approach to set it up for 3 years then say sorry project is done. [There is an] obligation to northern Inuit communities to provide sustainable monitoring services.”

Data accessibility/sharing
Access to weather, ice, and other monitoring data also came up frequently throughout discussions. Because of a relatively sparse weather station network across Inuit Nunangat, weather data is often not available for specific locations of interest. There is also the issue of data accessibility. Priorities for ease of data (information) access related to having user-friendly apps, ensuring that services work in areas of low bandwidth, and that apps/devices are useable in cold temperatures. Public access to weather data was also emphasized. Some stations run by private companies, government departments, or research programs do not provide public access to their data. The issue of data sharing was also highlighted in numerous discussions. There is great interest in sharing data across projects, communities, and regions. In particular, establishing weather data hubs in different regions was seen as valuable for making relevant information accessible in one place. Creating a "one-stop-shop" that works for everyone is considered challenging, but finding ways to make environmental information easier to find and use is a shared priority. Associated with data access are multiple considerations for data sovereignty, management, technology, scale, seasonality, visualization, interpretation, and accountability.

"Bandwidth is a technical program that can be solved in the future, but in RCMs [Regional Climate Models] right now so much money has gone into putting up satellites and getting that data into usable formats. We’re just missing that very last step of sharing that information with the final user. Bandwidth is an issue. Education is an issue – how to interpret the images. Those policies need to be less restrictive and we should be able to share them with the tax payer."
Priorities for next steps

“Continue ongoing efforts as there are so many great initiatives.”

After reviewing the key messages emerging from the workshop discussions, participants identified a number of priorities for next steps, including:

- **Follow up on new connections** and potential collaborations (across regions and political boundaries)
- **Improve coordination** of community-based monitoring programs (i.e. sharing of information and lessons learned between programs, reduce duplication)
- **Improve cultural awareness** for service providers and researchers
- **Consider equity, diversity and inclusion** in project/program prioritization
- **Increase end-user participation** in future workshops
- **Continue to refine training programs** (interest in integrated training involving local and Inuit knowledge along with satellite imagery and other technologies)
- **Develop more training for specific weather/ice applications** (e.g. Windy.com, SIKU, Floe Edge Service)
- **Have more discussions around lessons learned** from the various examples shared in the workshop, and how to apply those lessons in different community contexts
- **Develop more pilot projects** that tailor forecasts using local monitoring data and national/regional models, aiming for more real-time forecasts
- **Identify ways to improve data availability and accessibility** for existing products and services
- **Explore ways for local observations to be directly considered** in forecast outputs, considering local value propositions
- **Establish long-term funding programs** (including support for ongoing personnel and maintenance)
- **Improve communications** between community/northern organizations and service providers.

“Provide forecasts for where community members are going, not where they are.”

The sharing of experiences and feedback throughout the workshop was valuable for learning from each other and identifying ways to coordinate efforts to better address community needs for weather, water, ice, and climate services. **There are many directions these next steps can take us, and we all have a role to play, contributing according to our strengths in diverse roles.** Most participants expressed interest in having more workshops like this one to share ideas and coordinate efforts. As we learned through this meeting, there is a lot more to talk about and to work on together!

“Move weather services from novelty to necessity.”
Appendix 1

Workshop Agenda

The daily agenda is provided in Appendix 1.

The full workshop agenda can be downloaded from: https://straightupnorth.ca/march2022-presentations/
Welcome, introductions, overview of the day

1:30-1:50 Presentations

Nunavummiut uses and needs for weather, water, ice and climate information
Natalie Carter and Kukik Baker

Weather and ice on SIKU: Services and tools
Becky Segal and Andrew Arreak

1:50-2:30 Breakout 1

- Brief roundtable introductions including interest in the workshop
- Main concerns for safe travel in the communities where you live or work
- Environmental conditions that most affect local travel decisions
- Sources of environmental information relied on to make decisions

2:20-2:35 Break

2:45-3:05 Presentations

SmartICE real-time monitoring and mapping - Sikumik Qaujimajjuti
Andrew Arreak, Leanne Beaulieu, Rex Holwell, Lynn Moorman, Becky Segal, and Katherine Wilson

Harvest and environmental monitoring with InReach
Brent Puqiqnak, John Bryan Idlout, Stephan Schott, and Emmelie Paquette

3:05-3:45 Breakout 2

- Programs/projects in your community or region that you want to share about
- Programs/projects of interest to apply/adapt to community or regional needs
- Programs/projects of interest to inform service development

3:45-4:00 Wrap Up
Day 2
WEDNESDAY, MARCH 9, 2022

1:00-1:15 EST  Welcome, overview of the day

1:15-1:35  Presentations

Understanding and responding to changing sea ice and weather conditions in northern communities
David Atkinson, Armel Castellan, and Adrienne Tivy

C-CORE’s Floe Edge Monitoring Service
John Bennett

1:35-2:20  Breakout 1

• Brief roundtable introductions including roles in supporting the monitoring and distribution of weather, water, ice, and climate (WWIC) information
• Barriers faced as an individual and/or organization in fulfilling this role

2:20-2:35  Break

2:35-2:55  Presentations

A community weather station network in Cambridge Bay, Nunavut
Brent Else

The Meteorological Service of Canada: Review of products and services with a focus on the North
Kristine Confalone, Sara Hoffman, and Tom Zagon

2:55-3:45  Breakout 2

• Community challenges faced when trying to access and interpret online products
• Service provider limitations faced in trying to respond to diverse community needs
• Addressing challenges and limitations to better meet community needs

3:45-4:00  Wrap Up
Day 3
THURSDAY, MARCH 10, 2022

1:00-1:15 EST Welcome, overview of the day

1:15-1:35 Presentations
Getting more from Windy.com and other weather apps
Rick Thoman

1:35-2:20 Breakout 1
Choose your breakout group.
Choose one of the three breakout groups described below.

Training
- Facilitated by SmartICE
- Training ideas to meet community needs

Monitoring
- Facilitated by weather station developers and ECCC
- Monitoring and forecasting ideas to meet community needs

Funding
- Facilitated by CIRNAC
- Funding ideas and opportunities for community-based monitoring and climate change projects

2:20-2:35 Break

2:35-2:55 Presentations
Environmental monitoring with Cryologger weather stations
Derek Mueller and Adam Garbo

SIKU and Indigenous-led research and monitoring projects
Christina Macdonald

2:55-3:45 Breakout 2
Choose your breakout group.
You can stay in the same group as you chose for Breakout 1, or choose another one of the groups described above.

3:45-4:00 Wrap Up
Appendix 2

Presentation Descriptions

**Day 1**

*Nunavummiut uses and needs for weather, water, ice and climate information*

Natalie Carter  
(McMaster University, Hamilton, ON)

Kukik Baker  
(Aqqiumavvik Society, Arviat, NU)

Our research team brings together several long-term partnerships between Inuit, northern, and southern researchers. The goal of our project is to help improve weather, water, ice and climate information that is available, and how it is communicated in northern communities. We will present some initial results from surveys conducted in Arviat, Gjoa Haven, Iqaluit, Pond Inlet, and Sanikiluaq. We will provide an overview of what we learned from Nunavummiut about the types of sources they rely on to make travel decisions, how information is accessed, challenges with using available information, and training needs.

This presentation will provide an overview of the weather and ice tools and services available on SIKU: The Indigenous Knowledge Social Network. Services include: satellite imagery, SIKU Ice Map, SmartICE data, Ice Posts, Ice Watch, ice terminology, weather stations, traditional place names, and more.

*Weather and ice on SIKU: Services and tools*

Becky Segal  
(Arctic Eider Society and SmartICE, Courtenay, BC)

Andrew Arreak  
(SmartICE, Mittimatalik, NU)
SmartICE staff in Gjoa Haven, Mittimatalik, and Nain are creating near-real time maps of sea ice conditions, in areas of interest to their communities. Ice is described in a manner useful to travelers, using local terminology and sea ice IQ. Our team has co-developed a training program and method to integrate previously documented sea ice IQ and near real time interpretation of radar and optical imagery into safety maps which are distributed to the community weekly. This presentation will include an introduction to the sea ice IQ data collection, integration of this knowledge into the maps, and a demonstration of the remote sensing interpretation and mapping process with ArcGIS Pro.

In Gjoa Haven, Nunavut a fishery and food security study led to the collaborative development of a harvest study involving the Gjoa Haven Hunters and Trappers Association (HTA) and researchers at Carleton University. Monitoring applications were specifically designed for use with InReach satellite tracking devices. The project helped to establish direct links with the local Search and Rescue Committee, and several lives were saved because of the real-time tracking of hunter travel and emergency communications with InReach. Harvesters recorded their observations of environmental (marine and weather) conditions and hazards according to what is considered safe, reliable, and cost-effective for sea ice travel. The harvest study will continue for three more years in Gjoa Haven, and a pilot study will start in Taloyoak in 2022. The project extension will enhance connections between the two communities, focusing on biomonitoring, fishery observations, ice and weather conditions, as well as local data stewardship.
We will present an overview of work in the Western Arctic to identify and respond to Indigenous people’s needs for weather and ice information. The work is in direct response to community requests for better sea ice information, training on how to use information that is currently available on the internet, and development of a working relationship with federal weather and ice forecasting services to co-develop new products. We will provide a few examples from the Meteorological Service of Canada’s (MSC) response to specific requests in the Inuvialuit communities of Sachs Harbour, Ulukhaktok and Tuktoyaktuk. We will describe the establishment and use of a closed Facebook group page: Hilaakput. Participants in Hilaakput are elected by their community as a representative and are responsible for requesting information from the MSC to assist hunting activities. Hilaakput helps the MSC to respond directly to requests and provide ongoing forecasts on problematic weather events. The Hilaakput group is also used by community representatives to distributing information in their home community as well as report feedback to the MSC.

Since 2005, C-CORE's Floe Edge Monitoring Service has provided near real-time sea ice imagery and information to Canadian Arctic communities using an online delivery system. The service allows users to access land fast ice products in a timely manner. Through Defence Research and Development Canada’s funding, C-CORE is updating this service to expand our coverage to include all coastal communities in the Canadian Arctic. We aim to improve our overall product suite to provide northern communities with technology-based, innovative tools to help adapt to the consequences of climate change. The updated Floe Edge Monitoring Service will maximize the safety and efficiency of travel on the ice by allowing users to select the shortest route around hazards and minimize travel time, fuel costs, and equipment wear. An expansion such as this requires community consultation, interaction as well as observations.

C-CORE's Floe Edge Monitoring Service

John Bennett
(C-CORE, Ottawa, ON)
This presentation will provide an overview of three weather stations that have been set up near Cambridge Bay, NU (30 Mile, Melbourne Island, and Qikirtarrjuk Island). These stations send weather information to the internet every hour, and are available to the community through a project website as well as on SIKU.

**A community weather station network in Cambridge Bay, Nunavut**

Brent Else  
(University of Calgary, Calgary, AB)

The Meteorological Service of Canada: Review of products and services with a focus on the North

Kristine Confalone  
(Monitoring and Data Services, MSC/ECCC, Toronto, ON)  

Sara Hoffman  
(Edmonton Weather Office, MSC/ECCC, Edmonton, AB)  

Tom Zagon  
(Canadian Ice Service, MSC/ECCC Ottawa, ON)

The Meteorological Service of Canada (MSC) is a branch of Environment and Climate Change Canada (ECCC). The MSC maintains a Canada-wide observation network that monitors air, water and ice. The MSC is the government department responsible for providing warnings of severe weather, public weather forecasts, aviation forecasts, and sea ice charts and forecasts. In this presentation we will provide a quick overview of MSC networks, products and services, focusing on the North.
The Cryologger weather station (https://cryologger.org/) uses low-cost, open-source hardware and software to provide a robust, cost-effective and user-friendly platform for the collection of long-term weather measurements in real time. Carleton University has recently partnered with the Municipality of Igloolik to establish a weather station monitoring network that will help inform travel safety decisions and can be easily deployed and maintained. Community members will determine weather station locations and how travel safety information will be displayed. We will train local technicians to maintain these stations and hope that others in Nunavut and beyond can deploy their own Cryologger weather monitoring networks to better understand and adapt to the changing climate in their communities.

Environmental monitoring with Cryologger weather stations

Derek Mueller and Adam Garbo (Carleton University, Ottawa, ON)

This presentation will provide an overview of how to set up a project in SIKU: The Indigenous Knowledge Social Network, including data privacy and stewardship settings. Examples of how organizations and communities in the north are using SIKU to support their projects will be shared, along with information about how the Arctic Eider Society (AES) and SIKU can support your community climate action projects.

SIKU supporting community monitoring projects

Christina Macdonald (Arctic Eider Society, Halifax, NS)
Appendix 3

Presenter/supporting organization links and resources

- Alaska Center for Climate Assessment and Policy
- Aqqiumavvik Society
  - Ujjiqsuinig Young Hunters Program
- Arctic Eider Society
  - SIKU: The Indigenous knowledge social network
- C-CORE
  - Polar View Floe Edge Service
- Community weather station network in Cambridge Bay, NU
  - Outreach video
- Cryologger weather station
  - Water and Ice Research Laboratory
  - Automatic Weather Station Github
- Environment and Climate Change Canada
  - Meteorological Service of Canada
  - Canadian Ice Service
  - Canada Centre for Climate Services
- Indigenous Climate Monitoring Toolkit
- Ittaq Heritage and Research Centre
  - Clyde River Weather Network
- Polar Prediction Project
- SmartICE
- StraightUpNorth Research
  - Understanding Inuit Community Uses and Needs for Weather, Water, Ice, and Climate Information and Services

Funding opportunities

CIRNAC Climate Change Preparedness in the North Program

Environment and Climate Change Canada
Indigenous Partnerships

Indigenous Climate Monitoring toolkit
(Sustainability and Funding)

Indigenous Climate Hub
Appendix 4

Registered Workshop Participants*

We wish to acknowledge the workshop participants (listed below in alphabetical order, by first name). In total, 120 participants registered for the workshop. Attendance varied each day, and between sessions. Thank you to everyone for your time and for sharing your knowledge and experiences.

Ada Loewen, Carleton University
Adam Garbo, Carleton University
Adrienne Tivy, Canadian Ice Service
Aishwarya Sahai, Environment & Climate Change Canada
Alecia Boddie, Government of Nunavut
Alexandra Oakes, McMaster University
Alexis Polidoro, McMaster University
Alison Perrin, Yukon University and Carleton University
Andrew Arreak, SmartICE
Anne St. Clair, Simon Fraser University and Avalanche Canada
Annette Greenley, Defence Research and Development Canada
Armel Castellan, Meteorological Service of Canada
Aynslie Ogden, Polar Knowledge Canada
Becky Segal, Arctic Eider Society and SmartICE
Breanna Bishop, Dalhousie University
Brent Else, University of Calgary
Brent Puqiqnak, Gjoa Haven Hunters and Trappers Association
Brian Horton, Yukon University
Brian Sieben, Environment & Climate Change Canada
Camille Forest, Crown-Indigenous Relations and Northern Affairs Canada
Cara Patton, Environment & Climate Change Canada
Carolyne Marshall, Environment & Climate Change Canada
Charlotte Buttle, McMaster University
Christina Macdonald, Arctic Eider Society
Colin Tilley, Arctic Bay Adventures and SmartICE
Danielle Halle, University of Waterloo
David E Atkinson, University of Victoria

*Based on information provided at the time of workshop registration.
Dean Flett, Environment & Climate Change Canada
Derek Mueller, Carleton University
Dominique Henri, Environment & Climate Change Canada
Emilia Diaconescu, Canadian Centre for Climate Services
Emma Harrison, Dalhousie University
Emmelie Paquette, Carleton University
Eric Loring, Inuit Tapiriit Kanatami
Erik Wagenaar, Carleton University
Erin Abou-Abssi, Oceans North
Fritz Griffith, Government of Northwest Territories
Gita Ljubicic, McMaster University
Heather Smith, Environment & Climate Change Canada
Isaiah James Bolt, Nunavut Tunngavik Incorporated
Ivan Koonoo, Independent
Izaac Wilman, Nunavut Tunngavik Incorporated
Jackie Kidd, Inuit Tapiriit Kanatami
Jason Carpenter, Nunavut Arctic College and Carleton University
Jean Holloway, University of Ottawa
Jennifer Lukovich, University of Manitoba
Jesse Olayuk, Arctic Bay Adventures and SmartICE
Joel Mike, Nunavut Research Institute
John Bennett, C-CORE
John Bryan Idlout, Independent
John Parker, Environment & Climate Change Canada
Johnny Kasudluak, Independent
Jotanie Keyootak, SmartICE
Julia Conzon, Carleton University
Kate Ortenzi, Dalhousie University
Katherine Wilson, SmartICE
Kelly Murphy, Canadian Centre for Climate Services
Ken Kwok, Meteorological Service of Canada
Kenneth Peter Nookiguak, Arctic Bay Adventures and SmartICE
Kevin Scharffenberg, Fisheries and Oceans Canada
Kimberly Ovitz, University of Manitoba
Kukik Baker, Aqqiumavvik Society
Laura Eerkes-Medrano, University of Victoria
Leanne Beaulieu, SmartICE
Louise Mercer, Northumbria University
Lynn Moorman, Mount Royal University and SmartICE
Mallik Mahmud, University of Calgary
Marijo Cyr, Crown-Indigenous Relations and Northern Affairs Canada
Marlene Doyle, Crown-Indigenous Relations and Northern Affairs Canada
Mary Denniston, Nunatsiavut Government
Meagan Leach, Qaujigiartiit Health Research Centre
Megan Sheremata, University of Toronto Scarborough
Melissa Lafreniere, Queen's University
Melissa MacDonald, Meteorological Service of Canada
Michael Henschel, C-CORE
Michelle Blade, Government of Nunavut
Natalie Carter, McMaster University
Nicole McRae, Crown-Indigenous Relations and Northern Affairs Canada
Olivia Qamanirq, SmartICE
Rachel Chang, Dalhousie University
Regena Sinclair, McMaster University
Rex Holwell, SmartICE
Rick Thoman, University of Alaska Fairbanks
Roxanne Springer, Government of the Northwest Territories
Sara Hoffman, Meteorological Service of Canada
Sara Holzman, Government of Nunavut
Shanay Williams, Inuvialuit Regional Corporation
Shelly Elverum, Ikaarvik
Silvie Harder, Environment & Climate Change Canada
Stephan Schott, Carleton University
Steven Kasarnak, Independent
Stuart Anderson, McMaster University
Sunal Ojha, Trible Chief Ventures Inc.
Sylvie Blangy, CNRS (French National Research Center)
Terry Kalluk, Independent
Thomas Zagon, Canadian Ice Service
Trevor Bell, Memorial University of Newfoundland and SmartICE
Yukari Hori, University of Toronto Scarborough

As well as 20 others who asked not to be identified by name
(1 Inuit organization, 1 land user, 1 regional government, 14 federal government, 1 student, 2 non-governmental organization).
Appendix 5

Workshop Participants' Perspectives and Experiences*

*Based on information provided at the time of workshop registration.

Number of responses
(120 registered participants, and they could select multiple roles)
Appendix 6

Main Concerns for Travel Safety in Communities across Inuit Nunangat

Here we share some of the most common points emphasized across all Day 1 breakout groups relating to concerns for safe travel, providing details to expand on the summary in Figure 2.

Rapidly changing conditions

“Some regions are experiencing repeated (blizzard) events and no relaxation time between where communities can recover between blizzards.”

Experiences and observations of unpredictable ice and weather conditions were the most common concern for travel safety discussed in breakout groups. This unpredictability was closely linked to rapidly changing conditions such as fast and unexpected shifts in weather, and changes in transition times of freeze-up and break-up that lead to unreliable ice conditions (for boating or travel by snow machine). These changes were also emphasized in relation to the impacts on the applicability of Inuit and local weather and ice forecasting methods, as well as the use of historic travel routes. Some Elders no longer feel as confident in their way of interpreting the weather, and so they are changing their behaviour based on recent weather and ice conditions.

Difficult/dangerous conditions

Environmental conditions that are dangerous, or difficult to travel in, are also among the main concerns for travel safety. The most common conditions mentioned can be grouped into weather, ice, and water conditions (Table 2). Briefly though, wind is the most frequently referenced difficult weather condition, as it affects all modes of travel, and creates issues with visibility, rough water, and ice breaking up. With regards to water, tides and currents in the ocean, these can create dangerous travel on water and ice. River crossings were also highlighted as areas of special concern. Difficult ice conditions include travel over rough ice, and most concerns relate to ice thickness and movement (sea ice and lake/river ice).

Lack of knowledge/experience

While conditions are changing rapidly, and unexpected conditions can be encountered, that does not necessarily lead to safety concerns if travellers are well prepared. However, many concerns were expressed about people – especially younger and less experienced community members, or new to a community – travelling without the appropriate knowledge or preparation for potential conditions (see Appendix 9).
It was emphasized that leaving to go on the land without being properly prepared can have fatal consequences. It was recommended that before travel everyone should be:

- checking the weather to identify if/when it might be changing
- aware of current land/snow/ice/water conditions
- able to interpret weather and ice conditions to identify changing or dangerous conditions
- travelling with a more experienced partner (or group) to gain necessary skills
- packing extra supplies in case they are out longer than expected (enough camping gear, fuel, food, etc.)
- telling people where they are going
- developing basic engine repair skills
- taking emergency communication/locator devices (e.g. CB or VHF radio, satellite phone, SPOT device).

It was continually emphasized that young people need to develop strong land skills in order to be prepared and to be able to adjust to changing conditions. Part of this is gaining extensive experience on the land around their home community, and it is also important to learn which kinds of weather services (online information) are useful and reliable. Understanding seasonal and historical conditions of the area also helps to anticipate what may be coming in the near future.

“An example of what can happen when a hunter leaves without checking the weather, was a case where someone decided to go caribou hunting, and just left town without taking enough supplies and not telling anyone where they were going. When a blizzard hit, he hadn’t come back, and community members were searching for him for a week in bad weather. He survived but was hospitalized and ended up losing his hands to frostbite. This could have been avoided if he knew the weather was about to change, and he had brought more equipment with him in case of emergency.”

Need more monitoring and information sharing

Many of the concerns listed above can be at least partially addressed by increasing monitoring efforts and improving how weather, water, and ice information is shared. The kinds of monitoring that were of interest include:

- monitoring to anticipate ice fractures
- ice thickness
- what is happening under the ice
- slush and snowmelt in the spring
- floe edge position
- avalanche hazard.
There are already many creative ways that community members are sharing information about weather, water and ice conditions. Online groups have been created to share observations and warnings with friends and other community members, or to ask for advice. Many service providers are also sharing weather forecasts this way (e.g. from Environment Canada, Windy.com, etc). The main consideration is ease of access to information and understanding the relevance and reliability of that information to the area of interest for travel. Participants reiterated the need for more monitoring, with the interest of having more real-time observations to access and share.

[Referring to winter ice monitoring around Taloyoak]
“We are interested in ice thickness and floe edge. Some Elders and others use local radio to help address where the dangers are around and outside the community. Some people use the SIKU app. With the new pilot project with the inReach we will be using, hopefully harvesters will pinpoint the dangers around their community like slush during the spring or thin ice during the winter.”

[Discussed in relation to avalanche hazards, but may also apply to other kinds of hazards]
“Sometimes the hazard isn’t as obvious as a steep mountain, it can even be a smaller feature that might have higher consequences if the snow piles up and could really harm someone. Getting an understanding for where these locations might exist along primary travel routes would be of interest. Also, what communities are noticing in terms of how snowfall or weather patterns relating to avalanche conditions are changing.”

“I moved to Iqaluit and don’t know the area that well. I use Google, Windy.com, and a group of friends created a group chat together so anytime going out if I don’t know a place I ask if friends want to come or if there’s anything specific about the area that I should know. This way I can get confirmation on where I’m going. Friends caution to not go on my own or that place is fine.”

**Lack of community-relevant products/tools**

In dealing with rapidly changing conditions, and ensuring people are prepared for travel, breakout group participants emphasized the shared need for more community-relevant products and tools. Community members find it challenging to know which information sources are useful in their region or community, and how this may change depending on time of year and mode of transportation. The weather stations that people rely on are sparsely distributed and are usually in communities (at the airport), not where people are travelling. There is great interest in blending modern instruments and forecasting methods with Inuit and local methods of forecasting. However, to do this effectively, and in an understandable way, there is a need to better understand community priorities and needs for weather, water, and ice information.

“Inuit want to have access to the knowledge, information, and tools (including infrastructure) to support travel safety in a rapidly changing environment.”
Appendix 7

Environmental Conditions Most Affecting Local Decisions on When and Where to Travel

Unpredictable environmental conditions

Environmental conditions are changing and are so different from past years that at times community members do not know when to travel or what conditions to expect each season. This affects where people can go based on what trails are useable. An example is slushy areas that community members get stuck in, then tell others to avoid. Another example is when there is a lot of snow on ice it hides polynyas and rattles, which is very dangerous. The area may look fine, even though it is not. SmartICE maps of these dangerous areas alerts community members about their presence. Linked to the changing climate there have also been changes observed in the migration of terrestrial and marine animals that are hunted. Personal cabins, as well as hunting and fishing grounds, are the main destinations for many community members, and unpredictable environmental conditions strongly impact their ability to travel safely where they want to go.

Quantity and texture of snow

The quantity of snowfall is much less than usual in some years, which negatively affects travel. Snow still builds up around cabins, but there is less of it on the land, lakes, and sea. Places and rocks that would normally be covered by snow are not snow covered. Community members must travel slower and take longer to go through (or to avoid) those areas. Accidents are happening (e.g., crashing into rocks), snow machines are being broken, and travellers must use ATVs more often.

On certain parts of the land there is a lot of snow, but the texture is different. It is not as hard as it could be and instead there are really sugary ice crystals. While some people can still make shelters with the amount of snow available, the texture is a little bit different than previous years. Hard packed snow also does not cool snow machines very well. Knowing if it will snow or not is also important when planning travel.

Ice thickness and timing of freeze up

Sometimes ice is not too thick. Freeze up is happening later. Although people are anxious to get out on sea ice and lakes the very late freeze up affects fishing and sealing as people must wait for the ice to be thick enough for safe travel. Participants also noted freeze/thaw conditions are considered when making travel decisions.
Wind

Wind was mentioned often related to safe travel. This included wind speed (e.g. high winds) and direction. Wind was also connected to other environmental conditions in unique ways in different seasons. In spring: visibility, and snow. In summer: water and wave conditions. In the dark season: snow cover (exposed rocks) and ice conditions.

Visibility

Visibility was a critical concern for travel safety. Storms, fog, and mist were mentioned, along with multiple stories shared about community members crashing due to overcast conditions and a phenomenon called white out or flat light.

“A lot of people travel during white out, flat light (can’t see shadows) and fall into creeks and get stuck in rivers because in tundra it looks flat but there is a channel cutting you off and you don’t see it until you are falling into it.”

Visibility assessments were explained as being highly variable depending on the terrain (mountainous or flat), what kinds of land or ice markers people use for navigation, and what speed you are travelling at. Visibility is also very difficult to monitor. Some discussions included ideas for developing a sensor to monitor visibility within a range of 5 miles. Some participants mentioned that if visibility on the ground is less than a mile, they will not travel. Although, some participants also travel in complete darkness using GPS and head lamps. It was mentioned that ECCC does fog forecasting using general statements, and not how bad visibility will be. In the marine forecast, the visibility descriptions are scaled for ships, and not for people on the land.

Rain and clouds

Participants noted that when there is a lot of rain in the fall it impacts harvesters who travel out on the land. They also noted that the colour and form of clouds is important to consider when travelling. Overcast conditions can also be dangerous for travel, especially in relation to snowfall.

Permafrost

In some regions (more in the western Arctic), changes to permafrost conditions are affecting the ways people navigate on the land. In some places this leads to increasing numbers of lakes, and in others decreasing numbers of lakes. Ice features in the ground can also change in a season or two, bulging up to 2m high, while frost slumps can cause the ground to detach and slide downhill. Pingos, palsas, and frost blisters are also part of this dynamic permafrost landscape, where navigation indicators and commonly used routes can be changed in relatively short periods of time. As permafrost changes, land users must learn to reinterpret the landscape, retraining and broadening how they see the world around.

“On vegetation and food security. Permafrost is often linked with engineering and infrastructure but I look at it from a more holistic point of view including food security.”
Appendix 8

SmartICE and SIKU Details

While reflecting on all programs and projects discussed throughout Day 1, participants highlighted how long-term monitoring data is important to feed into identifying larger trends. They frequently referenced SmartICE and SIKU as the kinds of community-led programs that have potential to information service development, because they:

- collect a variety of types of local, long-term monitoring data
- are flexible with regards to the type of information collected (including local knowledge)
- engage community leadership and perspectives in development
- address and communicate local priorities (i.e. "what is truly important" to community members, such as local scale sea ice hazard maps)
- enhance local capacity
- balance technology and accessibility.

Discussions unfolded around the success and widespread uptake of SIKU and SmartICE, where their success was considered due to their operational model (i.e. social enterprises embedded with skills development), and their focus on youth. Their success indicates that training is a service that users want.

"Some communities are easier to get to and have a lot of people coming in (e.g., Nain, Pond Inlet) offering support and leading pilot projects, SmartICE, SIKU, but other communities don’t have the same benefit. Do they have their own programs or is the goal for SmartICE and SIKU to cover conditions [in every community]? I have heard there are communities where no one has ever presented about these initiatives to tell them about."

**SmartICE**

SmartICE is currently operating in 32 communities across Inuit Nunangat, as well as in First Nations and Metis communities in the Yukon and NWT. SmartICE uses an approach that brings a social enterprise to the environmental monitoring issue, which means a business model that focuses on maximizing that social impact. SmartICE is managed by community-management committees who decide how the social enterprise operates. One of the SmartICE operators in attendance explained the feeling of pride experienced in producing maps for their community.

"[SmartICE work is] more trusted, made by one of their own (an Inuk), and includes local experience of travelling on the ice. SmartICE is often evaluating the impacts of services and products. The Elders and community management committee are very grateful to have a voice in SmartICE, facilitating terminology workshops, and it is good to connect with them. [It is a] big difference when someone comes into the community and is hired on the spot versus being Inuit and getting that training is a completely different way of going about it. I think it is great that we have community management committees."
SmartICE provides data from their SmartQAMUTIK operators and SmartBUOYS on SIKU, sharing seasonal measurements of ice thickness and hazards. SmartICE is also an example of a program with sufficient flexibility to be modified to meet a service provider’s need: (e.g. to inform safer travel near glaciers).

[from a service provider]

"[About the] GIS workflow for SmartICE. It would be interesting [for] the remote sensing data to have real-time updates about how glaciers are changing over the melt season because these are areas we are travelling with communities in the valleys. [Knowing] if crevasses are forming, how much meltwater is coming off the glaciers, would impact travel in front of the glaciers."

[from a SmartICE representative]

"We can add that into our Pond Inlet [work] during break-up this year to see if we can see anything. We are not using inSAR but the optical at that time will be useful. Even radar to see what is happening under the snow [could help] to see if there are crevasses opening. We are covering a pretty broad area so the resolution might be an issue, but we are working to figure out what features we can detect such as leads."

SIKU

SIKU is the Indigenous Knowledge Social Network, and is an example of a program that collects multiple types of local conditions and observations with potential to provide and inform hazard services. SIKU is a free platform, open to anyone who abides by the terms of use, and can be used to develop community- or project-specific tools. SIKU is attractive to communities because it makes important travel information accessible, it is a place to share observations, and to access information within and between communities. It takes time to become a trusted source of information, but with options to tailor profiles and determine how community members want to share their observations, it is increasingly used across many communities.

SIKU is user-friendly. Arctic Eider Society (AES) representatives talked about how they offer training and workshops on how to use SIKU and all the tools and services. People also pick up SIKU and use it without the training or an intensive workshop. They also run various challenges to promote the use of SIKU (e.g. Ice Watch and Goose Watch).

"The strength of SIKU is that it is not project dependent and it is entirely up to individuals in the communities to use as they see fit. (e.g., share knowledge, share language, help people with safe travel)."

"Benefit of SIKU as an end user going in to get different remote sensing data - it is way easier that all [the images are] there rather than going to all the individual sources for those data. [SIKU] brings everything together."
SIKU has over 13,500 users, from over 70 communities. Much of SIKU's success is due to the fact that information is available in the mobile app. Way more people have cell phones rather than computers, and so the majority of users are interacting through the app, not the website.

AES is hiring regional coordinators who live in communities and who then deliver the training and stay engaged with community members (and they are working to expand that model). Communities are initially selected based on their expression of interest to learn more about SIKU, and then it has grown from there. For example, now people from Innu and Cree Nations are wanting to learn about SIKU and how it can support government and community-led research programs.

AES is continuing to expand the functionality of SIKU, including:
- developing new tools (including new features related to weather, permafrost, currents)
- platform and web maintenance
- developing ice classification algorithms
- bringing in more satellite imagery
- identifying community priorities
- adding Indigenous terminologies
- improving connections with other monitoring platforms (e.g. eBird, iNaturalist).

"Being able to overlay observed travel routes [like those recorded in SIKU] over the terrain, we can identify high exposure locations to avalanche hazard. Just so we can also identify communities that are most in need of these services. Knowing where people are exposed to terrain, the tracks, would be very useful [for avalanche warning]."

"The opening short videos Gita shared were very powerful and a great reminder to make sure the work we do has real-world applications for people in the north. I will keep that close to my heart in doing my work with AES."

SIKU also provides opportunities for funding, support, and connections to various climate change and monitoring activities (see p. 49).
Need help with a Climate Change Monitoring project in your community?

SIKU: The Indigenous Knowledge Social Network is a tool for communities to use their own language and knowledge systems to start projects and address their priorities for climate change and environmental monitoring.

*We can offer resources for starting or expanding projects...*

**Funding**
for Northern Indigenous Communities to implement climate monitoring projects using SIKU

**Support**
for training, project management, proposal writing, and developing custom tools to support data collection for your project

**Connection**
Connecting you to other Climate Action Projects in other Indigenous communities

Get in touch and apply for funding!

✉️ info@siku.org  🌐 sikuapp  🌐 www.siku.org
Appendix 9

Principles of Safe Travel

"[Emphasize] sources of resilience that northerners have... Northerners know how to get around. Northerners know what the risks are and what to know more about risks. Northerners have a lot to offer about managing risks and coping with them as they come."

Prepare for travel

- don't just bring what you need, bring extra everything
- get in the habit of having a mental checklist of all the equipment, camping gear, food, fuel, supplies, and spare batteries/parts needed to go out on the land
- in some communities they have an Elder-created worksheet that gives tips on how to be prepared to go off on the land, step-by-step what you need to know/bring/pack
- the amount of extra supplies needed depends on the length of the trip, but even for a short trip have emergency food and gear in case machines/motors break down or bad weather comes
- make sure you have a method of emergency communication to call back to the community, or nearby camp (e.g. satellite phone, inReach with SOS function, SPOT device, CB/VHF radio)
- bring extra tools and parts in case equipment breaks down

Develop and share a trip plan

- it is important to develop a trip plan and share it with someone staying in the community, in case of emergency
- Arviat Young Hunters program has developed a trip excursion form that includes:
  - location of where going
  - what planning to do
  - who going with
  - what vehicles
  - expected departure and return date (and when to send a search party e.g. # of days/hours after they were expected to return home)
  - emergency contact information in case the expected return time is missed
Technology only keeps you safe so far then it is all about Inuit knowledge (and other Indigenous knowledge elsewhere) about how to travel safely on the ice. Complete darkness, severe cold. Having a GPS tells me where home is but I wouldn’t follow it, I would follow my Inuit colleagues to get home because there are hazardous conditions out there. There is no replacement for that Indigenous knowledge of safe ice travel. That is the message we consistently hear and that is ultimately at the heart of climate resilience and adaptation.

Develop land, equipment, and survival skills

- having land skills is very important when out on the land, water, or ice
- learning place names, dangerous areas, and terminology helps to navigate, as well as to explain to someone where you are and what conditions you are travelling in/to
- weather can change dramatically from morning to afternoon, so you have to be prepared for any condition at any time
- developing survival skills also relates to traveling with – and learning from – a knowledgeable buddy (see above)
- having equipment skills is important so you can fix a broken machine (snowmobile, ATV, boat) yourself
Develop interpretation skills for environmental forecast products and services

- although environmental forecast products and services cannot replace Inuit and local knowledge, they can be helpful in travel planning or emergency response
- to use products and services in a safe and meaningful way, you have to be able to interpret them accurately
- it is important for travellers to check weather, water, and ice information available online before travelling - need to learn to identify and use appropriate websites
- if using Windy.com, it's important to know what the values and colours mean in relation to a particular place or region, and to understand the limitations of interpreting a global model for use in a local context
- the Floe Edge Service can be very helpful, as well as other satellite image products, but it is important to understand the difference between optical and radar imagery (and how to interpret them)
- New products being developed (e.g. automated tracking of rough ice, tidal cracks, polynyas) need to be extensively verified (i.e. ground-truthed) before they can be reliably used
- It is also important to understand the difference between forecasting products (i.e. based on an expert forecaster interpreting many different products and providing information based on their own interpretation) or raw model output (e.g. Windy.com data, a visualization of model data that has not been interpreted by anyone)
- To improve interpretation skills it can help to reach out to forecasters directly, learn how to talk to them, and even visit their office to learn what goes on and how products are developed and assessed for accuracy.
## Appendix 10

**Main Barriers Identified by Service Providers that Affect their Ability to Fulfill their Role as an Individual and/or Organization**

<table>
<thead>
<tr>
<th>Barrier</th>
<th>Select Participant Quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LACK OF FUNDING</strong></td>
<td></td>
</tr>
<tr>
<td>Funding programs are oversubscribed</td>
<td>“As a funder: access to funding. Our program is incredibly oversubscribed. What we’re seeing at a project level (also relating to funding) is a lack of opportunities, ongoing funding for operation and maintenance and data subscriptions”.</td>
</tr>
<tr>
<td>Fiscal years and time to transfer funds does not match community schedules, and can affect relationships</td>
<td>&quot;Administrative part of working in consortiums (e.g. MEOPAR, ArcticNet) and get proposals funded...we work in these fiscal frameworks, but to actually get that money to flow was a big hurdle. We work in southern-concept frameworks and it takes 2/3 of the year to get the money to flow to the recipients, but you can’t legitimately or meaningfully ask for collaboration or engagement until the money flows. Southern-based [personnel] are paid to be at the table so northern-based [personnel] must be paid too. Almost a number one reason to have more stable funding with that administrative piece taken care of before that flow and that relationship building, personal connection can really start. Have seen different flavours of that over the years.”</td>
</tr>
<tr>
<td>Not enough funding or investment in technologies.</td>
<td>“Funding structures are an issue where novelty seems to drive more funding. So, if some needs within the community are already being met but you are looking to extend the benefits to other facets of the community or marginalized groups within the community, that does not seem to get as much support. Entering new spaces or working with broader brush scales seems to get more support than really tackling diversity within a community’s needs.”</td>
</tr>
<tr>
<td>Northern needs are particularly under resourced</td>
<td></td>
</tr>
<tr>
<td>Funding programs are not long-term (enough) or sustained</td>
<td>“Short-term funding for projects is great for initiating projects but not sustaining them.”</td>
</tr>
<tr>
<td></td>
<td>“In the Yukon we lack sustaining funding to properly maintain weather stations (local) that feed into ECCC stations.”</td>
</tr>
<tr>
<td></td>
<td>“Many of these programs are project-funded, there needs to be more sustainable funding. Even some initiatives led by larger service operators don’t have sustainable funding.”</td>
</tr>
<tr>
<td>LACK OF FUNDING (CONTINUED)</td>
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<td>--------------------------------</td>
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<td><strong>Funds are more readily available to start new programs and rarely available for “continued operations”</strong></td>
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<tr>
<td>“Lots of money out there for shiny new things; little to maintain or gradually improve.”</td>
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<td><strong>Funders set unattainable expectations and constraints in reporting structures</strong></td>
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<td>“CIRNAC in their community programs they have a lot more flexibility, for instance you can roll-over funds into a new year, and different reporting constraints than government in general. It is really helpful for universities and local partners who can roll with it a little bit better.”</td>
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<td><strong>Communities lack access to funding</strong></td>
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<td>“And often times the community feels that they don’t have the funds or the ability to gain the funds to do self-determined research. Community-driven researchers would be ideal and giving training to people to create proposals and access those kinds of funds would definitely benefit the North in the long run. Funding is a roadblock to community-determined projects. Need training to access funding pots.”</td>
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<table>
<thead>
<tr>
<th>NOT ENOUGH TIME</th>
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<tr>
<td><strong>Insufficient time given current responsibilities to:</strong></td>
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<tr>
<td>• build and maintain relationships</td>
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<tr>
<td>• learn about and address user needs</td>
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<td>• spend time in communities.</td>
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<tr>
<td>“Recognize that relationships are so essential to this, and that to build relationships to truly understand user needs, sufficient time is important.”</td>
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<td>“[It requires] flexibility to take the time to build proper relationships and not rush the matter. Gita played the clips of Shirley Tagalik speaking about the Inuit concept of giving everyone an opportunity to share, not necessarily to reach consensus, but so everyone has a better appreciation of where we are all coming from. That takes a lot of time and often funding is short term or less flexible. We are starting to see an increase in flexibility. Academics are reporting deeper recognition of the importance of that and flexibility for relationship building.”</td>
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**COMMUNICATION CHALLENGES**

| Miscommunications arise in multi-disciplinary teams, between departments, and between community members/organizations and non-members. | “There is a culture in ECCC of not using Facebook but it is used a lot in communities...may be preventing them from more publicly sharing information.” |
| Lack of consideration of language and meaning when working across user groups and between languages leads to miscommunication. | “In the Yukon there is nowhere that makes sense to share environmental information more broadly...no online portals like SIKU for Yukon yet. Just parking it online is great but there is no central place to drive people to get it.” |
| "Work with community – Making sure that communications material we’ve developed is tailored in terms of length, language, audience is always top of mind. Ways we have been able to do that is through co-developing material from the beginning with the communities where we have those kinds of partnerships, running drafts by partners we work with in the region, and where they are in a position to take a leadership role in developing some of that language themselves supporting that effort." |

**LIMITED MANDATES**

| Limited federal mandates and limited authority to respond to user needs inhibit community-responsive service provision | “The need is known but the challenge is getting funded in a way that we can produce products regularly. Our mandate focuses on ship navigation but trying to get the mandate for community support, and the funding required to introduce a community focus into that mandate, even if the appetite is there, it is an ongoing process.” |
| | "Work with Inuit so they can develop the products and the systems and do it themselves. Focus on the self-determination side of things because you can keep going to the federal government and they have mandates and responsibilities, but those are such high-level questions. Doing things from the grass roots and building up instead of from the top-down is an approach I have found is really worthwhile and beneficial.” |

**PRESENCE OF POLITICAL WILL**

| Shifting, competing priorities and varying corporate cultures across collaborating departments | “Political will has substantial influence on public-facing delivery of services, and willingness to adapt to user needs in northern communities. It is upsetting and sad because it has long term impacts; a lot of the issues we are seeing now are from the long-term impact of 15 years ago.” |
| | “We need to make hay while the sun shines and right now we have political will and funding to push further; we are in a much better place culturally or societally speaking and decolonizing of systems, building relationships, breaking down barriers. The hope is that even with a change in government [these societal advancements] would be so much further ahead that they would be hard to diminish quickly.” |
### CONSTRAINTS ON HUMAN RESOURCES AND CAPACITY

- Insufficient capacity in the North to collaborate (high administrative burden, limited time and personnel to engage)
- Insufficient opportunity for local involvement (facilitators, youth)
- Insufficient funds to hire local facilitators
- Disrupted continuity (lack of funding, long-term programs, and high turnover in personnel)

- Over engagement from southern based organizations burdens Indigenous partners
- Virtual engagement inhibits building meaningful relationships
- Technological constraints (unreliable internet and ability to use certain programs)
- Insufficient support for community organizations running programs to address their own priorities, and enhance their capacity

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"Capacity change over, people leave."

"Developing relationships, trust in the process, maintaining the relationships so people don’t think they invested and then the person is gone. It’s difficult with graduate students as they move on and are out of the picture. It’s hard to maintain programs sometimes."

"SmartICE empowers communities to do the monitoring themselves. Stop thinking about bringing things into communities and instead build them into communities, bringing Inuit knowledge into decision-making."

"It shouldn’t be on communities and universities to fill [weather station] gaps, but not sure ECCC [Environment and Climate Change Canada] has the capacity."

"Government is challenged with how to incorporate Indigenous knowledge into products...The solution is to train Indigenous Peoples to be scientists so when they do the interpretations it includes their knowledge. This supports reconciliation and self-determination."

"Establish dedicated community researcher/monitoring positions who have the time and resources including capacity/skills to focus on partnerships and programs...too often community researchers have to be jack of all trades."

"Academia, government, ENGO [environmental non-governmental organizations] need to better align our focus so we’re not asking the same questions. And make linkages before doing something more holistic in communities."

"[There is] tension between the need for accessibility of this information for land users, Inuit, and having it relevant to a scale and to community needs. Capacity building needs to be step one in order for a lot of these initiatives to move forward."

"What motivates people to work more directly with some communities? Communities with very responsive, well-funded, well established HTOs [Hunters and Trappers Organizations], facilitate a lot of the conversations. Other communities may not have access to those same resources."
INSUFFICIENT DATA COVERAGE

- Insufficient available data
- Insufficient monitoring to provide enhanced observations and validate models

“We have a hard time getting a lot of data. We have a lot of questions about water and don’t have reliable data to talk about trends in precipitation and things like that in the Yukon.”

“One satellite is down in a super important area where people go every day, every week so I can’t get the images. It would be really good to have those images. We also have a lot of internet issues. Some days I can’t get online at all to do the [SmartICE] satellite maps [for my community].”

LACK OF DATA ACCESS

- Limited data access (data not always shared or made publicly available)
- Incompatibility between data needs and data availability for modelling

“Ice thickness data would be really valuable to C-CORE but we can’t get our hands on it. We could use it to tune our algorithms but data like that does not seem to be shared. Everyone could advance products more if data were shared. It does not need to be near-real-time to fine tune algorithms.”

“We ran across roadblocks trying to access the data. We can see landfast ice motion and if we can correlate that to ice thickness it might be pretty cool, because it might move more if it’s thinner ice, and less if it’s thicker ice. But we were not able to access the data. It was there. It did exist.”

“Remote weather stations in south-west and central Yukon are supporting research efforts but [are not connected] to centralized data repositories.”

“Critical to consider data management up front; Indigenous data sovereignty. [There are a] multitude of online platforms in Canada to support coastal and sea ice observations. Larger questions about challenges when it comes to managing and sharing data: don’t want a huge number of data platforms jostling to do similar kinds of things because it makes it challenging for everyone to know who to go to for what…duplication of effort that we don’t need given the pressing challenges facing our planet.”
**CHALLENGE OF PRIORITIZATION**

Due to many diverse needs and priorities across Inuit Nunangat service providers and funders find it hard to know:
- what to prioritize
- what gaps to fill
- how to balance diverse high priorities

Difficulties balancing:
- research interests
- community needs, and
- what is possible with available funding, logistics

“There are so many high priorities but we can’t address them all. We want to engage and better understand but then people feel ‘we told them our concerns but they [service providers/funders] are not meeting them’. Then we feel like we will never be able to meet all of the needs.”

“As a student I am still trying to balance what I want to do, with community needs, and what is possible with funding and logistics.”

“Recognize diversity of needs and capacity across the North – climate change is making it a moving target, pace of change is terrifying, and will be very hard to keep up with. [We are] always kind of 5 steps behind and it makes it hard to provide for user needs because needs are changing so rapidly especially if there is coastal erosion, ice melt – trying to race a train that is three cars ahead of us.”

**LACK OF AWARENESS AND TRANSPARENCY**

It is hard to pinpoint:
- who is doing what already, and
- where/how to collaborate.

Need to avoid duplicating effort

Need more transparency about government decision-making

Need more understanding of user needs

"I am disappointed that I haven’t noticed anyone [else] from my region. I joined this session on my own accord as a local citizen interested in this but I don’t see a representative from my region involved in these discussions. I don’t see my representative reaching out to communities in my whole region of Nunavik; and I see a lot of activities in the other 3 regions and Yukon...I want to figure out why there seems to be little involvement from my region. That’s my challenge.”

"Cooperation between all these groups collecting so much of the same information at different scales and resolutions. At some point, where do you go for that one stop shop to get everything?"

“[Service providers] do want to hear the feedback and how to make it work in our own systems. We need to be more transparent about how we make decisions”.

"It would be useful from a service provider point of view to have information about where or when search and rescue events happen".

"Create space for people who work in disparate niches to come together and realize there is opportunity to come together".
An internal cultural shift is needed within southern institutions

Institutional capacity and flexibility to be able to recognize and adapt to needs, interests, and priorities of northern communities will go a long way to addressing challenges identified. This point was especially targeted towards federal government departments and universities. An important starting point is simply improving how information is shared, and facilitating more conversations within and between organizations. Education within the decision-making chain is also important, and the number of ECCC managers attending the workshop was seen as very positive.

"[We’re starting to see] a cultural shift internally [referring to Sara Hoffman’s presentation] – this is major. We’ve had decades and decades of creating a monitoring program that could be seen as institutional racism in some ways because if you put a station into a defunct or a mining area and you don’t in a First Nations or Inuit community where there might be several hundred of thousand people you’re not representing where the people are; or where our [ECCC] mandate is. It might be easier to put it in a mining community with a generator but looking at cultural awareness where there is all the right intentions, and acknowledging the past, [correcting] things is an objective of a monitoring program."

Focus on holistic programs

It is important to think about program sustainability and community capacity when developing programs and services. To ensure a holistic approach, community priorities must come first, with a goal of enhancing community self-determination and not just making money. There is a need for community monitoring programs that are developed from the ground up, are locally-led and informed by local knowledge. Minimizing administrative burden, and acknowledging uncertainty and competing priorities for northern communities/organizations, is also important in sustaining long-term programs. Therefore, an emphasis on following community leadership is needed to adjust to changing priorities over time. Holistic programs also rely on funding secured for community capacity and leadership over time, not just a narrow focus on a research question. Funding itself can be a roadblock to community-determined projects, where training is needed just to access funding pots. Doing more training in the north helps to make programs more sustainable, by reducing reliance on people in the south. This also supports more long-term employment opportunities in the North, for northerners.
A way to address long-term funding and staffing issues in locally led initiatives is a social enterprise model (e.g. SmartICE, Kaapittiag in Cambridge Bay, and the Naujaaqaluit Hotel in Clyde River) to fund social programs. Also core to the success of these programs is establishing a local committee of Elders and local experts to guide the program. Emphasize sources of strength and resilience within northern communities and ensure the appropriate groups/individuals are part of the development, implementation, and follow-up necessary for environmental monitoring or forecasting programs. Work with communities to co-develop and test new products, then shift from a pilot program to an operational program that can go farther into the future.

"Letting the community do its own self-determination...self-governance, empowerment, ownership. Letting the community define the question and the answer, will be the key...Self-determined research goes a long way when we are able to show that we can do our own projects. The community has your back and supports you. And often times the community feels that they don’t have the funds or the ability to gain the funds to do self-determined research. But community-driven researchers would be ideal and giving training to people to create proposals and access those kinds of funds would definitely benefit the north in the long run."

Consider collaborative efforts to address challenges as an opportunity for reconciliation

It was clear from many discussions that the history of colonization cannot be ignored, we need to address systemic racism in institutions, and in service provision. We need to contribute to a shift in mentality. Innovative community-led efforts, and diverse approaches to partnerships, show that collaborations in tailoring services to meet northern needs are part of the process of reconciliation.

“Population density is very different but that does not necessarily mean that weather station density needs to be different. If every station contributes to the global effort to forecast weather, then weather station density is important wherever you are”.

Work on communication

Working to improve communications between land users, service providers, decision-makers, and researchers is an ongoing priority. Continuous consideration of, and reflection on, language and terminology are necessary to achieve mutual understanding. It is important to explore and improve on user-centred design by seeking feedback on visual elements, user interfaces, and clarity of instructions in all relevant languages. When sharing information on environmental forecasting services, use short publicly available videos to let communities know about why you are doing the work you do (just keep to the important topics). This will help land users to gain a better understanding of why it may be important to get involved in a project, or to provide their feedback on a product (compared to a survey for instance).

"Cooperation between communities. It is really nice to have a team for doing this kind of work even though conditions and terminology are different... just having people who are trying to collect similar data and do similar processes is really important. To be able to work in two languages - English and Inuktitut - having people talking in both languages."
Develop impact-based forecasting services and products

For forecasting services and products to be useable and relevant in Inuit Nunangat, development needs to be user-led and user-centred to account for the diversity of user needs. Increasing focus is being placed on impact-based forecasting (e.g. Consolidated Weather Impact Charts), that would look at probabilities of weather impacts for up to 5 days. Key impacts and warning thresholds need to defined according to the region and a particular set of users. ECCC is already developing experimental products for aviation and defence sectors, and there is more leeway in these areas because there is a specific client paying for service development. This experimental design, case studies, and pilot testing is important, but takes a while to go beyond internal use to more publicly accessible and broadly relevant products. We need to get creative with how things are designed. When food security is a primary objective, what tools can be tailored for that versus having just a singular focus (e.g. ice)?

"Need agile testing, participatory, novel ideas piloted then revise accordingly. In reality, this does not work in a large community with multiple stakeholders etc., agility is next to impossible. With the pace of climate change we need flexible agility to be able to change with change. The biggest challenge [is being] outpaced by change. Unless a small group is looking at small piece of the puzzle it will be hard to keep things on the same level and moving forward."

Invest in northerners

Investing in northern programs was seen as critical to recognize diverse northern needs. Throughout the workshop, participants reiterated the need to transfer the authority and funds directly to northern communities. This relates to developing holistic programs (see above), to support community leadership and reduce reliance on southern researchers and institutions. It is important to establish dedicated community researcher-monitoring positions who have the time, resources, skills, and capacity to focus on partnerships and programs. This is an investment that helps diversify the labour market in the north, and to support products developed by northerners.

"Too often community researchers have to be jack of all trades."

Northern investments also include establishing data portals/repositories in communities, for both local knowledge and measurements, to maintain an ongoing record of work that has been done. This involves creating data sharing agreements at the beginning of a project, and updating these as needed over the lifetime of a project. It was also highlighted that there is a need to address quality concerns related to community-owned weather stations, as well as to establish ways to connect such stations into the federal network to be included in forecasting.
"[related to developing Indigenous protected and conserved area around Inukjuak]...with all the data collecting still must develop a data sharing agreement but traditional knowledge or IQ [Inuit Qaujimajatuqangit] gathered will be locally owned. The drive has to come from within the community, the initiative of the community, supported by Elders. [This is] key for our communities to participate and get on board to answer the challenges. There are limitations on projects not driven by communities. When it’s the community there is very little limitations, basically, except for funding."

**Improve approaches to online collaboration/training**

We learned of several examples of innovative online training programs (e.g. through Zoom) developed during the pandemic, that could be valuable to continue or expand. Online collaboration and training can make opportunities more accessible across northern regions, in cases where travel is not possible due to timing or limited funding. Continuing to develop online programs in creative, engaging, appropriate, and accessible ways (i.e. for communities with low bandwidth, varied levels of education, and in different languages) is important to support local capacity and invest in northern programs. Although there are many benefits of remote training, it was also recognized that it is not a replacement for in-person training. Wherever possible, in-person training should be prioritized not only for the learning experience, but also for the relationship-building, collaboration, and cross-cultural learning that happens when people get together.

**Emphasize relationships**

Relationships are at the core of understanding community needs, working together to tailor environmental products and forecasts, and improving communications between community users and environmental information providers. Service providers and researchers need to spend more time in the north listening (to understand context and needs), and sharing their experiences to raise awareness of existing programs and services. Developing stronger connections and shared understandings/goals takes time, openness, creativity, and flexibility for all involved. Sharing of information and ideas helps to expand networks, learn from each other, leverage resources, and avoid overlap or duplication of efforts. Workshop participants suggested exploring community-research partnerships as a way to fund and develop expanded networks, or to identify specifications needed for tailored products/useability. These efforts can then be implemented by service providers (government, industry, or community). If pilot programs are successful, there is more chance of them being adapted or transferred to public facing services that support northern communities.

"Want to reduce university’s footprint. At some point it ceases to become a research question and becomes simply a relationship between the service provider and the client then the university can just fade away as there is no particular need for academia."
Thank you for reading!

To provide feedback, or to be added to our mailing list for upcoming workshops, please email: Natalie Carter
Weather & Society Workshop Report
October 2022