Community Guidelines for contributing to

the SAON Roadmap for Arctic Observing and Data Systems (ROADS)

**Background**

In recent decades, sustained observations of Arctic environmental and socio-economic systems have revealed a pace, magnitude, and extent of change that is unprecedented by many measures. These changes include rapid depletion of the cryosphere (*SWIPA ref*), shifts in ecological communities (*CAFF ref*) that threaten biodiversity while precipitating food security and other resilience challenges across northern communities (*ICC and Arctic Resilience Report ref*), and operational demands from increased human activity (*PAME ref*) that outpace the capabilities of responsible agencies. These changes are not confined to the Arctic region. Melting Arctic land ice impacts sea level globally (*IPCC ref*), while regional alterations to the atmosphere and ocean influence the timing and severity of weather in midlatitudes (*Overland ref*) and global ocean circulation (*IPCC ref*).  Sustained observations of the region along with model projections provide critical insights, yet Arctic observations are currently too limited and insufficiently coordinated to adequately inform adaptive responses. As the Arctic region is vast and spans many national boundaries, international cooperation and sharing of observational systems is critical. These challenges motivated the development of the Sustaining Arctic Observing Networks (SAON) process.

SAON is a joint initiative of the Arctic Council and the International Arctic Science Committee that aims to strengthen multinational engagement in pan-Arctic observing[[1]](#footnote-1). SAON's vision is a connected, collaborative, and comprehensive long-term pan- Arctic Observing System (AOS) that serves societal needs. To achieve this vision, SAON facilitates and advocates for coordinated international pan-Arctic observations and mobilizes the support needed to sustain them. In recognition of the complex dimensions of Arctic systems, and the equally complex organizational patchwork of observing partners, the concept for the AOS is of an interrelated system of systems, a significant portion of which are independently initiated from “the bottom up” by the academic research community through revolving funds.

The SAON process includes these guiding principles[[2]](#footnote-2):

● SAON values both research and operational needs for Arctic observations;

● The design and operation of the AOS will be guided by a balance between bottom-up and top-down needs and priorities;

● The AOS will use Indigenous and local knowledge guided by ethical use and honouring the proprietary rights of data contributors;

● SAON will work with counterparts in the Antarctic, global, and national observation communities, where appropriate.

Following these principles, SAON aims to mobilize the support needed to implement and sustain observations on time scales of decades and beyond. In its recent strategic plan (*SAON, 2017*), SAON has identified the need for a Roadmap to support this mobilization and ensure optimized benefits to users from the AOS, including free and ethically open access to all Arctic observational data. SAON’s Roadmap goal was enthusiastically supported by the Second Arctic Science Ministerial (ASM2 ref). To achieve a comprehensive Roadmap, SAON will need to call on its networks and partners for input. This document provides guidelines for how SAON envisions a Roadmap for Arctic Observing and Data Systems (ROADS) to be collectively developed. Following from SAON’s guiding principles and organization, ROADS development is not envisioned as a top-down process. Leadership from existing SAON networks and independently funded Arctic observing projects (as identified in previous SAON inventories[[3]](#footnote-3)) will be critical to achieving a successful ROADS, as will Indigenous experts, global networks and emerging activities. For ROADS to be effective in advancing sustained Arctic observations, it will also need to be relevant to national funding and operational agencies. As such, this document is targeted towards policy-makers at all levels, Arctic Indigenous Peoples organizations, non-Arctic states, academia, civil society and the private sector, as well as engagement from other multilateral/international groups.

A Roadmap is a planning tool used in science and technology development processes to set the conceptual direction for where, in this case, the AOS needs to go and how the various partners and players are going to collectively work towards getting there. Central to defining where the AOS needs to go will be a consensus view of observational priorities, the requirements for their acquisition and a strategy for their timely dissemination across a broad base of users. Developing such consensus views will require the inclusion of a diversity of subject matter experts.

In 2017, following the first Arctic Science Ministerial (ref ASM press release), SAON members, networks and representatives of its intended user base partnered with the US Science and Technology Policy Institute (STPI) to develop a critical tool to support the assessment of these requirements: The International Arctic Observing Assessment Framework (IAOAF, *IDA 2017*). The IAOAF identified 12 Arctic-specific Societal Benefit Areas (SBA’s) including Disaster Preparedness, Human Health, Fundamental Understanding of Arctic Systems and Food Security. These SBA’s were further specified into sub-areas and ultimately 160+ Key Objectives for the AOS to address. Employing the IAOAF as an assessment tool in the ROADS process, along with the United Nations Sustainable Development Goals (SDG’s), the Sendai Framework (ref) and the Paris Accord (ref) will assure that ROADS requirements go beyond the needs of the research community to result in an optimized network that broadly serves societal needs in the Arctic and globally.

In order to initiate the ROADS process, the SAON Board empaneled a task force (Road Map Task Force, RMTF) in early 2018 to set forth definitions and guidelines for the SAON community to follow. It is anticipated that the community will seek funds to engage in ROADS and that this document will support their efforts.

**Recommendations of the RMTF**

ROADS should proceed under the following principles and assumptions:

* ROADS should complement and integrate, without duplication, the current planning approaches used by existing networks (regional to global) and projects;
* ROADS should support step-wise development through a flexible, federated and evolving structure that allows “bottom-up” identification of themes and regional foci;
* Indigenous participation is critical to ROADS from its inception through its implementation.

1. **Essential Arctic Variables**

The RMTF reviewed planning approaches employed by a variety of global and regional observing networks[[4]](#footnote-4). The essential variable strategy clearly emerged as a best practice for supporting network development; the approach is conceptually holistic, yet can proceed step-wise as elements achieve readiness. ROADS will be organized around Essential Arctic Variables (EAVs): conceptually broad observing categories (e.g. “sea ice”) identified for their criticality to achieving Arctic societal benefit. EAV’s are defined by their observing system requirements, which are technology-neutral and should transcend specific observing strategies, programs or regions. They are implemented through specific recommendations based on best available technology and practices. A holistic and collaborative observing system of EAV’s is achieved through employing consistent, consensus strategies in identifying, linking and developing requirements for sampling. The EAV approach allows for progress on implementation, under an expectation of continuous innovation in the underlying technologies. Importantly, EAV’s provide a structured interface for coordination and collaboration in support of societal benefit.

In keeping with the ROADS principal of complementing current efforts in a non-duplicative approach, a rational starting point for identifying most EAV’s will be from existing essential variables associated with global networks. ROADS should refine the definition of their requirements based on regionally-specific user needs and recommend implementation strategies that account for Arctic conditions (e.g. polar night) and opportunities (e.g. community observers). The ROADS process for each EAV should fully specify the observing and data systems requirements from acquisition through high impact information dissemination.

Many global networks have defined templates[[5]](#footnote-5) and principles for essential variable development. The ROADS process will work closely through a series of pilot efforts to develop an EAV template that is consistent with SAON’s guiding principles, while complementary to other efforts.

1. **Governance Structure**

Given the complexity of the ROADS process, a well-defined governance structure is necessary. SAON, through its broad constituency of board and committee members, as well as its rigorous mandate from the Arctic Council, IASC and the Arctic Science Ministers makes it an appropriate governing body. Here, it should be underscored that Arctic Indigenous Peoples need to be recognized as rights holders in the Arctic, and research in their homeland needs to be conducted in partnership with them. Governance of and progress under ROADS shall be shaped by and benefit greatly from this critical consideration. ROADS shall proceed in accordance with guidelines on ethical research[[6]](#footnote-6) provided by Arctic Indigenous Peoples in the various locations.

The RMTF proposes that ROADS proceed under the following structure:

1. ROADS Advisory Panel, Empaneled by the SAON Board

**What:** A standing advisory body to support the ROADS process

**Who**: Representatives of SAON’s Board, committees, and partners

**Why**: The ROADS advisory panel will provide a neutral standing body to assure that each EAV is identified, defined and implemented according to ROADS principles. Further, the advisory body will have the ability to foster integration with other panels; facilitate inclusion of broadest expertise, including Indigenous experts; mobilize international participation and collaboration with global networks; identify potential overlap with other Expert Panels and work to cultivate consensus approaches across overlapping interests. The ROADS Advisory Panel can also work with relevant funding agencies to advance support for expert panel efforts.

**How:** Convenes as required to review and approve proposals from the expert panels to initiate all phases of work and to organize peer review of their recommendations.

1. ROADS Expert Panels

**What**: Expert Panels convene around subject and/or region of interest; scope should be broad enough to cover at least one “Essential Arctic Variable”, preferably a set of related EAV.

**Who**: Subject matter experts from academia, Indigenous organizations, northern communities, operational agencies, industry, etc. IAOAF

**Why**: SAON does not have the capacity to initiate EAV development. Self organization of the community, with funding developed through peer-reviewed process, will be the most effective and quality-driven means to proceed.

**How**:

1. Initiate - Write a brief proposal to the ROADS Advisory Board outlining a proposed scope of activities and participants.
2. Phase I - Convene a community-wide process to identify relevant EAV’s for the scope. Relevance should be systematically assessed using IAOAF principally, but support of SDG’s, Sendai and Paris Accord are also encouraged.
3. Phase II - Convene a community-wide process to specify the requirements for each relevant EAV for the scope. Requirements should be comprehensive of data collection, management, analysis, system management, and dissemination.
4. Phase III - Convene a community-wide process, in collaboration with relevant funding agencies, to outline strategies for implementation and engage commitments for sustainment. This process should describe which infrastructure are essential for current implementation. These include satellite earth observation programs, terrestrial stations, vessels, aircraft and various autonomous platforms providing observing systems. Implementation should also describe how these infrastructures will be integrated into value-added services and products and the strategy for their dissemination. This phase of work should also identify technology development needs in order to improve readiness of future generations of the observing system.
5. Evaluation System

Given the complexity and progressive nature of the proposed ROADS process, it will be critical to evaluate both the process and its elements on a revolving basis. The RMTF recommends that the ROADS process be evaluated after 3 years and each EAV be evaluated after 5 years.

**The ROADS Call to Action**

SAON has matured since its inception into an organized with a clear mandate, compelling vision and robust partnerships. With the recent attention of the Arctic Science Ministerial process and the convening power of the Arctic Observing Summit, it is poised to deliver a Roadmap that will mobilize substantial sustained investments in well-defined and coordinated Arctic observing. We call upon all members of the SAON community to take up this call to join the ROADS process.

**APPENDIX: Inputs from RMTF Homework assignments (for RMTF, only. To be removed before draft is circulated to the broader review group)**

1. David Arthurs

**SAON RMTF Homework Assignment**

**David Arthurs**

The Arctic Observing Systems needs to be seen as more than physical measurements for science. It needs to encompass environmental, economic, and social systems and their interaction.

**Context**

What is the current state of the Arctic Observing System? What are the drivers for change in the system?

* Strengths
* Weaknesses
* Opportunities
* Threats

**Why**

Why should there be an improved Arctic Observing System? What is the objective? What are the costs and benefits?

* Environmental
* Economic
* Social
* Health
* Safety
* Sovereignty

**Who**

Who are the relevant interest groups? What are their (unmet) needs? What should be their roles in a future Arctic Observing System?

* Indigenous Peoples
* Northern Communities
* Scientists
* Operational Services
* Local, regional, national, multi-national governments
* World citizens

**What**

What is the vision for the Arctic Observing System? What are the components? How should they interact? How should they be managed and governed?

* Data collection (in-situ, aerial and space-based)
* Data management and analysis
* System management and governance
* Policies and laws

**Where**

Where should the Arctic Observing System operate? What should be observed? What indicators need to be measured?

* Ocean
* Land
* Atmosphere
* Space
* Social
* Economic

**How**

How can the Arctic Observing System be improved? What should be done? What is needed for it to be done?

* Activities
  + Political
  + Organizational
  + Technical
* Human resources
* Financial resources
* Infrastructure

**When**

When do things need to be done? What is the urgency? What are the priorities?

1. Eva Kruemmel

Comments from Eva:

*I think what I feel is necessary is outlined in the two documents that I provided and gave an introduction about. Some important points:*

* *Arctic Indigenous Peoples need to be recognized as rights holders in the Arctic, and research in their homeland needs to be conducted in partnership with them. This needs to be clearly stated in SAON’s roadmap. Underlying to this approach are guidelines on ethical research provided by Arctic Indigenous Peoples in the various locations, which SAON should point to and recommend that any research in the Arctic adheres to those.*
* *The roadmap should point out that currently monitoring and research activities in the Arctic are fragmented and inefficient. Some things are repetitive, which puts a strain on resources and the people living in the Arctic. SAON should help with the coordination of research and monitoring activities in the Arctic, to avoid repetition and help create synergies, as well as show where the gaps are. This also includes highlighting input from Arctic Indigenous Peoples in terms of what pressing questions are.*
* *The roadmap should include elements that refer to specific objectives and actions that need to be done for the implementation (avoid overlap: some of this might be further outlined in the strategy/implementation and needs to be referred to).*
* *It would be good to include an evaluation plan to measure progress.*
* *Again, as mentioned in my summary of the Inuit documents, questions that should be answered overall include:*
  + *We did this for the SAON framework/strategy already, but probably have to repeat the overall vision, and explain why a roadmap is needed.*
  + *Outline what are the priorities?*
  + *What is the conceptional framework of Arctic observing?*
  + *Research and monitoring: for what purpose? One of the answers should include that “research is a tool for creating social equity” (taken from the National Inuit Strategy on Research).*
  + *How can it be relevant for policy and management purposes?*
  + *What are the dimensions of Arctic observing?*
  + *What are the different fields and topics within those dimensions?*
  + *What is holding it together?*
  + *What are the different actors?*
  + *What is needed for monitoring and research in the Arctic, what are the barriers?*
  + *What should research/monitoring in the Arctic look like? This then includes outlining what guidelines are, ethical conduct etc. It should include descriptions or links that point to answers such as how to deal with data, how we build capacity, how it can be funded sustainably (some of this is part of the SAON strategy and implementation plan, but should probably be referenced in the roadmap to some degree).*

1. SAON RMTF – AMAP input

The input is a ‘boil-down’ of the recently endorsed [AMAP Strategic Framework 2019+](https://oaarchive.arctic-council.org/bitstream/handle/11374/2321/SAOFI204_2019_RUKA_07-05-04_AMAP_Strategic-Framework-2019-2021.pdf?sequence=1&isAllowed=y).

Guiding principles

1. Scientific Integrity: All AMAP products undergo rigorous quality control and peer review as an essential part of the process to ensure objective and complete assessment of the state of knowledge
2. Value of Diverse Perspectives: AMAP is committed to encouraging and utilizing diversity in all of its activities
3. Inclusion of Arctic Indigenous Peoples and Local Residents: Permanent Participant organizations are an integral part of all Arctic Council and AMAP work, and AMAP is committed to working in partnership with Arctic Indigenous Peoples and local residents
4. Responsiveness to Emerging Challenges: AMAP will remain at the forefront of identifying and characterizing changing trends and emerging issues in order to continue to provide evidence-based and policy-relevant information
5. Knowledge Mobilization: AMAP commits to the development of such products that involve and target audiences appropriately and that are accessible both physically and intellectually to those audiences, and commits to the ethical collection and sharing of data
6. Cooperation, Coordination and Interaction: AMAP will encourage and facilitate cooperation and coordination among relevant bodies on cross-cutting issues.

Strategic Goals

1. Improved knowledge and understanding of Arctic change through collaborative assessment processes, for use in evidence-based decision-making
2. A strong, sustained and coordinated circumpolar monitoring and observation network (*additional text below*)
3. Enhanced understanding of Arctic change and its impacts through inclusive partnership with Indigenous Peoples and local residents
4. Effective communication on Arctic challenges and global implication
5. Support relevant international processes (*additional text below*)

Additional text on Strategic Goal 2:

Access to relevant data and information is essential for AMAP’s work. Data obtained through the AMAP network should be sufficient for detecting change, discerning trends and attributing reasons for these changes and trends over the entire Arctic region, for a wide range of environmental stressors including pollutants and climate forcers, and the interactions between them.

The Arctic has specialized challenges and needs for environmental monitoring in order to protect its inhabitants from the adverse impacts of environmental perturbation. Arctic monitoring is also necessary to understand global processes from ocean circulation to weather patterns. From the impacts of global change such as climate warming to the nature, extent, transportation and behavior of environmental pollutants, the Arctic requires specialized, consistent and long-term monitoring programs. Arctic monitoring and research is generally costly, and measurements and observations are often sparse and fragmented. AMAP will continue to collaborate and build on existing efforts, including national and international monitoring and research efforts and community-based monitoring, to secure access to relevant data. AMAP will also endeavor to take advantage of new approaches and tools to address growing knowledge needs and so facilitate more geographically and temporally comprehensive monitoring in the Arctic. AMAP also works to develop and implement Arctic monitoring guidelines for the standardized collection and analysis of samples, which are harmonized with guidelines applied under other relevant regional programs; to facilitate the quality assurance of observations and measurements; and to maintain appropriate data management systems.

Additional text on Strategic Goal 5:

Results and key messages from AMAP assessments are reported to the Arctic Council and governments of Arctic and observer states as well as to relevant international organizations and processes that use AMAP results in their work. Arctic data can be crucial to the success of international processes such as those under the UN Framework Convention on Climate Change, the Intergovernmental Panel on Climate Change, the World Meteorological Organization, UN Environment, the Stockholm Convention on Persistent Organic Pollutants, the Minamata Convention on Mercury, and the Convention on Long-range Transboundary Air Pollution. AMAP will continue to deliver data products and high quality assessments to support such international processes.

1. Roberto Delgado
2. Critical Assumptions include but are not limited to ensuring that any Roadmap for Sustaining Arctic Observing Networks serve society and be driven to promote human health and wellbeing from environmental conservation to sustainable development of the Arctic, with special care taken in economic growth and resource management; enhances local and regional security from the perspectives of food, water, and energy; and, to the extent possible, inform evidence-based decision-making (e.g., for development, management, policy, services, etc.)
3. Details & Specifics: This should include, at minimum, who implements, who finances, and a timeline with concrete milestones and means for the evaluation of progress and success.
4. From other Frameworks: I am less certain about from which other existing frameworks SAON should adopt its strategy. However, rather than a strict topical approach, I would encourage SAON to explore an integrative systems approach, particularly as we think about different “essential variables” among the diverse data streams. Similarly, as or bringing existing observing systems into an overall frameworks, that’s challenging. I would say improved collaboration, communication, and coordination but I am unsure as to how best to implement. I would potentially welcome the formation of regional Arctic Observing Hubs for defining and prioritizing the design and implementation of data collection and analysis for diverse stakeholder use that takes us from research to operations and other applications.
5. Stein Sandeven

0. There are some basic assumptions and rationale that underpin why we are creating a Roadmap and what the Arctic-specific challenges and opportunities of such a proposition entail for how we proceed. List what you think the most critical assumptions are that should be stated in this document:

* (e.g. from Sandven): The SAON Roadmap should acknowledge that Arctic observing (AO) is a complex system with several dimensions. Broadly speaking, AO is driven by the need to support:
* Scientific disciplines: atmosphere, ocean, cryopshere, terrestrial themes
* Societal benefit areas: weather, climate, environment, natural hazards, resources, economic activities, +
* Community-driven requirements: across several scientific and social benefit areas
* (e.g. from discussion) There are already numerous networks (regional, subject-oriented, led by different principles, global networks) that are active and have developed strong strategies. As example, the Global Crysophere Watch (GCW) under WMO has significant observing activity ongoing in the Polar regions. But in many cases these networks have little or no activity in the Arctic so far, but they aspire to become engaged in Arctic observing as part of global observing. The activities of the networks are dependent on the funding from national research and monitoing programmes, implying that observing are mainly located in the Arctic countries and their EEZ. In the high seas the observing activities are based on research programmes, which are increasing as more countries seek presence in the Arctic. SAON's ROA should not interfere or redefine what these groups are doing, but seek to add value at the "meta-level" to show some unification and system-level integration across these diverse organizational systems.

1. A well-developed Roadmap for Arctic observing should describe "where we are going". Our exercise is not simply to redefine the SAON Strategic Plan but to look specifically at how network requirements should be developed in a way that national funding bodies can understand and react to/fund and that global and regional partners can organize themselves around. What are the types of details and specifics that you think the RAO should include? What infrastructures are essential for Arctic observing across scientific disciplines and societal benefit areas. These include satellite earth observation programmes, terrestrial stations, vessels, aircraft and various autonomous platforms providing observing systems. Can SAON play a role to facilitate better integrated use of the infrastructures and more coordinated data production and data management ? For space data, there is already considerable coordination and standardisation of observations and data products. For in situ data, there is much more variety in the observing systems, serving a wide range of scientific disciplines and application areas. This makes coordination more challenging.

* (e.g. from GOOS), Essential Variable frameworks provided a valuable organization system where independent but overlapping expert groups can coordinate existing networks and merge their outputs around specific requirements for spatial and temporal observing scales and point to the specific observing strategies (e.g. ARGO floats) that are needed to get there.
* (e.g. from GOOS), system readiness and technology gaps were explicitly identified along with strategies for promoting their development

2. The inputs provided suggest some strategies for "how to get there". List the examples and ideas from other frameworks that you think provide this strategic framework. How do you think the RAO should adopt, reject or modify these strategies in the Arctic context:

* What role do you think the IAOAF should play in organizing this work? Should work with the organsiations and networks already taking steps to “get there”
* (e.g. from GOOS), the community organized into broad subject matter expert panels under specific topics: Physical oceanography, biogeochemical oceanography and used existing partner organizations to lead progress under these expert panels, all following the same expectations for identifying and describing Essential Variables.
* What are the specific processes needed in order to bring existing observing networks into an overall framework. What would be requirements to existing networks? How could the framework benefit existing networks?

In Europe there are national and European Research Infrastructures which play a role to coordinate specific observing systems, which are thematically defined. Existing European infrastructures which are in operation are partly covering Arctic areas or plan to extend to the Arctic (e.g. Euro-ARGO, ACTRIS, ICOS, EPOS), see <http://roadmap2018.esfri.eu/>. It is a priority of EU to strengthen these infrastructures, and they represent a framework within their disciplines. A common data management and open data distribution policy is an important part of the operating principles for these infrastructures.

1. Starkweather, with edits/input from Eicken

SAON Roadmap Task Force: Organizational strategy and homework assignment

A Roadmap is a planning tool used in science and technology development processes to set the broad conceptual direction for where an organization, network, or similar entity needs to go and how the various partners and players are going to work - with specific milestones identified - towards getting it there.

In short, it answers

1. Where do we (or the existing and developing networks and components of the Arctic Observing System) need to go?
2. How are we going to get there and who is going to take these actions?

But before this, there should be formulations about

0. An underpinning set of assumptions to concisely clarify, among other things:

1. Why the Arctic Observing System should be developed.
2. But also the findings/recognitions that are critical to setting the development context, such as the role of indigenous partners in Arctic observing or the need to provide both scientific and operational benefits.
3. Finally, it should clarify the intended audience(s) for the Roadmap.

SAON has already done quite a bit of work on these underlying formulations, many of which are well outlined in the guiding principles of the Strategic Plan, but as a stand-alone document, the definition should include or expand upon them.

We need to be careful not to simply rewrite the Strategic Plan for SAON as the Roadmap to the Arctic Observing and Data Systems (RAODS) is much more focused on the nuts and bolts of assessing and developing nuts and bolts requirements for the observation and data systems.

Homework assignment

For a homework assignment to move towards synthesizing the inputs, everyone should take the materials/inputs (including the national statements) and consider or respond to what they think fits under each header:

0. There are some basic assumptions and rationale that underpin why we are creating a Roadmap and what the Arctic-specific challenges and opportunities of such a proposition entail for how we proceed. List what you think the most critical assumptions are that should be stated in this document:

* AUDIENCE: Funding organizations, AC working groups, component networks (regional and global), long-term observing projects, Arctic research institutions (e.g., national institutes), operational services, communities, private sector.
* (FROM RMTF discussion) There are already numerous networks (regional, subject-oriented, led by different principles, global networks) that are active and have developed strong strategies. SAON's RAO should not interfere or redefine what these groups are doing, but seek to add value at the "meta-level" to advance system-level integration across these diverse organizational systems; such guidance should be formulated in a form that is easily digested and incorporated into planning by the intended RAO audience.
* SAON’s RAO should adhere to the Guiding Principles that were laid out in the SAON Strategy.
* SAON’s RAO should support research, operational and community needs consistent with the Arctic SBA’s. The Roadmap document should make explicit how following the RAO can help achieve societal benefits through synergies and collaborations that would elude individual, uncoordinated efforts.
* SAON’s Committee on Observations and Networks (CON) and SAON’s Arctic Data Committee (ADC) will be providing essential guidance and input to the RAO process. In particular CON’s task to maintain an inventory of relevant observing efforts at the national level ties in directly with the more specific aspects of RAO implementation.
* (e.g. from Sandven): The SAON Roadmap should acknowledge that Arctic observing (AO) is a complex system with several dimensions. Broadly speaking, AO is driven by the need to support:
* Scientific disciplines: atmosphere, ocean, cryosphere, terrestrial themes
* Societal benefit areas: weather, climate, environment, natural hazards, resources, economic activities, +
* Community-driven requirements: across several scientific and social benefit areas

1. A well-developed Roadmap for Arctic observing should describe "where we are going". Our exercise is not simply to redefine the SAON Strategic Plan but to look specifically at how network requirements should be developed in a way that national funding bodies can understand and react to/fund and that global and regional partners can organize themselves around. What are the types of details and specifics that you think the RAO should include?

* (**Integration**) RAO should offer a “holistic view” of the diverse regional projects, networks, infrastructures and data assets that are integrated into the Arctic Observing System. The IAOAF is a foundational input towards creating such a view. (e.g. Finnish national input, “The holistic picture is needed for most Societal Benefits as identified in the Arctic Observations assessment frameworks (IAOAF) first value tree. Most key objectives for SBAs depend on more than one information service.”) The application of the IAOAF towards RAO to address the “adequacy of the system” was also supported by Iceland. It is clear that the IAOAF is a long-term vision and the RAO will develop first around those topics/themes where there are resources to support it. None-the-less, each contribution should take the whole into consideration. The RAO may need to provide some guidance on how to meld the somewhat coarser granularity of the IAOAF with the finer details that are needed at the requirements and observations level in a full observing system framework.
* (**Integration)** Essential Variable frameworks provided a valuable organization system that is already being used by several key Arctic observing systems (e.g. CBMP, AMAP, INTAROS) and global systems (e.g. GCOS, GOOS, GCW, GEO-CRI). EV’s support coordination of existing observations and networks through merging their outputs around specific requirements for spatial and temporal observing scales and point to the specific observing strategies (e.g. ARGO floats) and data dissemination plans that are needed to get there.  Current system readiness and technology gaps should be explicitly identified along with strategies for promoting their development (e.g. from GOOS). RAO should be organized around EV’s, but these should not merely be a re-iteration of global/existing EV’s. RAO must set a standard for why an EV is included, demonstrate how it supports IAOAF, outline/extend specific requirements that are not ALREADY part of the global definitions, and demonstrate how it is linked to other EV’s in the RAO. The RAO should also provide guidance on how convergence can be achieved as broader EV-based guidance is translated into specific measurement or observing system protocols.
* (**Optimization**) RAO should go beyond inventories of current activities, which are largely to be derived from the SAON CON’s inventory efforts, to assess **priorities and optimized approaches** so that national & multi-national funding bodies can understand where their efforts will be most impactful (e.g. French national input, “From the national standpoint, it would be useful if the Roadmap addresses questions such as how national initiatives could optimally contribute to the development and coordination of joint Arctic infrastructures and observing networks.”) The US supports quantitative (OSSE’s) and qualitative (IAOAF) oriented assessments to assure maximized return on observing investments (multiple use).
* (**Governance and Relationships, Regional)** The RAO, including the process by which Essential Variables are identified and assessed, should be strongly informed by Indigenous subject matter experts and adhere to principles of equitable inclusion (US principles of research, Canadian Inuit Research Strategy). What remains a subject for debate is whether SAON should suggest any type of thematic organization strategy (e.g. INTAROS input) for the participating networks to follow or if we should seek to “group” existing SAON networks into “work units” (e.g. GOOS defined 3 thematic groups for its “expert panels”, Polaris had user categories and themes) or if we should continue to let the community self-organize. Given that much of this work will be accomplished through national/multi-national proposals (e.g. Eicken et al), we need to consider allowing for flexibility and bottom up approaches. SAON is in a unique position to suggest some high-level organizational units, but doing so without explicit CHAMPIONs identified could prove dangerous. It should also be noted that Arctic regionality itself is something the RAO will need to acknowledge and address. Fostering formation of and nurturing continuity of communities of practice that assemble around thematic foci driven by pressing research or societal problems may be a promising approach to overcome governance and organizational challenges.
* (**Governance and Relationships, Global**) RAO should specifically identify how it is aligning with and supporting (related to) global programs within the Arctic (e.g. from Finland, “The working definition needs a relationship to roadmaps like European Science Foundation Research Infrastructure or Earth Observation programs like Copernicus have. We need to highlight the Arctic parts of many different networks and bring in their proposals into the pool of proposals that we would shape in SAON.”) Clarifying relationships with e.g. Arctic Cluster was also supported by Italy.
* (**Commitments, Research Infrastructures**) RAO should indicate budgetary and timeline requirements. (Germany) It should indicate how current research infrastructures (e.g. ESFRI) will be included or utilized. Sweden also indicated the importance of understanding the impacts on near and long-term infrastructure utilization and improvements. (TO DO) Attilio mentioned an important part of the ESFRI plan that I can’t find in my notes.
* (**Data Access, “Delivering Science Services”**) RAO should take guidance from the SAON ADC on the integral nature of data management and delivery; RAO should identify viable pathways towards the definition, operational production, and delivery of data and information products with a focus on a few signature pan-Arctic data/information products

2. The inputs provided suggest some strategies for "how to get there". List the examples and ideas from other frameworks that you think provide this strategic framework. How do you think the RAO should adopt, reject or modify these strategies in the Arctic context:

* The IAOAF should be used to assess how specific observations (Essential Variables) accrue value and support Arctic Societal Benefit Areas.
* (e.g. from GOOS), the community organized into broad subject matter expert panels under specific topics: Physical oceanography, biogeochemical oceanography and used existing partner organizations to lead progress under these expert panels, all following the same expectations for identifying and describing Essential Variables. We should explicitly state that experts include those with traditional technical training but also those with Indigenous Knowledge.
* We need to carefully consider how to enlist the support/help of existing SAON Networks; identify needs within AC working groups that do not already have EV frameworks; identify research priorities from IASC.
* Even developing a portion of the RAO will require funding. SAON should consider a strategy for adding support directly to the Secretariat to support RAO.
* RAO should include a vision for assessing and re-evaluating the outcomes on a periodic basis.

1. The SAON process was established in 2011 at the Seventh Ministerial Meeting of the Arctic Council (AC) via the Nuuk Declaration. [↑](#footnote-ref-1)
2. A complete list can be found in the SAON Strategy (<https://www.arcticobserving.org/strategy>) [↑](#footnote-ref-2)
3. <https://www.arcticobserving.org/inventories> [↑](#footnote-ref-3)
4. Including the GOOS Framework for Ocean Observing; Circumpolar Biodiversity Monitoring Program (and GEOBON); Arctic Monitoring Assessment Program (and GCOS); GEO Global Water Sustainability (GEOGLOWS) [↑](#footnote-ref-4)
5. For example, specifications for: [GCOS ECV](http://climatemonitoring.info/ecvinventory/), [GOOS EOV](http://www.goosocean.org/index.php?option=com_content&view=article&id=14&Itemid=114), [GEOBON EBV](https://geobon.org/ebvs/what-are-ebvs/). [↑](#footnote-ref-5)
6. Examples from Canada: <https://www.itk.ca/wp-content/uploads/2018/03/National-Inuit-Strategy-on-Research.pdf>, and US <https://www.nsf.gov/geo/opp/arctic/conduct.jsp> [↑](#footnote-ref-6)