

1 Guidelines for contributing to SAON's  
2 Roadmap for Arctic Observing and Data Systems (ROADS)

3 **Background**

4 In recent decades, sustained observations of Arctic environmental and socio-economic systems have  
5 revealed a pace, magnitude, and extent of change that is unprecedented by many measures. These  
6 changes include rapid depletion of the cryosphere (*AMAP, 2017*), shifts in ecological communities (*ICC-  
7 AK, 2015; CAFF, 2017*) that threaten biodiversity while precipitating challenges to food security and  
8 resilience across northern communities (*ICC-AK 2015; Arctic Council, 2016*), and adaption demands from  
9 increased human activity (*Arctic Council, 2009 and 2016; ICC-CA, 2008; ICC-CA, 2014*) that outpace the  
10 capabilities of responsible agencies. The local impacts of these changes result in coastal erosion,  
11 increased storm surges, wild fires, damage to infrastructure and risks to fresh water supplies from  
12 degrading permafrost to name a few. Observed impacts from Arctic change are not confined to the  
13 region. Melting Arctic land ice impacts sea level globally (*IPCC, 2013*), while regional alterations to the  
14 atmosphere and ocean influence the timing and severity of weather in midlatitudes (*Overland et al.,  
15 2016*) and global ocean circulation (*IPCC, 2013*). Sustained observations of the region along with model  
16 projections provide critical insights to needed adaptive responses, yet Arctic observations are currently  
17 too limited and insufficiently coordinated to adequately inform them.

18 The Arctic region is vast; it crosses many national boundaries and is home to Indigenous Peoples. Scores  
19 of independently sponsored activities are responsible for collecting and disseminating Arctic  
20 observations without a comprehensive mechanism for linking and coordination. Challenges of Arctic-  
21 specific conditions (e.g. Polar Night, extreme cold) increase observing system costs and constrain  
22 coverage. Fragmented research and observing activities that do not work in equitable partnership with  
23 Arctic Indigenous Peoples put a strain on Indigenous communities and are unlikely to address the needs  
24 they have determined to support holistic decision making across scales. International sharing of  
25 observational assets and partnership approaches with Arctic Indigenous Peoples are thus imperative.  
26 Collectively, these challenges of collaboration in response to rapid change motivated the initiation of the  
27 Sustaining Arctic Observing Networks (SAON) process.

28 SAON is a joint initiative of the Arctic Council and the International Arctic Science Committee (IASC) that  
29 was created to strengthen multinational engagement in and coordination of pan-Arctic observing (*Arctic  
30 Council, 2011*). In recognition of the complex dimensions of Arctic observing activities, and the equally  
31 complex organizational patchwork of observing partners and infrastructures, SAON's intent is to unite  
32 Arctic and non-Arctic countries and Indigenous Peoples in support of a systematic network of activities  
33 through structured facilitation. SAON partner nations have already considerably invested in Arctic *in situ*  
34 and satellite observing in support of operational needs and academic research; regional governments,  
35 Indigenous Peoples and local communities sustain their own networks as well. An important portion of  
36 these activities are independently initiated from "the bottom up" through revolving funds. SAON's  
37 vision is to bring these parties into a connected, collaborative, and comprehensive long-term pan-Arctic  
38 Observing and Data System that serves societal needs. To achieve this vision, SAON will facilitate and  
39 advocate for coordinated international pan-Arctic observations and mobilize the support needed to

40 sustain them. SAON's Strategic Plan (SAON, 2018) outlined these guiding principles to follow in achieving  
41 its vision:

- 42 • SAON values both research and operational needs for Arctic observations;
- 43 • The Observing System is implemented and sustained through open cooperation among all those  
44 committed to Arctic observations under a common SAON umbrella;
- 45 • The design and operation of the Observing System will be guided by a balance between bottom-up  
46 and top-down needs and priorities;
- 47 • SAON will promote contributions of all types of observations including but not limited to *in situ*,  
48 remotely sensed, and community-based observations, and the infrastructure supporting them;
- 49 • The Observing System will use Indigenous and local knowledge guided by ethical use and honouring  
50 the proprietary rights of data contributors;
- 51 • SAON will promote ethically free and open access to ethically-collected data;
- 52 • SAON will work with counterparts in the Antarctic, global, and national observation communities,  
53 where appropriate.

54

55 Several of these principles address critical ethical considerations for partnership with Arctic Indigenous  
56 Peoples and use of their Indigenous Knowledge. In particular, processes for the direct engagement and  
57 involvement of Indigenous Knowledge holders in the analysis and use of the information need to be in  
58 place, and sensitive data need to be protected. They also support rigor, as Indigenous Knowledge  
59 holders have noted that segmented science efforts can lead to wrong conclusions. Following these  
60 principles, SAON aims to mobilize the support for sustained observations on time scales to decades and  
61 beyond. How does SAON propose to do this?

62

### 63 **Roadmapping Approach**

64 In its recent strategic plan, SAON identified the need for a Roadmap for Arctic Observing and Data  
65 Systems (ROADS) to set a course for the needed system and to specify how the various partners and  
66 players are going to collectively work towards getting it there. The purpose of ROADS is to stimulate  
67 multinational resource mobilization around specific plans with clear value propositions, to serve as a  
68 tool for the joint utilization of Indigenous Knowledge and science, to coordinate engagement and to  
69 ensure that maximal benefits are delivered to SAON's intended users. A well-defined assessment  
70 process is required to establish a communal view of "societal benefit" and the intended user base of  
71 Arctic observations. A key tool for such assessment will be The International Arctic Observing  
72 Assessment Framework (IAOAF, *IDA 2017*), jointly created by SAON and the Science and Technology  
73 Policy Institute following the 2016 Arctic Science Ministerial. The IAOAF identified 12 Arctic-specific  
74 Societal Benefit Areas (SBA's) including Food Security, Disaster Preparedness, Human Health, and  
75 Fundamental Understanding of Arctic Systems. These SBA's were further specified into sub-areas and  
76 ultimately > 160 Key Objectives for ROADS to address. The IAOAF has already been used by the EU  
77 IMOBAR project (*IMOBAR, 2018*) and by a Finnish-led effort to support improved climate and weather  
78 observations. Employing the IAOAF as an assessment tool in the ROADS process, along with on-going  
79 input from Indigenous, scientific and other subject matter experts, will assure that observing system

80 requirements result in an optimized network that broadly serves societal needs in the Arctic and  
81 globally.

82 SAON’s goal for this Roadmap was presented to and supported by the Second Arctic Science Ministerial  
83 (ASM2, 2018); continuing multinational coordination through SAON was endorsed in their Joint  
84 Statement with an emphasis on: “moving from the design to the deployment phase of an integrated  
85 Arctic observing system”. ROADS is a critical tool in making this move from design to deployment as it  
86 will systematically develop and integrate requirements for observing and data systems along with  
87 implementation strategies that are based on mature approaches, linking new deployments to existing  
88 infrastructures for maximal efficiency. ASM2 mobilized new resources to benefit SAON and related  
89 Observing and Data System imperatives under funding calls like the U.S. National Science Foundation’s  
90 Navigating the New Arctic<sup>1</sup> and the E.U. Horizon2020 call to establish an Arctic GEOSS<sup>2</sup>. To achieve a  
91 comprehensive ROADS in a timely fashion, SAON will need to call on its networks and partners for input,  
92 partnering with them in directing these resources towards deployment plans.

93 This document provides guidelines for how SAON envisions ROADS to be collectively developed by those  
94 networks and partners, with SAON serving in an advisory and facilitation role. In keeping with SAON’s  
95 guiding principles, ROADS development will proceed at the interface between ROADS guidelines with  
96 active advising from SAON (top-down) and a collection of community-led (bottom-up) expert panels.

97 **Who will lead these expert panels?** Leadership from existing SAON partner networks (e.g. INTERACT,  
98 CBMP, IASOA) and independently funded Arctic observing projects (e.g. INTAROS) and infrastructures  
99 (e.g. SIOS) will be critical to achieving a successful ROADS, as will Indigenous experts, global networks  
100 and regional activities. For ROADS to be effective in advancing sustained Arctic observations, it must be  
101 relevant to national funding and operational agencies and the global networks. Therefore, this  
102 document is targeted towards policy-makers at all levels, Arctic Indigenous Peoples organizations, non-  
103 Arctic states, academia, civil society and the private sector, as well as other multilateral/international  
104 groups.

105 **How will participation in ROADS benefit these efforts?** While many of SAON’s partners have their own  
106 processes for identifying observing system priorities, there is currently no meta-structure to tie these  
107 efforts together into a systematic, pan-Arctic view. The community-led Arctic Observing Summit process  
108 (AOS, 2015) and the Arctic Science Ministers have both upheld the need for such structure and SAON’s  
109 role in shepherding it forward. Clear partnerships with SAON continues to be a critical success factor for  
110 community-drive proposals and several pilot partnership efforts are emerging to begin ROADS  
111 development. These pilot Expert Panel efforts must include direct or indirect support for SAON for  
112 ROADS to succeed; they must also include funding for equitable partnership with Indigenous Peoples  
113 from inception through implementation.

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<sup>1</sup> [https://www.nsf.gov/funding/pgm\\_summ.jsp?pims\\_id=505594](https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=505594)

<sup>2</sup> [https://ec.europa.eu/research/participants/data/ref/h2020/wp/2018-2020/main/h2020-wp1820-climate\\_en.pdf](https://ec.europa.eu/research/participants/data/ref/h2020/wp/2018-2020/main/h2020-wp1820-climate_en.pdf)  
(H2020 LC-CLA-20-2020)

114 To initiate ROADS, the SAON Board empaneled a task force (Road Map Task Force, RMTF) in early 2019  
115 to set forth definitions and guidelines for the SAON community to follow. What follows are the  
116 recommendations of that task force.

### 117 **ROADS Guidelines – Recommendations of SAON’s Roadmapping Task Force**

118 ROADS should proceed under the following principles and assumptions:

- 119 - It should complement and integrate, without duplication, the current planning approaches used  
120 by existing networks (regional or global), activities and projects;
- 121 - It should support step-wise development through a flexible, federated and evolving structure  
122 that allows “bottom-up” identification of themes and regional foci;
- 123 - Indigenous Peoples equitable partnership and funding for their active participation is critical to  
124 ROADS from its inception through its implementation.

125

#### 126 **A. Essential Arctic Variables**

127 The RMTF reviewed planning approaches employed by a variety of global and regional observing  
128 networks<sup>3</sup>. The essential variable strategy clearly emerged as a best practice for supporting network  
129 development; the approach is conceptually holistic, yet can proceed step-wise as essential variables  
130 achieve readiness. ROADS will be organized around Essential Arctic Variables (EAVs): conceptually broad  
131 observing categories (e.g. “sea ice”) identified for their criticality to achieving Arctic societal benefit.  
132 EAV’s are defined by their observing system requirements (e.g. spatial resolution, frequency, coverage,  
133 accuracy), which are technology-neutral and should transcend specific observing strategies, programs or  
134 regions. They are implemented through specific recommendations based on best available technology  
135 and practices. A holistic and collaborative observing system of EAV’s is achieved through employing  
136 consistent strategies in identifying, linking and developing requirements for sampling. The EAV approach  
137 allows for progress on implementation, under an expectation of continuous innovation in the underlying  
138 technologies. Importantly, EAV’s provide a structured interface for coordination and collaboration in  
139 support of societal benefit.

140 In keeping with the ROADS principle of complementing current efforts in a non-duplicative approach, a  
141 rational starting point for identifying most EAV’s will be from existing catalogs of essential variables  
142 associated with global and regional networks. It is recognized that new EAV’s - unique to the Arctic - will  
143 also be identified through relevant topical expert groups, following practices of knowledge co-  
144 production. ROADS should define EAV requirements based on regionally-specific user needs and  
145 recommend implementation strategies that account for Arctic conditions (e.g. polar night) and  
146 opportunities (e.g. community observers). The ROADS process for each EAV should fully specify the  
147 observing and data systems requirements from acquisition through high impact information  
148 dissemination.

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<sup>3</sup> Including the GOOS Framework for Ocean Observing; Circumpolar Biodiversity Monitoring Program (and GEOBON); Arctic Monitoring Assessment Program (and GCOS); GEO Global Water Sustainability (GEOGLOWS)

149 Many global networks have defined templates<sup>4</sup> and principles for essential variable development. The  
150 ROADS process will evolve step-wise through a series of pilot efforts to develop an EAV template that is  
151 consistent with SAON’s guiding principles, while complementary to other efforts.

## 152 B. Governance Structure

153 Given the nature of the ROADS process, a well-defined governance structure is necessary. SAON,  
154 through its broad constituency of board and committee members, as well as its rigorous mandate from  
155 the Arctic Council, IASC and the Arctic Science Ministers constitutes an appropriate governing body.  
156 Here, it should be underscored that Arctic Indigenous Peoples need to be recognized as rights holders in  
157 the Arctic, and research in their homeland needs to be conducted in partnership with them. Governance  
158 of and progress under ROADS shall be shaped by and benefit greatly from this critical consideration.  
159 ROADS shall proceed in accordance with guidelines on ethical research (e.g. *NISR, 2018; IARPC, 2018*)  
160 provided by Arctic Indigenous Peoples in the various locations.

161 The RMTF proposes that ROADS proceed under the following structure:

### 162 a. ROADS Advisory Panel

163

164 **What:** A standing advisory body to support the ROADS process, empaneled by the SAON Board.

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

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

172 **How:** Convenes as required to review and approve proposals from the expert panels to initiate all  
173 phases of work and to organize peer review of their recommendations. It is anticipated that thematically  
174 broad efforts will include resources to support additional demands on the SAON Secretariat.

### 175 b. ROADS Expert Panels

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

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<sup>4</sup> For example, specifications for: [GCOS ECV](#), [GOOS EO](#), [GEOBON EB](#).

178 **Who:** Subject matter experts from academia, Indigenous organizations, northern communities,  
 179 operational agencies, industry, etc. These will mostly likely be led by existing regional programs (e.g.  
 180 AMAP) or global networks (e.g. GCW) or large Arctic research networking activities.

181 **Why:** SAON does not have the capacity to initiate EAV development. It will be imperative to draw on  
 182 those existing bodies that already have the expertise and remit to develop requirements and  
 183 implementation strategies. Self-organization of the community, with funding developed through peer-  
 184 reviewed process, will be the most effective and quality-driven means to proceed. SAON's advisory  
 185 process will support alignment between and across Expert Panels at each phase of their progress.

186 **How:**

- 187 1. Initiate - Write a brief proposal to the ROADS Advisory Panel outlining a proposed scope  
 188 of activities and participants. SAON will have the opportunity to assure panel alignment  
 189 with ROADS principles, like the equitable inclusion of Indigenous experts, and can  
 190 furnish a support letter to acknowledge that alignment.
- 191 2. Phase I - Convene a community-wide process to identify relevant EAV's for the scope.  
 192 Relevance should be systematically assessed using IAOAF principally, through Value Tree  
 193 Analyses, as well as using ethical guidelines – i.e. partnership with Arctic Indigenous  
 194 Peoples.
- 195 3. Phase II - Convene a community-wide process to specify the requirements for each  
 196 relevant EAV for the scope. Requirements should be comprehensive of data collection,  
 197 management, analysis, system management, and dissemination.
- 198 4. Phase III - Convene a community-wide process, in collaboration with relevant funding  
 199 agencies, to outline strategies for implementation and engage commitments for  
 200 sustainment. This process should describe which infrastructure are essential for current  
 201 implementation. These include satellite earth observation programs, terrestrial stations,  
 202 vessels, aircraft and various autonomous platforms providing observing systems.  
 203 Implementation should also describe how these infrastructures will be integrated into  
 204 value-added services and products and the strategy for their dissemination. This phase  
 205 of work should also identify technology development needs in order to improve  
 206 readiness of future generations of the observing system.

#### 207 C. Evaluation System

208 Given the complexity and progressive nature of the proposed ROADS process, it will be critical to  
 209 evaluate both the process and its elements on a revolving basis. The RMTF recommends that the  
 210 ROADS process and each EAV be evaluated after 5 years.  
 211

#### 212 **Where will ROADS take us?**

213 ROADS is both a holistic concept, building from the systematic approach of the IAOAF, and one that can  
 214 proceed step-wise so that the most imperative Arctic observing elements can be rapidly deployed. For  
 215 each Essential Arctic Variable identified, ROADS will result in well-specified requirements for observing  
 216 and a strategy for their implementation and timely dissemination. Funding agencies will recognize the

217 merits of an integrated and systematic community-wide process with coordinated international  
218 engagement. And global networks will recognize the value of regional facilitation through EAV's that  
219 extend the definitions and utility of their own essential variables.

220 **How to get Involved...**

221 SAON has matured since its inception into an organized with a clear mandate, compelling vision and  
222 robust partnerships. With the recent attention of the Arctic Science Ministerial process and the  
223 convening power of the Arctic Observing Summit, it is poised to deliver a Roadmap that will mobilize  
224 substantial sustained investments in well-defined and coordinated Arctic observing. We call upon  
225 SAON's partners in networks, infrastructures and observing activities to take up this call to join the  
226 ROADS process.

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