

Arctic Science Ministerial Meeting Fall 2016: Notes and an informal U.S. perspective on potential priorities, frameworks, outcomes

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Key points

- The Arctic Science Ministerial presents an opportunity to tackle major challenges and advance comprehensive, cross-cutting initiatives that are urgently needed to respond to transformational, rapid Arctic change
- Sustained, coordinated observations require an international implementing and guiding body with sufficient resources; the Sustaining Arctic Observing Networks Initiative (SAON) can be built out and restructured to serve this role
- Out of a handful of specific activities identified as high priorities (incl. funding mechanisms, system design, data sharing, and community-based observations), the implementation of a Distributed International Central Arctic Ocean Observatory stands out as a key first step to put a new implementation framework into action

Rationale

The Arctic Science Ministerial Meeting (ASM) provides an opportunity to address urgent albeit challenging issues surrounding the impact of rapid Arctic change on Arctic people and stakeholders outside the region, as well as the role of academia in providing response options to the changes based on advances in the scientific understanding of the Arctic system. From the scientific perspective it is important to identify issues to address at the meeting that are of a nature appropriate for a gathering at the ministerial level (relevance, complexity, urgency, scope, and international resonance). Whereas, regardless of outcomes, such a meeting is a major step forward in Arctic collaboration, it ideally would not simply highlight already planned national initiatives or join disparate efforts of limited scope that could be implemented or addressed through existing channels. A more forward-looking and timely outcome would be if participating nations could map their interests and commitments onto a coordinated and sustained observing system.

Substantive agreements require prior coordination at the national and international level. In essence, the agreements have to be drafted before the meeting. This document is meant to help outline and present for discussion a U.S. research community perspective and facilitate international communication and coordination prior to the meeting. The document draws on input from the U.S. Study of Environmental Arctic Change (SEARCH), and has been coordinated with international partners, including the International Study of Arctic Change (ISAC) and a number of polar research centers outside of the U.S., contacted by the lead author in his role as immediate past chair of SEARCH and director of the International Arctic Research Center at the University of Alaska Fairbanks during visits in May of 2016.

The document draws on deliberations at the 2016 Arctic Observing Summit (AOS) and Arctic Science Summit Week (ASSW) and the 2015 ASSW, all of which

have emphasized the importance of sustained observations of rapid Arctic change and highlighted key priorities reflected in the text below. A complete copy of the AOS 2016 Conference Statement is appended.

(1) Towards a framework for coordination and implementation of sustained Arctic observations

The recent AOS and ASSW confirmed that while there are a number of bottom-up initiatives (e.g. IASOAS, INTERACT, PAG-DBO, CALM, SIOS, etc.) as well as very few broader pan-Arctic or global frameworks (e.g., the Sustaining Arctic Observing Networks Initiative, SAON, or Group on Earth Observations, GEO) to plan and conduct Arctic sustained observations, there is currently no entity or program strong enough and resourced at the appropriate level to oversee and drive this process at the international level. As recognized by the more than 500 AOS 2016 participants as part of the conference statement, there is an urgent need to:

Coordinate the implementation of a pan-Arctic observing system with regional and global observing initiatives, and organize efforts in securing resources for its sustained operation through the leadership of the Sustaining Arctic Observing Networks (SAON) initiative.

There is an emerging consensus on this need among the research community and government agencies, and first steps towards an alignment of SAON to address this challenge are underway. The ASM provides an opportunity for a broader group of nations to gather support for and address technical or scientific obstacles to a transformation of SAON. Specifically, the creation and backing of a technical, cross-sector and cross-disciplinary entity is needed to help guide the scientific and technical foundation for design and implementation of coordinated sustained observations, culminating in an observing system of systems. Drawing upon past accomplishments of the Arctic Observing Summits (AOS) and expanding the role for this platform and forum as a continuous process – highlighted by biennial summits under leadership of SAON, the International Study of Arctic Change (ISAC) and the International Arctic Science Committee (IASC), AOS is expected to ensure broad participation by stakeholders and the research community.

(2) Specific tasks and priorities for improved coordination and implementation of sustained Arctic observations

The U.S. research community under the auspices of the SEARCH program, the Interagency Arctic Research Policy Committee (IARPC), a National Research Council study and other efforts, as well as the international community through a number of programs and frameworks have identified key priorities and tasks towards sustained, coordinated, long-term observations of a changing Arctic. The ASM provides an opportunity to address priorities and advance tasks that require near-term, concerted action. The following categories are of particular relevance for the ASM.

Observing system design and prioritization: Consensus is emerging that sustained observations in the context of rapid Arctic change need to serve multiple functions, i.e., simultaneously addressing high-priority scientific research questions and

satisfying relevant stakeholder information needs. Hence, an approach that allows for identification and prioritization of observations over a range of scales and problems, and also recognizes the value of existing observing programs and the need to integrate them appears to hold the greatest promise. A commitment from the ASM to support such a duality of sustained observations, the associated resources required, and the central role of research in both problem definition and development of modern tools and approaches to observations in response to Arctic change is essential for success.

Planning and coordination of observations: At the tactical level, several national and international research programs have made progress towards coordination in space and time targeted sustained observations. However, with the exception of narrowly focused operational programs such as the World Meteorological Organization's Global Atmosphere Watch or Global Cryosphere Watch's CryoNet, concerted efforts by groups of nations to implement joint planning and implementation mechanisms are still needed.

Joint support and funding mechanisms: As highlighted in the AOS 2016 conference statement, coordination and joint planning requires clearly defined and mutually agreed upon national commitments and responsibilities for specific types of observations. This task is greatly helped by internationally coordinated funding mechanisms. This is an issue that the ASM may help address (see also #3 below for a specific example).

Observing technology: The nature of the Arctic environment requires innovative new developments observing capabilities, in particular with respect to autonomous sensor development to reach remote and hostile environments. A successful effort in such an initiative has to ensure interoperability of sensors and platforms across different countries and programs.

Major observing platforms: An international effort to secure agreements and funding mechanisms for major observing infrastructure that is open to the research community would address a critical need. For terrestrial flagship observatory sites important steps have been taken. A similar approach for a few key marine research platforms (icebreakers, research aircraft, marine observatory sites) would be of tremendous value. Programs that have established successful approaches to international management and commitment of resources, such as the International Ocean Drilling/Discovery Program (IODP) or the bartering system for open ocean research vessels, may inform Arctic approaches.

Community-based observations: Arctic Indigenous peoples and residents of the region have a major role to play in tracking and responding to rapid change. Community-based observations are evolving as an important component of any type of multi-use observing system, but support is needed for sustained rather than one-off efforts and the development of best practices for such observation programs.

Data archival and sharing: As reaffirmed by the AOS 2016, open access and common standards are key aspects of data collection and management for sustained Arctic observations, along with ethical use and proprietary rights relevant for Indigenous Knowledge and certain types of community-based observations. While frameworks for modern data management have been defined, the ASM can help substantially by ensuring that agencies and researchers from participating countries have the

resources and awareness to follow agreed-upon data sharing principles guidelines, and policies.

(3) Towards a Distributed International Central Arctic Ocean Observatory (DICA00)

The ASM provides an opportunity to address a number of the issues identified above in a context that combines relevance, urgency, and the need for international partnerships while offering opportunities to develop a framework and operating procedures that apply to a broad range of sustained observations. Thus, due to its remoteness, challenges resulting from major changes in the sea ice cover and lack of concerted action, we are currently in great need of an observatory that examines key changes in the ocean-ice-atmosphere system of the central Arctic Ocean, including impacts on diversion of freshwater, ice-albedo feedback and potential transformation of ecosystems and biogeochemical processes in the high marine Arctic. Such a distributed observatory, comprising sensor networks, repeat transects and point-based measurements, would be situated north of the Arctic coastal nations' EEZs and would be ideally served by an international partnership to put in place and sustain observations of major transformations underway at the top of the world – similar in some respects to international collaboration in Antarctica or the exploration of space.

A DICA00 would be a natural step in developing international partnerships and protocols to address the key elements of coordinated observations outlined under #2 above. With the region's remoteness and increasing access problems due to loss and thinning of ice suitable for ice-based research stations, the central Arctic is an ideal site for an internationally administered observatory. Its location calls for use of major research infrastructure, coordination of icebreaker deployments and offers opportunities for emplacement of innovative sensor technologies to overcome the challenges of the region.

(4) Thematic priorities

The ASM offers an opportunity to identify key initiatives deserving of immediate attention and support, building on planning processes in particular the AOS, or some aspects of the International Conference on Arctic Research Planning (ICARP). Potential priorities to be addressed at the ASM include:

- (i) Integration of flagship observatories around the Arctic Ocean margins, including agreements on data and observation standards, interoperability of sensor systems, cross-sectoral and cross-disciplinary balance;
- (ii) National commitments and coordination towards tracking of Arctic Ocean in/outflows and large-scale repeat transects that capture ocean and ice freshwater and heat content, nutrients, biological variables, etc. Such an effort would represent a long-outstanding integration of the Arctic Ocean into global ocean survey programs started during the World Ocean Circulation Experiment (WOCE) and the Joint Global Ocean Flux Study (JGOFS) in the 1990's and continued under the CLIVAR/CO2 Repeat sections now conducted under GoShip. These programs left out the Arctic not because of the importance of the region, but because the platforms used for the open ocean could not be deployed in the ice-covered Arctic Ocean.

Internationally coordinated icebreaker deployments could fill this important gap in our understanding of the global ocean.

(iii) Integration of efforts under (ii) into distributed marine observatories focused on broader Arctic system questions, including ocean-ice-atmosphere interaction, ecosystem functions and change, feedbacks of global significance (ice-albedo, degradation of terrestrial and subsea permafrost and impact on atmospheric methane concentrations, freshwater budgets and fluxes and impacts of global thermohaline circulation, etc.);

(iv) Development of protocols and frameworks for integration of community-based observations into distributed observatories, with a focus on coastal regions;

(v) Comparative studies and synthesis of regional responses to global and Arctic climate change, with an initial focus on contrasts between the Pacific and Atlantic Arctic sectors.



ARCTIC OBSERVING SUMMIT 2016 - CONFERENCE STATEMENT

The Arctic is experiencing the fastest rate of climate change and related impacts on the planet. Co-occurring changes are widespread across the biological, physical and human components of the system. These changes are of concern for Arctic peoples and nations and also to the wider global community. For people that call the Arctic home the changes affect livelihoods, economies and cultures, including the ability to respond and plan for the future. The Arctic is also an integral element of the larger Earth system. Arctic change is contributing to global sea level rise and is expected to lead to environmental and weather changes in mid- and lower latitudes, thereby affecting millions of lives and having significant social, economic and political impacts. As a result, Arctic Change is moving to the forefront of scientific and societal concern.

Timely access to information and data about the Arctic is critical as projections of future change and identification of emerging issues are increasingly urgent. A diverse range of information is needed for managing, planning, adaptation, and sustainable development at local to planetary scales. The users of this information are diverse with varied and pressing needs and addressing Arctic change requires cooperation across cultural, disciplinary, and political boundaries. It demands a pan-Arctic, cross component, multi-purpose observing system that can provide information over time and across space and that answers the needs of a wide range of stakeholders. Of necessity, this system needs to be co-designed to incorporate the best of Indigenous Knowledge and scientific approaches with local expertise.

Last week in Fairbanks, Alaska, at the 3rd Biennial Arctic Observing Summit, over 450 delegates, from 30 countries, representing a broad spectrum of the scientific community, Indigenous peoples from Alaska, Northern Canada, Greenland, Arctic Scandinavia and Arctic Russia, representatives of the private sector, governmental agencies, non-governmental and nonprofit organizations, and Arctic Council observers, Permanent Participants and working group representatives came together to discuss and develop recommendations and a pathway toward the implementation of an internationally supported, pan-Arctic observing system that is considerate of and responsive to both local and global needs.

Seven major recommendations emerged from the 2016 Arctic Observing Summit. These are:

1. **Develop** international principles and protocols that establish ethical guidelines for research, for the involvement of Arctic Indigenous Knowledge holders, for the use of Indigenous Knowledge and the co-production of knowledge. Develop mechanisms to enable collaborative approaches and building of trust among partners, such as researchers, Indigenous Peoples, private sector entities and others, to define observational needs, and to plan, prioritize, implement, and use sustained observations.
2. **Propose** to the highest levels of government, the business case for a comprehensive pan-Arctic observing system. This proposal should assess the costs and demonstrate the benefits for society at various levels, including an Implementation Plan that builds upon the present system and past planning, and that identifies needed resources including infrastructure, instrumentation, human capacity, the pathways to financing, and a strategy for sustained financing.
3. **Create** opportunities for stakeholder engagement as a critical component of an effective pan-Arctic observing system that includes strategies for improved communication, takes advantage of existing natural capital, creates avenues for research collaboration, identifies resources for capacity building and participation of local and Indigenous knowledge holders, and resolves jurisdictional, regulation and policy hindrances to active participation.



4. **Coordinate** the implementation of a pan-Arctic observing system with regional and global observing initiatives, and organize efforts in securing resources for its sustained operation through the leadership of the Sustaining Arctic Observing Networks (SAON) initiative.
5. **Advance** a strategy for international funding, ideally with a single application and review process and contributions of resources from all partner countries, along with established national support mechanisms. Full implementation of a pan-Arctic Observing System requires coordination of funding efforts to support a globally connected and internationally accessible network.
6. **Prioritize**, on an ongoing basis, observations that should be started and maintained over the long-term by operational and other relevant agencies. Collaborative, sustained observations need to be implemented through a combined research-operational system that extends across all scales relevant to those it serves, making use of both long-term national/institutional funding and of project based competitive funding.
7. **Work**, through the SAON Arctic Data Committee, to develop a broad, globally connected Arctic observing data and information system of systems that is based on open access data and standards, in addition to recognizing and addressing ethical use and proprietary rights of Indigenous Knowledge and that delivers value to Arctic and global communities.

The Arctic community has the knowledge and expertise to collaborate on the development and implementation of a sustained observing system that supports decision-making in response to rapid Arctic change. However, resource and coordination limitations have, to date, hampered appropriate progress. International investment into sustained, coordinated observations will actively ensure bi-directional capacity building, relevant education, and best practices. Most critically, it will provide the information that is necessary to minimize the environmental, social and economic impacts of rapid Arctic change and the associated and even unanticipated costs. Arctic change is a consequence of global change, with global repercussions, and addressing it is a global responsibility. It is time to move forward with full intent and full engagement and act on these recommendations of Summit participants.

The Arctic Observing Summit (AOS) is an international, biennial forum of scientists, agencies, Indigenous Peoples' organizations, Arctic community members and the private sector. Its purpose is to coordinate the design, development and implementation of a comprehensive and sustained pan-Arctic observing system at the international level. The International Study of Arctic Change (ISAC) leads the development and planning of the AOS in partnership with SAON and local organizers. AOS is an outreach event of SAON. SAON is co-led by the Arctic Council through the Arctic Monitoring and Assessment Programme (AMAP) and the International Arctic Science Committee (IASC). SAON works to support and strengthen the development of multinational engagement for sustained and coordinated pan-Arctic observing and data sharing systems that serve societal needs, particularly related to environmental, social, economic and cultural issues. AOS 2016 is the third Summit, with previous events held in 2013 in Vancouver, Canada and 2014 in Helsinki, Finland. The fourth AOS is scheduled for 2018. Dates and location will be announced at www.arcticobservingsummit.org