DEVELOPMENT AND APPLICATION OF THE INTERNATIONAL ARCTIC OBSERVATIONS ASSESSMENT FRAMEWORK

Jason Gallo, PhD | IDA Science and Technology Policy Institute

SAON: Towards a Roadmap for Coordinated Arctic Observing

24 October, 2018

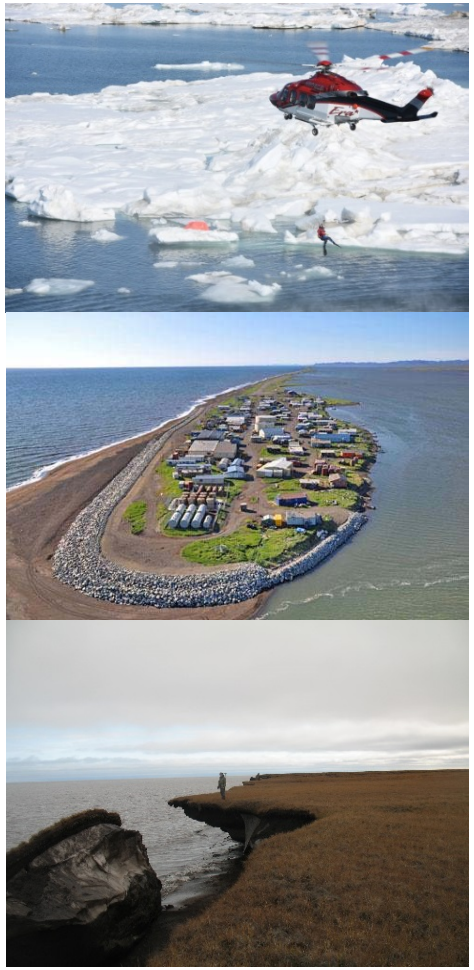
IDA SCIENCE AND TECHNOLOGY POLICY INSTITUTE

IMAGE CREDIT: Beaufort Sea. NASA & USGS (Landsat 8 – OLI & TIRS, Terra – MODIS, Aqua – MODIS)

SOCIETAL BENEFITS ARISING FROM ARCTIC SCIENCE AND OBSERVATIONS

Arctic science and observations contribute to:

- The protection of life and property
  - *e.g.* Weather predictions, sea ice forecasts, atmospheric and water models
- Economic productivity
  - *e.g.* Identification of energy and mineral resources, surface and ocean transportation systems and infrastructure, fishing
- Community resilience
  - *e.g.* Long-term trends that disrupt local activities and safety, including coastal erosion, changes in permafrost, reduction in seasonal sea ice cover
- Fundamental understanding of the Arctic system
  - *e.g.* Increased understanding of connections between Arctic and non-Arctic systems, reducing uncertainty in seasonal and inter-annual projections
- Arctic science and observations improve decision-making across sectors (e.g. scientific, economic, social, and security).



WHAT IS UNIQUE ABOUT SCIENCE AND OBSERVATIONS IN THE ARCTIC?

- The Arctic is remote, but its processes are not isolated.
  - Changes to physical, social, and economic systems and processes globally affect the physical, social, and economic processes in the Arctic.
  - Changes to physical, social, and economic systems and processes in the Arctic affect physical, social, and economic processes globally.
- Societal benefits in the Arctic are both local and global.
  - *e.g.* Understanding sea ice extent and thickness benefits communities, governments, researchers, and commercial interests in the Arctic as well as international governments, researchers, and commercial interests.
- Because the Arctic is remote and sparsely populated relative to other areas, there are challenges deploying and maintaining observational system. This can lead to significant information gaps.
  - These observations are a mixture of remotely sensed and in situ physical, social, and economic measurements.
- Many Arctic communities and social and economic infrastructure in the Arctic are vulnerable to rapid changes in the Arctic system and its processes.

UNDERSTANDING THE VALUE OF ARCTIC SCIENCE AND OBSERVATIONS

- The benefits of Arctic science and observations may not be obvious to the public or to policy-makers. It is important to increase public understanding of fundamental Arctic processes and how Arctic science and observations support decision-making across sectors that benefit society.
- Rigorously assessing how national and international objectives are achieved in the Arctic and how those benefits are distributed across specific sectors will help increase public and policy-maker understanding of the value of Arctic science and observations.
- Only through a categorization of the set of Arctic objectives relevant to a nation or international body can one comprehensively understand what is relied upon to deliver societal benefits through Arctic science and observations and inform policy decisions that impact the prioritization and allocation of resources.

WHY ASSESS ARCTIC OBSERVATIONS?

- While many countries observe the Arctic's physical, biological, and human systems, and share the resulting data, the current global network of observations can be optimized and gaps in observational coverage addressed.
- In order to improve observations and address gaps systematically, it is necessary to first understand what observations currently exist and, more importantly, are being used, by whom, and for what purposes.
- Once the current portfolio of Arctic observations used to support objectives in the Arctic is understood, it is possible for governments, non-governmental organizations, the research community, and Arctic citizens to collaborate to:
  - Strengthen existing Arctic observing networks
  - Identify where new or modified observations are observations are needed and should be integrated
  - Identify where new or modified data, information products, and services are needed
  - Identify opportunities for data- and information-sharing

WHAT IS AN ARCTIC OBSERVATION ASSESSMENT?

- An Arctic observation assessment could provide a **comprehensive quantitative assessment** of the **current portfolio** of Earth observation systems, sensors, networks, human observations, and surveys that contribute to data and information products, public services, and research that **provide societal benefit** through the objectives identified by experts and policy makers.

- The results of an Arctic observing assessment can be used to:
  - Develop of a census of the Earth observations relied upon to provide Arctic societal benefits within specific contexts (e.g. national, regional, local, etc.)
  - Quantify the relative reliance on individual Earth observation systems, sensors, networks, and surveys
  - Identify unanticipated applications of Earth observation sources that deliver societal benefits by contributing to objectives beyond those considered during the design and deployment of those sources
  - Provide an evidence base to inform decisions on the maintenance and continuity of existing Earth observations and the programs that support them
  - Inform the development of a pan-Arctic observing network

BACKGROUND ON THE INTERNATIONAL ARCTIC OBSERVATIONS ASSESSMENT FRAMEWORK

- The Arctic Observing Summit (AOS) 2016 issued a call 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 SAON initiative."

- STPI and Sustaining Arctic Observing Networks (SAON) initiative held a workshop in January 2017 to develop a framework for an international Arctic observations assessment.

- The major elements of the framework—Arctic benefit areas and objectives—were derived from 25 international Arctic strategy documents from 16 countries and the European Union.

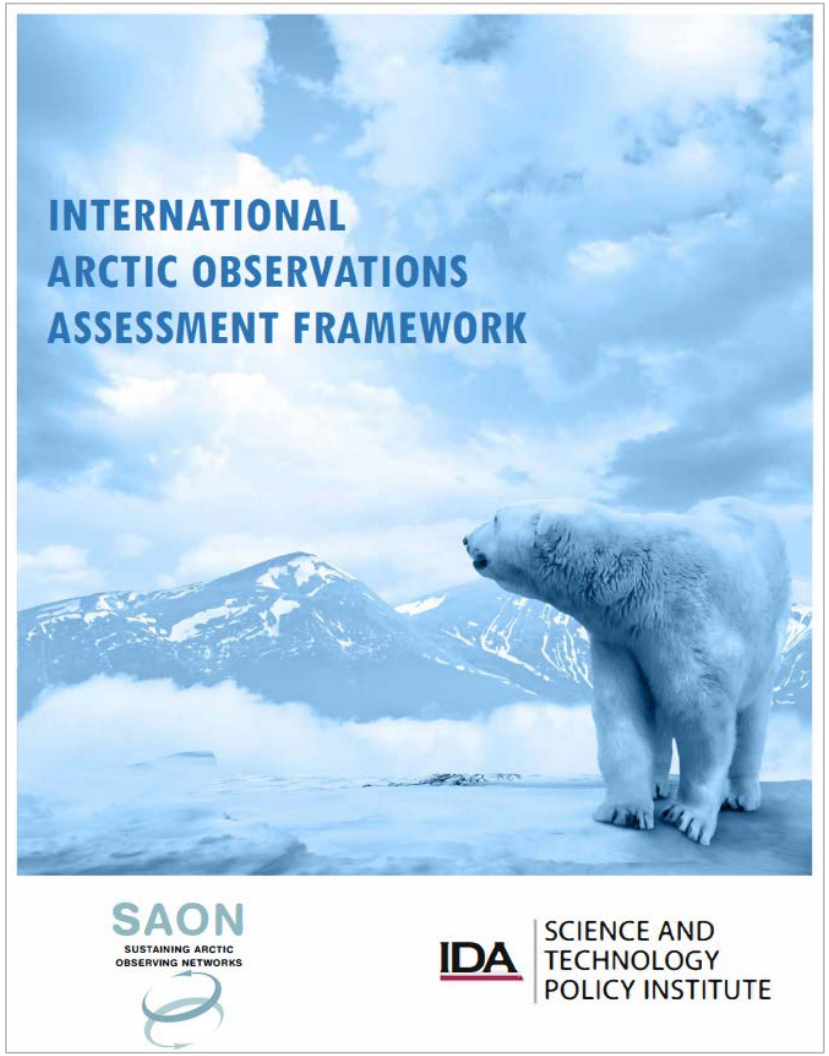
- The benefit areas and objectives were further developed and agreed to by an international group of 48 subject matter experts from 9 countries representing national, state, and local governments; industry; academia; non-governmental organizations, and citizen groups.

- The output of this workshop was published as the *International Arctic Observations Assessment Framework* in 2017 by STPI and SAON.

INTERNATIONAL ARCTIC OBSERVATIONS ASSESSMENT FRAMEWORK WORKSHOP

- Attending the STPI and SAON January 2017 workshop at the U.S. National Science Foundation to develop the *Framework*:
  - Sustaining Arctic Observing Networks members
  - Workshop Organizing Committee (WOC) members
  - Invited Arctic subject matter experts representing multiple organizations
- Nations represented:
  - Canada, Denmark, Finland, Germany, Italy, Japan, Norway, Russia, and USA

THE INTERNATIONAL ARCTIC OBSERVATIONS ASSESSMENT FRAMEWORK



- The *International Arctic Observations Assessment Framework* contains:
  - 12 Arctic societal benefit areas (SBA)
  - 41 SBA sub-areas
  - 163 key objectives to which observations contribute
  - 64% of key objectives are operational and 36% are research-oriented

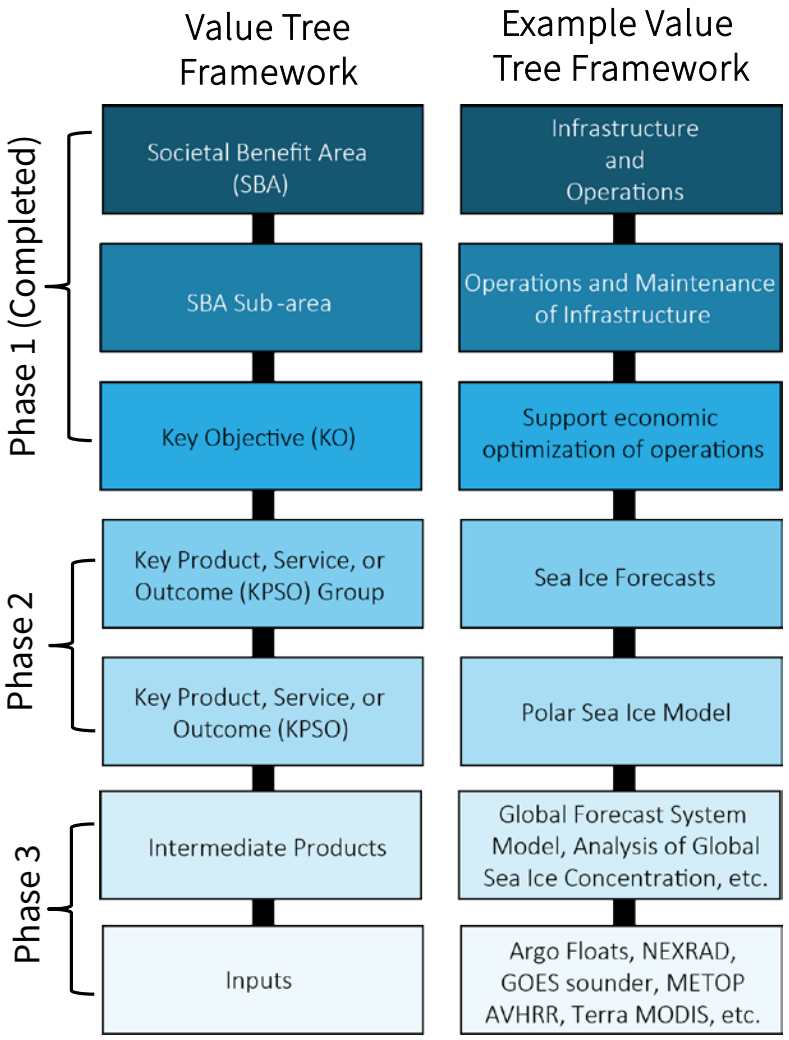
Available for download at:
https://www.arcticobserving.org

Arctic Societal Benefit Areas

- Disaster Preparedness
- Environmental Quality
- Food Security
- Fundamental Understanding of Arctic Systems
- Human Health
- Infrastructure and Operations
- Marine and Costal Ecosystems and Processes
- Natural Resources
- Resilient Communities
- Sociocultural Services
- Terrestrial and Freshwater Ecosystems and Processes
- Weather and Climate

VALUE TREE FRAMEWORK DEVELOPMENT

- The *International Arctic Observations Assessment Framework* uses a Value Tree Analysis approach.
  - Relies on expert domain knowledge to develop a hierarchical framework connecting thematic areas of societal benefit and underlying objectives (both operational and research).
  - Establishes the connection between societal benefit and Earth-observing inputs through the key products, services, and research outcomes that they support.
  - Observations include sustained and experimental remote and in situ observations at national, regional, and local and community scales taken by governments, academic researchers, local groups, and individual citizens.



INTERNATIONAL ARCTIC OBSERVATIONS ASSESSMENT FRAMEWORK

- The 2017 *International Arctic Observations Assessment Framework* presents a common structure for understanding the purposes to which Arctic observations are applied.
- The *Framework* can be used by a single organization, or by multiple organizations using its common data collection process, to map and quantify the societal benefits derived from Earth observations of the Arctic region. This can be accomplished by:
  - Identifying the key products, services, and research outputs that rely on Earth observations that contribute to the achievement of international objectives in the Arctic, and
  - Assessing the reliance of each product, service, or research output on a portfolio of individual observations.
- The application of the international Arctic Observations Assessment framework could:
  - Develop a **census** of the Earth observations relied upon to provide Arctic societal benefits within specific contexts (e.g. national, regional, local, etc.);
  - Assess the relative **impact** of individual Earth observations, **regardless of source;**
  - Identify the **multiple pathways** through which individual Earth observations can contribute societal benefits (e.g. through direct use, through modeled outputs, as reference measurements, in combinations with other observations, etc.); and
  - Provide an **evidence-base** for informing decisions.

INTERNATIONAL APPLICATION OF THE FRAMEWORK

- We will hear from our European and Japanese colleagues about their implementation of the *Framework* shortly.
  - STPI has had the privilege of collaborating with both groups and we are excited about how they are extending the *Framework* to incorporate cost-benefit and policy analyses.
- In the United States, Sandy Starkweather of the US Arctic Observing Network and Hajo Eichen of the University of Alaska have been leading an effort to comprehensively map observations to research and operational sea ice models, forecasts, and products.
- STPI will begin conducting expert elicitations with the Polar Geospatial Center (PGC) at the University of Minnesota to understand their dependency on U.S. Government, commercial, and international observations to produce continuous Arctic digital elevation models (DEM).
  - STPI is incorporating lessons from our European and Japanese colleagues into our work and will pilot new elicitation modules with PGC to also understand their reliance on computing, research, and policy infrastructures and the international use of the Arctic DEM.

THANK YOU

SPECIAL THANKS TO SAON AND THE EC JRC

IMAGE CREDIT: Gates of the Arctic National Park and Preserve, Alaska (© 167/Michael Melford/Corbis)

jgallo@ida.org

IDA SCIENCE AND TECHNOLOGY POLICY INSTITUTE