



National Snow and Ice Data Center  
*Supporting Cryospheric Research Since 1976*



# Challenges and Needs of System-Scale Science

*Perspectives from AON*

# *Key Gaps to our Understanding of the Arctic*

AON report summarized key information gaps including

- Gaps in Key Variables
  - Long-term records for key arctic variables are incomplete and there are measurement gaps in all domains
    - Geographical gaps (e.g. sea ice thickness, precipitation)
    - Temporal gaps (e.g. lack of year-round temperature in ocean)
    - Thematic gaps (e.g. biological systems – species list; physical systems – glacier contributions to freshwater fluxes)
- Data Management and Data Access Gaps
  - Gap in synthesis and integration of data collected
    - Difficult to combine observations that span different time frames, sampling frequencies and levels of accuracy
  - Data accessibility
    - Different nations often have different data distribution and access rules
    - No infrastructure to integrate the diverse arctic observing systems and programs
    - Individual scientists often only store their data in personal archives
- Lack of long-term funding and incentives for data archival

# *Barriers to Implementing System-Scale Science*

- Scientific barriers
  - Challenges of achieving spatial coverage
  - Difficult to compare multidisciplinary data
  - Difficult to access pan-Arctic datasets
  - Technology limitations
- Institutional barriers
  - Mindsets towards long-term funding
  - Difficulties for international coordination on producing datasets (i.e. aligning funding from different sources, lack of coordination between operational and research funding)
  - Differences in data sharing across disciplines

## *AON Suggestions in Overcoming these Barriers*

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- Need for a comprehensive Arctic observing network that is based on a common vision;
  - Philosophy that values systematic, long-term, extensive measurements
- Data and metadata standards and interoperability of software and tools;
- Incentives and rewards for building high-quality, long-term data sets;
- Protection of intellectual property rights while making data accessible to a larger community of users;
- Long-term funding commitment to network and observational systems;
- Network needs to be flexible to adapt to improved understanding and new technology;
- Develop a single portal that connects data across disciplines and themes.

# *How to Integrate Different Types of Information*

- Many “value added” products are generated by blending data from different sources (e.g. blending in situ and satellite observations)
- Before we can begin to integrate in situ, remote sensing, local and traditional knowledge, a comprehensive network such as recommended by AON is needed
  - Encourage the use of data and metadata that conform to national and international standards
    - Professional data management can facilitate data integration but only if scientists provide standardized data, metadata and documentation
    - Data centers should be responsible for dissemination of procedures and tools to ensure quality metadata are collected
    - Semantic interoperability – need agreement on meaning of terms (community and language neutral)
  - Establish standardized temporal and spatial reference frames
  - Provide useful tools for data access and delivery
  - Provide a central portal for data discovery and data access in a distributive system

# *Short-term Approaches to Gain Predictive Understanding*

- Identify key measurements;
- Assess technological capacity and spatial and temporal adequateness of existing network components;
  - Perform a system design assessment in the next 2 years
- Build upon existing platforms, observatories and data management centers;
- Maintain ongoing critical observations and fill gaps (invest in new sensor and observer deployment);
- Create high-quality, long-term datasets for key variables;
- Facilitate breakdown of international barriers;
- Design and implement a data management system immediately that can be accessed through a central portal;
- Involve arctic residents;
- Identify what predictions of change are most useful to stakeholders;
- Provide data in a format that is “friendly” to all users;
- Better representation of high-latitude processes in global climate models;
- Need long-term, coordinated international resources and efforts to sustain observing platforms, provide incentives to contribute data, coordinate and integrate the network, communication and human resource development.