

## 8. Summary and Action Items

The dramatic retreat of the Arctic sea ice cover in summer 2007, during the first quarter of the International Polar Year, drew further attention to the Arctic and the large, rapid, system-wide changes that are occurring there. Notwithstanding the fact that it was possible to watch the sea ice retreat in near-real-time, thanks to the NASA cyberinfrastructure that links the satellites to a global audience via Worldwide Web, the Arctic remains one of the most data-sparse, under-observed regions on Earth.

A lack of observations hinders the ability to identify and understand the global and regional causes and consequences of Arctic Change, and predict the future course of events, via knowledge synthesis and numerical modeling. Incomplete understanding and limited predictive capability are, in turn, obstacles to the identification of global and regional adaptive responses to Arctic Change. Improved observing capability in the Arctic will not only enable understanding and prediction of, and response to, Arctic Change, it will permit the assessment of the effectiveness of efforts to mitigate the effects of global warming and regional feedbacks in the Arctic.

Improved observing capability in the Arctic can be realized by coordinating, integrating and maintaining existing observing activities, adding new observing activities to fill spatial, temporal and disciplinary gaps, and sustaining and continuing to enhance the whole over the long-term. This report is the first step toward achieving the goal of improved observing capability in the Arctic through the development of AON.

An important feature of the report is the comprehensive inventory of Federal and other observing activities in the Arctic (Section 5) that shows that a nascent AON exists. However, it is evident that inter-agency coordination and integration of the myriad Arctic observing activities can be improved. Moreover, most of these disparate observing activities pre-date SEARCH and were designed to meet the specific mission of a particular agency rather than address a broader

goal, i.e., enabling SEARCH. The transition from a nascent to an actual AON that enables SEARCH observing, understanding and responding will require the continued attention of the Federal agencies and their staff.

**Action item 1. IARPC will continue to meet on a regular basis to examine ways to improve coordination and integration of agencies' Arctic observing activities in partnership with the academic community, northern residents, maritime users and other stakeholders, in order to answer the SEARCH questions and address the SEARCH priorities described in the SEARCH Implementation Plan.**

**Action item 2. IARPC will assess the integrated Arctic observing and research activities to determine the extent to which they are answering the SEARCH questions and addressing SEARCH priorities. Agencies will strive to align their Arctic observing and research activities with the SEARCH questions and priorities, while meeting their mission goals and evolving user needs, including the need for easy access to near-real-time data.**

The report documents the wide variety of Federal Arctic observing activities that have the potential to become a coordinated and integrated AON, but it does not provide information on the frequency, accuracy and uncertainty of the many measurements being made. Moreover, the report does not fully address whether the right measurements are being made in the right places at the right times for the purpose of SEARCH. A qualitative comparison of the SEARCH observing location priorities maps (Figures 6 to 11) with actual observing locations (Figures 13 to 24) indicates that the nascent AON is far from optimized.

**Action item 3. IARPC will enable the application of quantitative, objective tools, e.g., OSSEs (Observing System Simulation Experiments, also known as OSEs, Observing System Experiments), to guide the development of AON through system design**

exercises that identify optimal in-situ observing site locations and satellite observing networks, required measurement accuracy and frequency, and acceptable levels of uncertainty.

**Action item 4.** IARPC will also investigate the use of a Collaborative Observation and REsearch (CORE) strategy for optimization as well as coordination and integration of observing activities. In applying CORE, measurement frequency, accuracy and uncertainty would also be documented.

A valuable feature of the report is the comprehensive list of Federal Arctic data and information holdings that are available online via the Worldwide Web. It is evident that Federal agencies hold large amounts of accessible and scientifically-useful data and information. However, they are in widely-distributed archives that operate largely independently of each other. Free, open and timely access to data can be improved further.

**Action item 5.** In consultation with related Federal interagency activities, such as the Climate Change Science Program and the US Group on Earth Observations, IARPC will explore the development of a user-friendly online portal, i.e., a single point-of-entry, to Federal Arctic data and information. A portal would have many advantages for IARPC and for users and stakeholders – it would raise the visibility of the data and information holdings, making them more openly and freely accessible to a broader audience and increasing their use, thereby maximizing the value-added services and societal benefits to be derived from AON. An Arctic data portal can also play a valuable role in the coordination and integration of AON.

An online portal to Federal Arctic data and information would represent the use of cyberinfrastructure to enable data discovery, an essential first step in the process of analysis, synthesis and modeling that lead to understanding of Arctic Change and identification of responses to that change. An online portal would be just one among many possible uses of cyberinfrastructure for developing a coordinated and integrated AON that enables scientific discovery and innovation that inform decision- and policy-making.

**Action item 6.** As IARPC collaborates in the devel-

opment AON, it will strive to maximize the use of cyberinfrastructure for coordination and integration from the moment of data acquisition through data discovery, analysis, synthesis and modeling, to the realization of Arctic and global value-added services and societal benefits.

The report describes a small number of community-based observing projects and programs, e.g., the NWS Cooperative Observer Program and the NSF-funded BSSN in Alaska, which engage the people of the north directly in environmental observing. The report also refers to the traditional knowledge of northern residents. Though the level of activity is small relative to research and operational observing, community-based observing and traditional knowledge have an important role to play in AON.

**Action item 7.** IARPC will endeavor to increase engagement with northern people and communities to identify local observing needs as well as create mutually beneficial observing partnerships that build human and physical capacity. All observing activities will be guided by the Principles for the Conduct of Research in the Arctic (<http://www.nsf.gov/od/opp/arctic/conduct.jsp>) that were created at the direction of IARPC.

Most of the observing activities described in Section 5 are either in the operational observing (e.g., NWS weather stations, NOAA satellites, USGS stream gauges) or research observing (e.g., NASA satellite missions, NSF AON projects [Appendix 1]) categories. Research observing activities are typically short-term and not intended to be sustained over long periods of time. Nevertheless, they are essential to AON, e.g., as test-beds for experimentation and equipment testing, proving a concept, establishing baseline data sets, improving models and testing predictions, etc. Research observing activities can make the transition to operational observing, but this is not always straightforward, as the NASA/NOAA experience shows (NRC, 2000, 2003). USGEO is also considering the issue, e.g., the USGEO Research-To-Operations Federal Roundtable held on 11 September 2007 in Washington, DC.

**Action item 8. As part of the coordination and integration necessary to the development of AON, IARPC will discuss the issue of sustaining the entire program over the long-term, and explore ways for the effective transfer of research observing activities to the operational observing realm. Policy and strategy for the transition of research observing to operational observing will need to be developed. 'Transition' will require criteria for the identification of which research observing activities will cross over into operational observing, and processes to effect the transition.**

USGEO is a leader in and major contributor to GEOSS. USGEO is composed of all of the observing components of the US federal agencies. AON is a focused, regional component that has much to offer USGEO and GEOSS, and all three share the same ultimate goal – achieving value-added services and benefits to society. In the Arctic alone, almost 4 million people from more than 30 different societies living in 8 countries (Canada, Finland Greenland/ Denmark, Iceland, Norway, Sweden, Russia, USA) stand to gain from those services and benefits. The Arctic eight countries are, in turn, working with other countries, e.g., EU members, China, Japan and Korea, during International Polar Year 2007-2009 to observe and understand the changing Arctic.

**Action item 9. IARPC will remain engaged internationally, working with regional partners to achieve a multinational, pan-Arctic observing network that is coordinated, integrated and sustained over the long-term. IARPC, in turn, will engage with USGEO and GEOSS to ensure that the Arctic is represented at domestic and international planning and policy forums, and involved in the transition to implementation of coordinated national and international Earth observation efforts to benefit society.**

The intellectual framework for the development of the US contribution to pan-Arctic observing is the SEARCH program. The international counterpart of SEARCH is ISAC, a long-term program initiated by IASC, the International Arctic Science Committee. The core activities of both SEARCH and ISAC are observing change, understanding change and responding to change. ISAC, therefore, provides an

intellectual framework for the entire multinational pan-Arctic observing network that is envisioned as a lasting legacy of IPY.

**Action item 10. The US contribution to a coordinated, integrated and sustained multinational, pan-Arctic observing network will be based on an intellectual framework that reflects the scientific goals, priorities and recommendations of the SEARCH and ISAC programs.**