Arctic Observing Summit 2013 (AOS)
"Status of current observing system" white paper synthesis brief

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Introduction

A total of fourteen white papers were placed in the category of "Status of the observing system". These are the contributions by Atakan et al. on the European Plate Observing System (EPOS), Fairall et al. on the World Weather Research Program's Polar Prediction Project (PPP), Henry et al. on the International Tundra Experiment (ITEX), Key et al. on the Global Cryosphere Watch (GCW), Kim on CO_2 efflux and temperature in Alaska soils, McCLelland et al. on Arctic River Observatories, Proshutinsky et al. on the Beaufort Gyre Observing System, Pulsifer et al. on data management, three contributions by the Sustaining Arctic Observing Networks initiative (SAON) on the background and status of SAON as well as the national surveys and reports, Sambrotto et al. on submarine-based programs, Scambos et al. on technology for ice-ocean system monitoring, and Toole et al. on ice-tethered profiler systems.

In addition, we considered additional white papers that also speak to key aspects of observing system status, including Berkman on governance and observing systems, Callaghan et al. on integrating terrestrial observing networks, Eicken et al. on observing system scope and hierarchies, Manley et al. on asset mapping tools, Tweedie et al. on coastal flagship observatories

The scope of papers on observing systems status submitted to the AOS roughly matches the main categories of observing networks by SAON activities as highlighted in the SAON paper (2013c), the 13 country status reports available on the SAON website (www.arcticobserving.org) and a more detailed analysis in a white paper by Eicken et al. (2013). However, the latter white paper also suggests that the AOS is missing contributions that reflect observing system initiatives from the private sector which are of increasing importance, e.g., in the context of offshore resource development. These issues need to be taken up in the AOS break-out sessions.

The present synthesis does not speak to observing system activities covered by the 11 white papers and statements summarized by Huntington (2013) that address community-based observations, citizen science and related topics.

Key findings

The key findings from this synthesis and the white papers themselves have been grouped into five categories.

(1) Scope and disciplinary breadth

The entirety of white papers submitted provides a reasonable reflection of disciplinary breadth of existing efforts as charted by SAON (2013b and SAON website, www.arcticobserving.org; see also more detailed analysis by Eicken et al., 2013, Table 1ff.). The SAON database as of 2012 reflects activities from 20 countries, 127 organizations, and 196 networks.

Most of the white papers on specific programs are quite focused, with the BGOS (Proshutinsky et al.) or the ITEX white papers representative examples of PI-driven efforts, and the planned PPP and GCW activities reflecting both operational and academic observing interests. While there is some indication from white papers by Proshutinsky et al. and Toole et al. that marine observatories are increasingly accommodating biogeochemical sensors, there is little to no discussion on how to synthesize or – as needed – increase the disciplinary breadth of observing systems. However, the white paper by Callaghan et al. on the Arctic Biodiversity Coalition points towards the need and potential pathways for such synthesis. At the same time, the paper by Tweedie et al. articulates the need for coastal flagship observatories, which in turn would promote cross-disciplinary synthesis as well, as would the Svalbard Integrated Observing System (Ellis-Evans et al., 2013).

Community-based monitoring networks and citizen science observations require special considerations discussed in more detail in the synthesis paper by Huntington (2013). While some of these latter networks are broad in scope it is not clear how they tie into the observing systems driven by science questions rather than stakeholder concerns. Initiatives at the planning stage, such as those focusing on biodiversity (white papers by Callaghan et al. and Goedkoop et al.) may result in opportunities to combine community-based observing networks with efforts driven by academia or government agencies, generating products of interest to decision-makers at the relevant spatial scales.

Many of the networks in the planning or early implementation phase discuss the for a data management plan and standards for data collection and associated protocols. Many also discuss an education and outreach component, emphasizing the widely acknowledged need to keep society informed.

White papers on existing observing programs (e.g., the river monitoring network PARTNERS described by McClelland et al., or IBCAO ocean bathymetry discussed by Jakobsson et al.) suggest that there are opportunities to improve coordination among existing efforts to build and integrate new, overarching networks. This is true in particular for more narrowly focused efforts such as these two, where the benefit/cost ratios are bound to be large. Another opportunity for improved coordination is arising through the types of technological advances described by Toole et al. and Scambos et al. that result in advanced measurement platforms or autonomous sensors. These systems in turn can address other research questions or monitoring needs through the expansion of sensor capabilities. At a larger scale, a similar outcome can be expected through the establishment and coordination between flagship observatories (Tweedie et al., 2013).

(2) Regional coverage

The SAON inventory is comparatively coarse with respect to the detail of activities resolved but indicates that observing programs are distributed across the pan-Arctic. Tools to map activities are evolving (Manley et al. report specifically on such tools, Eicken et al. analyze data on regional distribution from a couple as well). However, a more quantitative analysis of the spatial and temporal distribution of assets that can guide obseving system design and optimization is lacking.

Several white papers (e.g., Henry et al., McClelland et al.) comment on the challenge of including Russian observations in international networks such as ITEX. In part this may be a result of the substantial logistical challenges for terrestrial observations in Siberia, but needs to be discussed further, with a substantial effort to include strong Russian participation in the next AOS. Establishment of flagship sites may help as well, with the site at Tiksi near the Lena Delta serving as an example of international collaboration in establishing and maintaining a range of different monitoring programs.

(3) Data availability and information products

The white papers highlight the importance of the IPY 2007-08 in exploring different data management and dissemination approaches. However, not enough progress appears to have been made since in working towards a pan-Arctic data management policy. Even fully functional networks are associated with a range of different data management approaches and protocols. Some activities, such as the PPP and the GCW efforts (Fairall et al., Key et al.) tie into the World Meteorological Organization (WMO) Information System with establish, uniform guidelines. Other efforts such as the ice-tethered buoy program follows international Argo ocean drifter protocol. In general, it is not clear how much of data collected through Arctic observing systems is reported into global networks. Here, an update on existing and planned linkages into the Global Earth Observation System of Systems (GEOSS) may be of interest as well.

Challenges

The breadth of white papers submitted and their comparatively narrow focus highlight the importance of developing overarching sets of priorities at the international level that can lead to a more consolidated and coordinated set of observing programs through voluntary alignment of individual efforts. Here, ISAC and SAON have major roles to play; the white paper by Eicken et al. highlights how at the national level these challenges are being addressed in the U.S. Efforts such as PPP or GCW that have emerged from large international organizations such as the WMO can help with such consolidation but because of their typically narrow focus are ultimately meeting some of the same challenges themselves.

Balancing scientific and stakeholder information needs is a major challenge that few of the white papers reference or address in any detail. The synthesis paper by Huntington (2013) discussed steps forward for community-based observations, Eicken et al. (2013) highlight the importance of a hierarchical approach that involves stakeholders at the critical steps (such as problem definition). At the same time, for international networks with shared resources, it is difficult to balance national priorities and scientific needs while being sensitive to financial contributions (illustrated in the Sambrotto et al. paper). Here, a direct engagement with the private sector and agencies that are directly representing stakeholder interests in the development of observing networks (such as those implemented in the context of offshore oil and gas development) may help.

Facilitating funding and coordination are reported as critical roles for SAON. Networks referenced in the white papers mostly have a narrow focus (e.g., freshwater biodiversity, atmosphere observations to improve predictions) have a narrow focus and for some activities (such as GCW) it is not clear whether activities tying into such a focused program can meet all the expectations and requirements with respect to data acquisition and interoperability protocols. The bottom-up approach taken in many observing networks ensures scientific focus and continuous review of guiding questions but poses challenges in establishing a robust funding structure. Data interoperability is an ongoing challenge for data access and discovery (see Pulsifer et al., 2013). Currently, data sources are widely distributed and can be hard to access. It may also be difficult to establish standard data collection protocols, particularly when attempting to coordinate ongoing monitoring efforts that differ by country (e.g., McClelland et al., 2013).

Challenges associated with funding of observing programs are discussed in Schlosser's synthesis paper. However, the existing networks highlight major challenges related to funding as well, these include: difficulty maintaining long-term observations on a project-by-project basis for both science and community-based monitoring; high costs of maintaining field sites and data archives, national funding limitations to obtain pan-Arctic data (see Henry et al., 2013). In his white paper, Berkman (2013) provides some suggestions on how to obtain financial support, including mandate to support observing system coordination through part of lease-hold payments, support at the Arctic Council level to find ways to spread the burden among Arctic and non-Arctic nations and to work with a broader range of organizations and institutions towards novel funding mechanisms.

Recommendations

Recommendations shared amongst different white papers include the following:

• For pan-Arctic observations, leverage existing agency and national mandates collecting long-term observations,
• Utilize common platforms, such as autonomous sensor systems for flagship observatories to promote synthesis and coordination,
• Utilize technology for increased automated observations/ cheaper observing tools where feasible to reduce costs and obtain year-round observations,
• Use available tools to promote data discovery and interdisciplinary research (e.g. Moore et al. data paper, AOOS workspace),
• Create web-based, easy-to-use tools to encourage compliance with data sharing and community involvement in observations (e.g. metadata authoring, citizen-science monitoring input),
• Develop a single portal for data discovery only to reduce cost of archiving (e.g. Antarctic Master Directory), have certification of other data portals as partners to archive actual data

At an overarching level, the following recommendations emerge as a potential basis for discussion in the AOS Working Sessions:

• Prioritization: Build on existing frameworks and priorities to develop a prioritization document that references consensus science questions (e.g., ISAC Science Plan, Murray et al.), near-term hazards and threats (such as those identified by Arctic Council and international working groups on emergency preparedness, prevention and response in the context of, e.g., maritime activities or resource development) and mid- to long-term adapation to a changing Arctic (such as discussed in the Arctic Council SWIPA report, http://amap.no/swipa/);

• Gaps in existing or planned activities: Gaps need to be identified by referencing prioritization efforts as outlined above, without such reference it will be challenging, if not impossible to achieve progress in the context of the AOS and broader observing activities;
• Coordination: existing and planned framework that foster cross-disciplinary and local to pan-Arctic synthesis need to be identified and next steps discussed; this applies, for example, to the development of protocols and network linkages for flagship (coastal) observing sites or for joint activities such as the Year of Polar Prediction (YOPP) promoted by PPP;
• Regional balance: regions under-represented in the distribution of networks and sensors need to be identified and strategies developed to ensure broader participation, both in observing system efforts and in the next AOS;
• Balance between science and stakeholder information needs: to achieve better balance, partnership with private sector and stakeholder-driven initiatives need to be discussed and advanced (e.g., World Ocean Council initiative and others; stipulations for data co-management through lease agreements etc.); such balance also requires integration of private sector and community-based observations into co-managed data archival and dissemination systems;
• Data management: formal adoption and explicit formulation of pan-Arctic data management policies and agreements is a key step towards coordination; tools that advance interoperability and data exchange such as master directories and meta-data centers need to be developed and implemented; better communication and collaboration with stakeholders on data management and dissemination is needed;
• Automated, autonomous sensor systems need to be developed that are affordable, intercompatible and readily deployable (by non-experts, from platforms of opportunity)

Conclusions

The specific conclusions and recommendations derived from the submitted white papers can serve as a framework for discussion at the AOS. A few broader issues that relate to these issues but may require further deliberations include the question as to the role of satellite remote sensing observations in the context of Arctic observing system design and implementation. Few of the white papers make explicit references to or develop ties with remote sensing efforts. Yet at the same time, Arctic long-term observations rely to a large degree on a host of data sets derived from instruments on (polar orbiting) satellites. Here, more work, potentially in collaboration with GEOSS is needed to develop a robust strategy of how the AOS and the activities it can help spawn should interface with the remote sensing community.

Given the degree of activities in the Arctic, a clearer definition and inventory of observing system activities is needed. The SAON effort based on self-reporting is a great start but needs to be kept updated or transformed into a more easily searchable database. Possibly, this is best tied to the development of meta-data centers or a master data directory.

While the submission of white papers to the AOS 2013 and the mechanisms developed to review and synthesize these are promising, the effort also highlights the lack of mechanisms or entities at the national and international level that can help with the synthesis of such information. Both mechanisms and support for such synthesis efforts may help turn the next AOS into an even more effective tool to improve coordination, planning and implementation of Arctic observing system activities.

References (NB: below all references cited in the paper are listed mostly by first author only; full white papers availalble on AOS website)

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