Enabling Discovery:
A New Registry of Polar Observing Networks (RoPON)

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Diverse, Distributed, and Fragmented Efforts

A fundamental challenge exists for optimizing the study of climate and environmental change in the polar regions. Observing-related infrastructures and activities – such as monitoring sites, mobile platforms, research projects, field campaigns, and observing programs – are deployed in a diverse and distributed fashion across numerous efforts (cf. Metcalfe et al., 2018; Bradley et al., 2021; ASM3, 2021; IARPC and NSTC, 2021; AOS, 2022; EU-PolarNet, 2022). Dozens of agencies, organizations, projects, and initiatives observe or monitor climate and environmental phenomena at high latitudes – each with its own geographic extent, thematic scope, governance, or funding. These efforts are for the most part uncoordinated and disconnected.

Thus, there is no comprehensive perspective across a fragmented landscape on who is actually doing what where. Because of this, it is currently difficult for:
- science planners to assess status, overlap, and gaps
- network managers to co-locate or optimize limited resources
- community members to leverage observational efforts and data collected nearby.

Enabling Information Exchange for Polar Observing

To help address this challenge, a new informational resource was released in October of 2023 for demonstration purposes. The Registry of Polar Observing Networks (RoPON; https://polarobservingregistry.org/) is a catalog of systems or organizations that conduct or coordinate observation and monitoring at high latitudes, typically with data management, research stations, platforms, and instrumentation (e.g., SIOS, GTN-P, and NASA ABoVE). RoPON also displays portals or tools that are not observing networks *per se*, but which compile and share structured information about observing activities and infrastructure (e.g., ARMAP, AOV, ISAAFFIK, and Polardex; i.e. asset-level aggregating metadata catalogs). Users can browse, search, or filter for discovery-level details encompassing: network description, observational scope, spatial extent, data or metadata access, and links to information (Fig. 1).

RoPON highlights each network's "observing assets": components of *in situ* observing infrastructures and activities, categorized into various asset types:
- **sites** – fixed stations, facilities, plots, moorings, observatories, stationary platforms, supersites, community-based observations, or locations wherever repeat measurements have been made.

- **mobile platforms** – buoys, vessels, aircraft, floats, gliders, UAVs, AUVs, animal-borne sensors, and other mobile platforms.
- **projects** – research projects, studies, and other activities typically funded or coordinated by an agency or program within a defined timeframe.
- **campaigns** – scientific cruises, aircraft operations, fieldwork, and other planned routes or completed activities.
- **initiatives** – coordinated ongoing efforts including organizations, networks, observing systems, and programs.

These definitions are based on a cluster analysis of terms used by 43 networks and discovery portals to describe what they track.
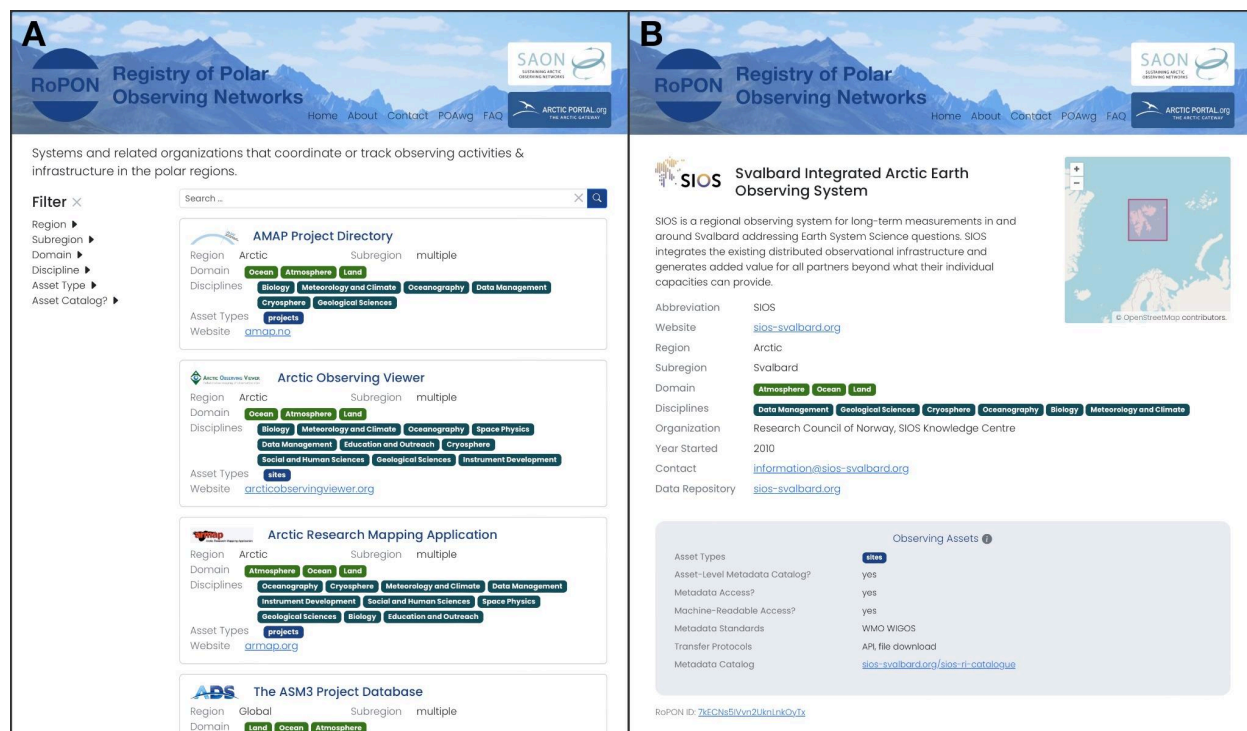

Fig. 1. A) The RoPON home page, at left, allowing the user to browse, search, or filter among summary "cards" for polar observing networks. B) An example landing page, at right, with a network description, map of network extent, and numerous descriptive elements.

RoPON was created as a collaborative effort by the Sustaining Arctic Observing Networks initiative (SAON) initiative (https://www.arcticobserving.org), the Arctic Portal (https://arcticportal.org), and the SAON Polar Observing Assets Working Group (POAwg, https://www.polarobservingassets.org; see Manley et al., 2022).

Plans are underway for RoPON to move beyond a prototype with improvements in scope and functionality:

- more networks (currently with only twenty out of hundreds)
- refinements to the front end (with a "Suggest a Network" option, web accessibility, and various enhancements to the user interface and user experience)

- an upgraded backend to enable essential features (e.g., curator- and network-level logins to populate or update records; web metrics; machine-readable public access to the RoPON database via an API; ability to harvest network information interoperably; and more)
- enhancements to the network-level metadata model that underlies the RoPON database (see below)
- potential development of a schema.org-like JSON-LD profile for observing networks (cf. Shepherd et al., 2022).

Contingent on additional funding, these steps will advance a proof of concept to a level of comprehensiveness, responsiveness, and sustainability. Feedback is appreciated.

Also released was a network-level metadata model listing the elements that describe polar observing networks (https://polarobservingassets.org/resources). For each there are definitions, as well as example entries and guidance on whether an element is required or can be populated with multiple entries. Lastly, some of the elements in the model are constrained by custom or standardized vocabularies (e.g., for asset types, domain, discipline, region, subregion, and asset-level metadata standards). The model was developed by POAwg based on a crosswalk of previous inventories and surveys (e.g., SAON CON and EU-PolarNet), expanding on a few network-level metadata models (e.g., DEIMS-SDR and INTERACT), and considering user needs and use cases. It underlies the structure of the RoPON database, and may be of interest to others that wish to track details about observing networks.

Metadata Interoperability for Observing Assets

RoPON and the network-level metadata model are part of a broader collaboration through POAwg to make structured information about polar observing more Findable, Accessible, Interoperable, and Reusable (the FAIR Principles, Wilkinson et al. 2016). This group builds upon steps taken by the polar data community for the interoperability of "dataset-level" metadata, but in this case for "asset-level" metadata (cf. Habermann, 2018; Wohner et al., 2020, 2022; ENVRI-FAIR, 2021; IODE ODIS, 2021; JERICO-CORE, 2022). POAwg promotes the use of observing-related standards (such as ISO 19115/19139, WMO WIGOS, INSPIRE EF), semantic technologies (e.g., codelists, vocabularies, and ontologies), and interoperable service protocols (e.g., OAI-PMH, CSW, WFS, or custom APIs). Beyond the registry, tasks of the working group include: building crosswalks and tools to facilitate aggregation and harmonization across implementations; as well as creating recommendations for adoption, making it easier for networks and aggregators to populate, deploy, and share a catalog of observing assets. An overarching vision is to improve the interoperability of the granular observing metadata needed to showcase and integrate the summed contributions of multiple systems.

Participation in POAwg is open and encouraged. Participants are network coordinators, data managers, and others with familiarity of network assets or metadata management. Monthly web meetings include presentations, discussion, and collaboration. Sign up at https://polarobservingassets.org.

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