Integrating Activities for Advanced Communities

D2.8 Pocket guide on metadata standards for scientific networks

Project No.871120– INTERACT

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Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the Consortium (including the Commission Services)	
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Publishable Executive Summary

Research stations are knowledge hubs and play a vital role for observing, understanding and responding to Arctic change. INTERACT promotes implementation of standardised measurements across the INTERACT station network with the aim of contributing to more robust assessments. Relevant information about existing scientific organisations, networks, programmes and projects are therefore paramount for the ability of INTERACT station managers and staff to assess the feasibility of implementing standardised protocols developed by these organisations, networks, programmes and projects.

INTERACT III therefore included a task to identify and promote standardised information about scientific organisations, programmes and projects and networks. INTERACT III began in 2020, and soon hereafter the Sustained Arctic Observing Network (SAON) under the Arctic Council, established the Polar Observing Assets working group (POAwg) that should develop a Registry of Polar Observing Networks (RoPON). It was therefore decided that INTERACT would work with POAwg to develop such a registry based on standardised information about scientific organisations, networks, programmes and projects (including the standards developed by INTERACT).

The circum-arctic integration led to a delay in the deliverable (partly also due to a pause to Arctic Council work following the invasion of Ukraine), but in October 2023, a first version of the system was released and is now available online - https://polarobservingregistry.org/.

1. Aligning focus with international efforts

1.1. Aim of INTERACT Task 2.3 on metadata standards for scientific networks

Task 2.3 '*Making station data and publications widely available*' was designed to address INTERACT's Societal Challenges 3 and WP6 to ensure that all forms of data from research stations are captured and made widely available. Specifically, subtask 2.3.1 should '*introduce metadata standards (identified in INTERACT II) for description of international scientific networks and organisations in collaboration with the Data Watch Guard (D2.8)*'.

This task was designed to make standardised metadata available to INTERACT stations to allow station managers to assess the relevance of specific scientific networks for potential implementation at the station. By making this information available to station managers they would be able to assess the purpose, aims, methodology, instrumentation, etc. needed to implement standardised research and monitoring at the station.

1.2. International efforts to create a repository for observing assets

Arctic Council's Sustained Arctic Observing Network's (SAON) Committee on Observing Networks (CON), in 2020 established the Polar Observing Asset Working Group (POAwg). POAwg should facilitate the "*discovery and interoperability of structured information about research and monitoring assets at high latitudes: sites, mobile platforms, projects, campaigns, and initiatives*". This includes standardised metadata for scientific networks operating in the Arctic and hence overlap with Task 2.3.

POAwg gathered a team of experts to provide technical guidance for sharing information about observing activities (including scientific networks and research stations included in Task 2.3), including issues of interoperability and solutions for the '*deployment of interoperable, observing-related metadata catalogues*'.

POAwg's task was to develop an online Registry of Polar Observing Networks – RoPON.

It was therefore decided that INTERACT Station Managers' Forum would integrate its efforts into the POAwg to help build an online catalogue based on standardised metadata for observing networks in line with the aim of Task 2.3.

2. Polar Observing Assets working group

2.1. About POAwg

The Polar Observing Asset working group was established in 2020 in an open process inviting all organisations and projects working with observing assets to join the development of a registry of polar observing networks.

The group is led by William F. Manley from the Institute of Arctic and Alpine Research at University of Colorado, Boulder, USA, with participants from a multitude of networks and organisations including: ACPS, ACTRIS, ADAC, ADC, ADIwg, AMAP, AOV, Arctic SDI, ARMAP, BOEM, CALM, CCADI, eLTER RI, EPB, ESIP, EuroARGO, GC-NET, GCW, GEO, GOOS, GTN-P, IASC/SAON ADC, ICOS, INTAROS, INTERACT, IODE, ITO, MODAAT, Nordicana D SILA, NPRB, NSIDC, OBO, PROMICE, RDA, SAON, SCADM, SIOS, SOOS, TCCON, U.S. TPC, UN Decade, US AON, and WMO.

The goals of the POAwg are to:

- Make asset information more Findable, Accessible, Interoperable, and Reusable

- Promote best practices for interoperability "beyond the dataset level"

- Help span a spectrum across science planning, data management and disciplinary or inter-disciplinary science

- Create a registry of Polar observing networks, documenting asset-related metadata standards, semantic technologies, and transfer protocols in use

- Build crosswalks and facilitate existing tools for translation across standards

- Create recommendations for adoption and implementation of established standards and solutions

INTERACT participated in monthly coordination meetings to develop the framework of the registry together with 5-10 other network representatives and contributed with the comprehensive list of metadata developed as part of the INTERACT GIS platform, including suggested standard metadata for scientific networks and organisations (see Appendix 1). The INTERACT metadata standard was included in the crosswalk to facilitate the translation of metadata across existing observation asset metadata from participating networks and organisations.

2.2. The process for developing the Registry of Polar Observing Networks

POAwg formed a group of technical experts within the international data community with representation from the Arctic and beyond, and representatives from existing networks and organisations dealing with arctic observing assets.

The groups gathered existing metadata used by participating networks and organisations and through a series of meetings identified essential metadata for the registry. One of the primary challenges was lack of interoperability when it comes to metadata structures, custom vocabularies, lack of machine-readable access and duplication. The initiative was presented at numerous international scientific conferences (see e.g. Appendix 5).

The initiative is being implemented in phases as funding is not secured yet for the complete project. The first task towards the goals is to create a Registry of Polar Observing Networks – RoPON—focusing on interoperability, parameters and documenting: Asset-related metadata standards (e.g., ISO 19115/19139, WIGOS, INSPIRE EF, etc.), semantic technologies (observing-related vocabularies and ontologies), transfer protocols (e.g., OAI-PMH, CSW, WFS, or custom APIs), and machine-readable endpoints that are currently in practice. User cases for the registry have been identified and will guide the development process moving forward.

The group developed the 'first phase registry' in accordance with the FAIR data principles and identified key functionalities and required technical front- and back-end solutions for demonstration purposes.

3. The Registry of Polar Observing Networks

3.1. Contents and functionalities

The Registry of Polar Observing Networks contains asset level metadata (Table 3.1) that can be filtered through a filtering function in the left side of the website (see Figure 3.1).

Table 3.1 List of discovery-level metadata identified for the registry and example for INTERACT:

a) Discovery-level metadata   b) Descriptive metadata example

Region ▼	Parameter	Example: International Network for Terrestrial Research and Monitoring in the Arctic
Arctic		
Subarctic		
Antarctic		
Southern Ocean		
Global	Description	*[text]*
Subregion ▼	Abbreviation	*INTERACT*
Alaska	Website	*www.eu-interact.org*
Canadian Arctic	Region	*Arctic , Subarctic*
Greenland	Subregion	*Multiple*
Svalbard	Domain	*Atmosphere Land*
Scandinavia	Disciplines	*Data Management, Geological Sciences, Cryosphere, Biology, Meteorology and Climate, Education and Outreach*
Canadian Subarctic		
European Subarctic		
multiple		
Domain ▼		
Atmosphere	Organization	*INTERACT Non-Profit Association*
Land	Year Started	*2001*
Ocean	Contact	*eu-interact.org/contact*
Discipline ▼	Data Repository	*dataportal.eu-interact.org*
Biology		
Cryosphere		
Data Management		
Education and Outreach		
Geological Sciences		
Instrument Development		
Meteorology and Climate	**Observing assets**	
Oceanography		
Social and Human Sciences	Asset type	*Projects, Sites*
Space Physics	Asset-Level Metadata Catalogue	*Yes*
Asset Type ▼		
sites	Metadata Access	*Yes*
mobile platforms	Machine readable Access	*Yes*
projects		
campaigns	Metadata standards	
initiatives	Transfer protocols	
Asset Catalog? ▼	Metadata Catalogue	*www.interact-gis.org*
Yes		
No		
Under Development		
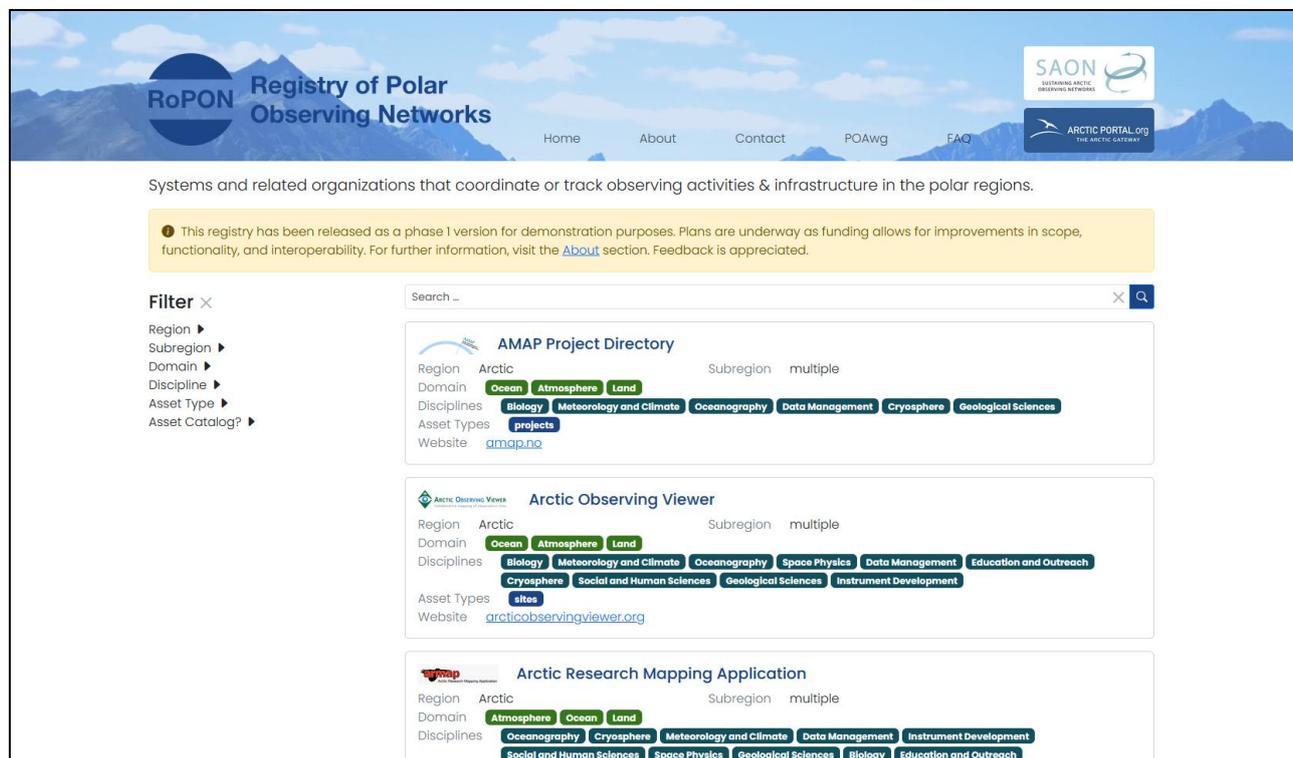
Figure 3.1 The Registry of Polar Observing Networks, https://polarobservingregistry.org/.

The registry is hosted by Arctic Portal – '*a provider of expert web development, data and consulting services focusing on the collection, processing, evaluation, interpretation and presentation of information and data*'. The '*first phase registry*' is populated with information from networks or network representatives that have been involved in the devleopment of the registry.

The Registry of Polar Observing Networks can be found here:

https://polarobservingregistry.org/.

3.2. Launch and further work

The 'first phase' of RoPON was officially launched in autumn 2023 and POAwg is currently gathering the first feedback to inform the continued development of the system.

The POAwg will continue the efforts to build a system where users can enter and edit information to populate the site with more networks and organisations, continue technical development related to interoperability and machine-readable access, etc. These future efforts depend on available funding and active participation of relevant networks and organisations.

Appendix 1. INTERACT GIS station metadata

Overall theme	Sub-theme	Field Alias	Required (R) Optional (O) Super User (S)	Field Definition	Format
	Station name	Station name	R	Full name of station	Text
		Station acronym/short name	R	Short name to be used in publications when referring to the station.	Text (max 20 characters)
Station name and operati	Status	Operational status	R	Is the station in operation and open to visitors or has it been closed without current plans of	Select one: Open, Closed (permanently or for period of years)
	Coordinates	Station longitude	S	Longitude of station main building (entered by INTERACT GIS Super user)	Decimal degrees
		Station latitude	S	Latutude of station main building (entered by INTERACT GIS Super user)	Decimal degrees
	Station contact information	Station address	R	The postal address for where to send goods to the station.	Text
		Station manager name	R	Full name of station manager	Text
		Station manager e-mail	R	Contact e-mail for the station (need not to be the station manager)	e-mail
		Station website link	R	Link to station website or the webpages of an institution where the station is	Link
		Station contact e-mail	O	e-mail for general contacts to the station (if different from station manager)	e-mail
		Station contact phone number	O	Phone number to contact station	International country code and number
	Station operation	Type of station	R	The general type of station/facility. Station is a fixed, permanent and staffed facility offering accommodation, Camp is a temporary facility offering facilities for longer	Select one: [Station, Camp, Shelter, Measuring site (no buildings), Other (text)]
		Opening year	R	The first year of operation.	Year
		Operational period (month to month)	R	Months that the station is open to visitors.	[month to month]
		Name of managing institution	R	Name of the institution or organisation that manages the station (takes care o	Text
		Managing institution country	R	The country in which the station managing institution or organisation is locate	Select one: [country]
		Name of station owner (if different from 'Managing institution')	R	Name of institution or organisation that owns the station.	Text
		Type of owner	R	The type of owner institution/organisation, see Format for choices.	Multiple select: [Government, Research institution, NGO, Private, Other (text)]
		Station owner country	R	The country in which the station owner institution or organisation is located.	Select one: [country]
		Partner institution	O	Are there other institutions involved in the operation of the station?	[yes/no]
		Partner name and country	O	Name other partner institutionand the country in which they are located.	[add one to multiple]
	Text description	Station name and owner	R	Text - max. 25 words	Text description
		Location	R	Text - max. 100 words.	Text description
		Biodiversity and natural environment	R	Text - max. 100 words.	Text description
		History and facilities	R	Text - max. 100 words.	Text description
		General Research and Databases	R	Text - max. 100 words.	Text description
		Human Dimension	R	Text - max. 100 words.	Text description
		Access	R	Text - max. 75 words.	Text description
	Visuals	Station and institution logos	R	Logo of station and if relevant owner institution/organisation and/or managing institution/	Upload function - attachments
		Station photo	R	Photo of station building(s) (close up and landscape scale allowed)	Upload function - 1 attachement.
		Featured image(s)	R	Additional photos showing facilities, fieldsites, instrumentation and landscape	Upload function - max. 15 attachements
		Virtual tour	O	Link to 360 degree photos (e.g. Google Street View, Mapillary or similar) of sta	Link to 360 photography at and around station
		Station movie	O	Link to one or more movies about the station and the science consucted there	Link(s) to movie about station
		Social media	O	Link to relevant social media accounts of the station.	Link(s) to social media platforms

Continued...

Overall theme	Sub-theme	Field Alias	Required (R) Optional (O) Super User (S)	Field Definition	Format
	Station name	Station name	R	Full name of station	Text
		Station acronym/short name	R	Short name to be used in publications when referring to the station.	Text (max 20 characters)
Station name and operati	Status	Operational status	R	Is the station in operation and open to visitors or has it been closed without current plans of starting up again.	Select one: Open, Closed (permanently or for period of years)
	Coordinates	Station longitude	S	Longitude of station main building (entered by INTERACT GIS Super user)	Decimal degrees
		Station latitude	S	Latutude of station main building (entered by INTERACT GIS Super user)	Decimal degrees
	Station contact information	Station address	R	The postal address for where to send goods to the station.	Text
		Station manager name	R	Full name of station manager	Text
		Station manager e-mail	R	Contact e-mail for the station (need not to be the station manager)	e-mail
		Station website link	R	Link to station website or the webpages of an institution where the station is	Link
		Station contact e-mail	O	e-mail for general contacts to the station (if different from station manager)	e-mail
		Station contact phone number	O	Phone number to contact station	International country code and number
	Station operation	Type of station	R	The general type of station/facility. Station is a fixed, permanent and staffed facility offering accommodation, Camp is a temporary facility offering facilities for longer stays, Shelter gives lee for wind and weather and nothing else, Measuring site have no housing facilities.	Select one: [Station, Camp, Shelter, Measuring site (no buildings), Other (text)]
		Opening year	R	The first year of operation.	Year
		Operational period (month to month)	R	Months that the station is open to visitors.	[month to month]
		Name of managing institution	R	Name of the institution or organisation that manages the station (takes care o	Text
		Managing institution country	R	The country in which the station managing institution or organisation is locate	Select one: [country]
		Name of station owner (if different from 'Managing institution')	R	Name of institution or organisation that owns the station.	Text
		Type of owner	R	The type of owner institution/organisation, see Format for choices.	Multiple select: [Government, Research institution, NGO, Private, Other (text)]
		Station owner country	R	The country in which the station owner institution or organisation is located.	Select one: [country]
		Partner institution	O	Are there other institutions involved in the operation of the station?	[yes/no]
		Partner name and country	O	Name other partner institutionand the country in which they are located.	[add one to multiple]
	Text description	Station name and owner	R	Text - max. 25 words	Text description
		Location	R	Text - max. 100 words.	Text description
		Biodiversity and natural environment	R	Text - max. 100 words.	Text description
		History and facilities	R	Text - max. 100 words.	Text description
		General Research and Databases	R	Text - max. 100 words.	Text description
		Human Dimension	R	Text - max. 100 words.	Text description
		Access	R	Text - max. 75 words.	Text description

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	Station name	Station name	R	Full name of station	Text
		Station acronym/short name	R	Short name to be used in publications when referring to the station.	Text (max 20 characters)
Station name and operations	Status	Operational status	R	Is the station in operation and open to visitors or has it been closed without current plans of starting up again.	Select one: Open, Closed (permanently or for period of years)
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	Station contact information	Station address	R	The postal address for where to send goods to the station.	Text
		Station manager name	R	Full name of station manager	Text
		Station manager e-mail	R	Contact e-mail for the station (need not to be the station manager)	e-mail
		Station website link	R	Link to station website or the webpages of an institution where the station is	Link
		Station contact e-mail	O	e-mail for general contacts to the station (if different from station manager)	e-mail
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		Opening year	R	The first year of operation.	Year
		Operational period (month to month)	R	Months that the station is open to visitors.	[month to month]
		Name of managing institution	R	Name of the institution or organisation that manages the station (takes care	Text
		Managing institution country	R	The country in which the station managing institution or organisation is locate	Select one: [country]
		Name of station owner (if different from 'Managing institution')	R	Name of institution or organisation that owns the station.	Text
		Type of owner	R	The type of owner institution/organisation, see Format for choices.	Multiple select: [Government, Research institution, NGO, Private, Other (text)]
		Station owner country	R	The country in which the station owner institution or organisation is located.	Select one: [country]
		Partner institution	O	Are there other institutions involved in the operation of the station?	[yes/no]
		Partner name and country	O	Name other partner institutionand the country in which they are located.	[add one to multiple]
	Text description	Station name and owner	R	Text - max. 25 words	Text description
		Location	R	Text - max. 100 words.	Text description
		Biodiversity and natural environment	R	Text - max. 100 words.	Text description
		History and facilities	R	Text - max. 100 words.	Text description
		General Research and Databases	R	Text - max. 100 words.	Text description
		Human Dimension	R	Text - max. 100 words.	Text description
		Access	R	Text - max. 75 words.	Text description

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Overall theme	Sub-theme	Field Alias	Required (R) Optional (O) Super User (S)	Field Definition	Format
	Visuals	Station and institution logos	R	Logo of station and if relevant owner institution/organisation and/or managing institution/ organisation.	Upload function - attachments
		Station photo	R	Photo of station building(s) (close up and landscape scale allowed)	Upload function - 1 attachement.
		Featured image(s)	R	Additional photos showing facilities, fieldsites, instrumentation and landscape	Upload function - max. 15 attachements
		Virtual tour	O	Link to 360 degree photos (e.g. Google Street View, Mapillary or similar) of sta	Link to 360 photography at and around station
		Station movie	O	Link to one or more movies about the station and the science consucted there	Link(s) to movie about station
		Social media	O	Link to relevant social media accounts of the station.	Link(s) to social media platforms
	Station access	INTERACT access programmes	R	Is the station involved in INTEACT TA, RA or VA?	Multiple select: [Transnational Access, Remote Access] Link to Virtual Access
		Station access application link	R	Link to the station's online application system or to a website where application procedures and forms can be found.	Link
	INTERACT GIS application modu	Station use INTERACT GIS application module	O	Click on link if station want to use INTERACT GIS application module	Link take user to application module set-up.
		Set-up: Show link to INTERACT GIS application module	O	Tick off if station use INTERACT GIS applicaiton module for handling, storing and sharing project applications and metadata	
		Set-up: e-mail address to receive applications	O	E-mail address of mailbox that submitted aplications and -e-mails are sent to.	e-mail
	Landscape and environment	Landscape features	R	Landscape features reachable within a days fieldwork from the station.	Multiple select: [Mountains, Nunataks, Volcanoe(s), Lava fields, Plateaus, Moraines, Valleys, Homothermic springs, Lake, Thermokarst lake, River, Delta/Estuarie, Fjord, Sea, Beach, Rocky shores, Sea cliffs, Other (text)]
		Permafrost zone	R	Permafrost type in the station study area.	Multiple select: [Continuous, Discontinuous, Sporadic, Pingos/ice lenses, Palsa mires, None]
		Snow and ice on land	R	Types of snow and ice normally present in the station study area.	Multiple select: [Ice caps, Glaciers, Permanent snow patches, None]
		Vegetation	R	Vegatation features in the station study area.	Multiple select: [Tree line, Polar desert/Semi-desert, Gramminoid tundra, Shrub tundra, Forest tundra, Peatlands/mires, Wetlands, Deciduous forest, Evergreen forest, Alpine heath, Other (text)]
		Wildlife	R	Wildlife groups present in the station study area.	Multiple select: [Terrestrial carnivores, Ungulates, Hares, Rodents, Bird colonies, Polar bear, Whales, Seals, Fish]
		Human use	R	Current human activities in the area, or if there are historic signs of human presence.	Tourism, Animal Husbandry, Tourism, Leisure activities, Only historic signs of human presence, Other (text)]

Continued...

Overall theme	Sub-theme	Field Alias	Required (R) Optional (O) Super User (S)	Field Definition	Format
Facilities and staff	Staff and sevices	Number of staff peak season/ summer	R	Number of staff at the station in peak season (summer)	Number
		Number of staff off season/ winter	R	Number of staff at the station off season (winter).	Number
		Staff able to assist (fieldwork)	R	Are staff able to assist with data/sample collection?	Select one: [No , Yes - if time allows, Yes – at a cost, Other [text field]]
		Staff able to assist (workshops)	R	Are staff able to assist with practical work in workshops, e.g. woodwork, plexiglass construction, mechanical engeneering tasks, etc.	Select one: [No, Yes - if time allows, Yes - at a cost, Other [text field]]
	Housing and accommodation	Area under roof (m²)	R	Total indoor area of the station facilities, including housing and accommodation, conference rooms, kitchen, storage, workshops, garages, etc.	M2
		Max number of visitors	R	Maximum number of visitors that can be accommodated at the station (number of beds available for visitors).	Number
		Showers	R	Are showers available?	[yes/no]
		Laundry facilities	R	Are there laundry facilities at the station?	[yes/no]
		Power supply - period	R	When during the day can visitors expect power supply at the station?	24 hours or [time to time]
		Power supply – plug type	R	What type of electrical plugs can be used at the station? Info button: https://www.worldstandards.eu/electricity/plugs-and-sockets/	Multiple select: [A, B, C, D, E, F G, H, I, J, K, L, M, N, O]
		Power sources at station	R	What power sources are used at the station (can be a combination of several types)?	Select one: [Municipal grid, Dielsel/oil/gas, Wood, Solar, Wind, Water, Geothermal, Biofuel, Other (text)]
	Logistics	Logistics area (m²)	R	What is the total area of indoor logistical facilities, including storage, workshops, garages, etc.	m2
		Conference room capacity	R	If the station has conference room(s), how many are there room for in the largest conference room?	Number
		Workshops	R	What types of workshops are available to visitors at the station?	Multiple select: [Electrical and IT technologies, Mechanical, Metal, Wood, Plexiglass, Other (text)]
		Means of transport to/from station	R	What means of transport can be used to reach the station form the nearest international airport?	Multiple select: [Walk, Ski, Snowmobile, Boat, Car, SUV (4x4), Bus, Train, Scheduled flight, Chartered plane/helicopter, Other (text)]
		Air landing facilities at station	R	Airtransport landing facilities at the station	Multiple select: [None, Airstrip, Helipad]
		Airstrip length and width	O	Length and width of airstrip in metres	Length [number], Width [number]
		Airstrip surface	O	Type of surface airstrip consist of	Select one: [Tarmac, Gravel/sand, Snow/Ice]
		Transport on land - at station	R	What vehicles/travel means are vailable for visitors for transport on land?	Multiple select:[Tracked vehicle, Truck, SUV (4x4), car, ATV, snowmobile, bicycles, ski, snow shoes, kick sledges, Other (text)]
		Transport on water - at station	R	What vehicles/travel means are vailable for visitors for transport on water?	Multiple select: [Zodiac, Open boat/Dhinghy, Closed boat, Amphibie vehicle, Other (text)]
		Water landing facilities	R	Ship/boat landing facilities at station.	Multiple select: [None, Harbour/port, Warf/pier, Pontoon/float bridge, barges, Beach]

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Overall theme	Sub-theme	Field Alias	Required (R) Optional (O) Super User (S)	Field Definition	Format
	Field equipment	Compulsory safety equipment	R	Safety equipment that staff and visitors are obliged to carry with them during fieldwork.	Multiple select: [PLB, VHF, HF, Satelite phone, Mobile phone, GPS, Weapon/rifle, Flare gun, Bearspray, First Aid Kit, Glacier rescue kit, Avalanche rescue kit, Overnight equipment, Other (text)]
		Recommended safety equipment	R	Safety equipment that staff and visitors are recommended to carry with them during fieldwork.	Multiple select: [PLB, VHF, Satelite phone, GPS, Rifle, Flare gun, Glacier rescue kit, Avalanche rescue kit, Other (text)]
		Safety equipment available at station	R	Safety equipment that is available for visitors.	Multiple select: [PLB, VHF, Satelite phone, GPS, Rifle, Flare gun, Glacier rescue kit, Avalanche rescue kit, Other (text)]
		Camping equipment available at the station	R	Camping equipment that is available for visitors	Multiple select: [Tent, Sleeping matress, Sleeping bag, Cooking equipment and utensils, Gas/alcohol for cooking, Other (text)]
		Field power supply available at the station	R	Are there areas with reliable power supply in the field (does not have to be the entire study area of the station)	[yes/no]
		Field instruments available at the station	O	Field instruments that visitors can borrow/rent from the station.	[text]
	Communication and IT services	Field to station	R	Means of communication used for information exchange between field and st	Multiple select: [Mobile phone, VHF, Satelite phone, other (text)]
		Station to outside world	R	Means of communication used for information exchange between station and the outside world	Multiple select: [Satellite phone, Mobile phone, Internet, other?]
		Wireless transfer of data from field site to station	R	Do the station offer wireless transfer of data from field sites to station (doesn't have to be the entire study area around the station.	[yes/no]
		IT infrastructure	O	IT infrastructure available to visitors	Multiple select: [Wifi, Computers, Printer, Data storage, Statistical tools, GIS tools, other (text)]
	Laboratory	Laboratory area (m^2)	R	The area of laboratory space at the station.	M2
		Laboratory equipment	O	What laboratory equipment is available to visitors?	Multiple select: [Freezer < -80, freezer -40 - -10, Fridge, Microscopes, Basic laboratory equipment, Advanced laboratory equipment, Basic chemical reagents, Analytical instrumentation, other (text)]
		Laboratory available in nearby town/settlement	R	Are there access to laboratory facilities in nearby settlement?	[yes/no]
	Medical facilities	Medical facilities	R	Room dedicated to medical work.	[yes/no]
		Medical capability	R	Medical kit, equipment and facilities. Basic refers to simple first aid, Extensive refers to advanced treatment facilities, technologies and medication. Dental refers to at least simple (temporary?) dentist work and surgery ability to carry out simple surgery operations.	Multiple select: [Basic, Medium, Extensive, Dental, Surgery, Other (text)]
		Staff with medical training	R	Number of staff that has a certificate on completed medical training or is an educated doctor	Select one: [None, In peak season, When open]
		Distance to hospital [estimated time - hours]	R	Distance to nearest public hospital (estimated time - hours)	Hours

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Overall theme	Sub-theme	Field Alias	Required (R) Optional (O) Super User (S)	Field Definition	Format
Science network and projects	Organisations and networks	Arctic Council Expert Groups	R	See subcategories alreadu in INTERACT GIS	Working groups and expert group of Arctic Council initiatives that station staff or associated scientist contributes to
		Scientific networks	R	See subcategories already in INTERACT GIS	Established scientific networks with standards methodologies and open for membership of stations or associated institutions aor scientists
Monitored variables	Climate - Monitored variable	Meteorology	R	See subcategories already in INTERACT GIS	Yes/No, Start year, link to data
		Energy balance and radiation	R	See subcategories already in INTERACT GIS	Yes/No, Start year, link to data
	Geo - Monitored variables	Geology/Geomorphology	R	See subcategories already in INTERACT GIS	Yes/No, Start year, link to data
		Sub-surface characteristics	R	See subcategories already in INTERACT GIS	Yes/No, Start year, link to data
		Snow characteristics	R	See subcategories already in INTERACT GIS	Yes/No, Start year, link to data
		Atmospheric composition	R	See subcategories already in INTERACT GIS	Yes/No, Start year, link to data
		Greehouse gas exchange	R	See subcategories already in INTERACT GIS	Yes/No, Start year, link to data
		Energy budget	R	See subcategories already in INTERACT GIS	Yes/No, Start year, link to data
		Hydrology/Limnology	R	See subcategories already in INTERACT GIS	Yes/No, Start year, link to data
		Pollution	R	See subcategories already in INTERACT GIS	Yes/No, Start year, link to data
	Glacio - Monitored variables	Glacier characteristics	R	See subcategories already in INTERACT GIS	Yes/No, Start year, link to data
		Mass balace	R	See subcategories already in INTERACT GIS	Yes/No, Start year, link to data
		Climate	R	See subcategories already in INTERACT GIS	Yes/No, Start year, link to data
		Glacier hydrology	R	See subcategories already in INTERACT GIS	Yes/No, Start year, link to data
	Bio - Monitored variables	Vegetation	R	See subcategories already in INTERACT GIS	Yes/No, Start year, link to data
		Arthropods	R	See subcategories already in INTERACT GIS	Yes/No, Start year, link to data
		Birds	R	See subcategories already in INTERACT GIS	Yes/No, Start year, link to data
		Mammals	R	See subcategories already in INTERACT GIS	Yes/No, Start year, link to data
		Lake ecology	R	See subcategories already in INTERACT GIS	Yes/No, Start year, link to data
		Genetics	R	See subcategories already in INTERACT GIS	Yes/No, Start year, link to data
		Socio-ecological issues (disturbance)	R	See subcategories already in INTERACT GIS	Yes/No, Start year, link to data

Appendix 2. Data provider metadata

Overall theme	Field Alias	Required (R) Optional (O)	Field Definition	Format
Provider of Metadata	First name	R	First name of user.	Text
	Surname	R	Surname of user.	Text
	Email	R	e-mail address	xx@yy.zz
	Username (Account ID)	R	User name chosen by user	Text
	Address	R	Name and address of institution/organisation where user is employed	Text
	Born	R	Year user is born.	Year
	Profession or Discipline	O	Employment title or area of work	Free text e.g. Station managers, Logistician, Scientist, Biology, Permafrost
	Degree	O	Current academic level	Student, Bachelor. Master, PhD, Post Doc, Senior scientist, Professor
	Mobile	O	Mobile phone number including country and area codes	Number
	Phone	O	Telephone number including country and area codes	Number
	Nationality	O	Country	Country, dropdown list
	GDPR	O	Sign GDPR agreement if needed	Standard agreement

Appendix 3. Application module metadata

Overall theme	Field Alias	Required (R) Optional (O)	Field Definition	Format
Project metadata	Short title	R	Short title	Text
	Long title	R	Full title of project	Text
	Start Year	R	Yesr fieldwork began	Year
	End Year	R	Year fieldwork ended	Year
	Description and purpose	R	Describe	Text
	Specific research methods	O	Describe researech methodologies or link to scientific networks with standard methodologies or provide referenced to journal articles describing method	Text and link where relevant
	Discipline	O	Main discipline the stady addresses	Select from dropdown menu/vocabulary recognition
	Keywords, other disciplines	O	Keywords and other disciplines addressed by the project	Text, vocabulary recognition
	Preliminary project plan	R	Describe have the project is implemented, activities and timeline.	Text
	Environmental impact	O	Describe potential environmental impacts of the research and logistical activities associated with the project.	Text
	Resoration plan	O	If relevant, describe how you will restore areas altered by your project activities (e.g. removal of plant cover, soil)	Text
	Projecta activities: Label	R	Short display name for GIS tool	Text
	Projecta activities: Station	R	Select station, where the activity takes place.	Select from dropdown menu
	Projecta activities: Activity details	R	Describe the specific research activity for the project activity.	Text
	Projecta activities: Environmental impact	R	Describe the environmental impact for the project activity.	Text
	Projecta activities: Restoration plan	R	If relevant, describe how you will restore areas altered by your project activities (e.g. removal of plant cover, soil)	Text
	Projecta activities: Projecta activities:	R	Describe any safety related issues and how they are dealth with by the team.	Text
	Projecta activities: Location description	R	Provide the local name of the study site and a description of the exact location if relevant	Text
	Projecta activities: Location drawn GIS (point, transect, area)	O	Provide GIS info if possible (point, transect, area)	GIS information
	Parent project	O	If the project is part of a larger project (time limited), provide the name of the parent project	Text
	Homepage	O	If relevant, provide the url of the project or parent project.	Url
	Funding agency - grant ID	R	If relevant, list the funding agency grant number.	Text
	Linked to programme	O	If the project is linked to a larger programme (not time limited), state the name of this programme.	Text
	Transnational access project	O	Funded by INTERACT TA funding mechanism	Yes/No
	EU project - grant ID	O	If relevant, list EU grant number.	Text
	Publications	O	Provide reference(s) for publications using data from the study.	Text
	Data publishing plan	O	Describe how you intend to handle data - from acquisition through quality assurance, storage to publication and sharing.	Text
	Safety aspects and mitigations	O	Describe any safety related issues and how they are dealth with by the team.	Text
	Post season report	O	Describe the projects succesfulness in geeral terms and any deviations from planned activities.	Text

Appendix 4. INTERACT suggested scientific network metadata

Parameter	Field definition	Drop down menu choices (only where relevant)	Drop down menu definitions (only where relevant)	Format
Network name	Full name of the scientific network			Free text
Acronym	Abbreviation or short name of the network			Free text
Website	Network website address			URL
Contact information	e-mail address for making contact to the network			e-mail address
Parent organisation name	Name of organisation hosting the network			Free text
Type of network	What activity is the primary focus of the network	Scientific – monitoring	Scientific network/organisation who's main activity is the continuous collection of standardised data within one or more disciplines	Dropdown meny choice
		Scientific – assessment	Scientific network/organisations who's ,main activity is the periodical gathering of historic data to make assessments within one or more disciplines - specific topics may change.	Dropdown meny choice
		Scientific – research project	Scientific network/organisation who's main activity is to conduct short term research projects, often with changing topic and or geographical coverage within one or more disciplines	Dropdown meny choice
		Database/Data journal	Institution/Organisation who manages and operates online data repositories or data journals	Dropdown meny choice
		Advisory organisation	Organisation established to provide advise on sustainable use of natural ressources to government authorities	Dropdown meny choice
		Infrastructure network/organisation	Network/Organisation of research infrastructures established to improve services offered to the scientific community	Dropdown meny choice
		Other	None of above	Free text
Discipline	Discipline(s) covered by the network activities	Diciplines taken form INTERACT Research and monitoring report		Multiple select
Key words	Key words describing the network			Free text
Standard methodology	Data generation in the network	Standard monitoring protocols	Network/organisation have developed standard sampling protocols to be followed by members	Dropdown meny choice
		Harmonisation of data sets	Network/organisation harmonise data sets gathered from different memebers using different methodologies	Dropdown meny choice
		No standard monitoring methodology or harmonisation of data sets	Network/organisation use whatever methodology is relevant for their specific purpose	Dropdown meny choice

Continued...

Parameter	Field definition	Drop down menu choices (only where relevant)	Drop down menu definitions (only where relevant)	Format
Database	Do the network operate a data repository or use a common repository operated by others	Yes	The network has a common data repository/database, whether publically available or not.	Dropdown meny choice
		No	The network does not have a common data repository/database	Dropdown meny choice
Geographical coverage	Regions where network has ongoing activities. A network can be global if the focus habitat/species are distributeed across the globe even if it only occurs sporadically (e.g. tundra ecosystem)	Global		Dropdown meny choice
		Arctic		Dropdown meny choice
		North american		Dropdown meny choice
		European		Dropdown meny choice
		Asian (including Russia)		Dropdown meny choice
		Atlantic		Dropdown meny choice
		Pacific		Dropdown meny choice
		Multilateral	Network between several countries, crossing regions	Dropdown meny choice
		Bilateral	Network between two countries	Dropdown meny choice
		National	Network within one country	Dropdown meny choice
Membership		Person	Person/scientist associated with station	Dropdown meny choice
		Research station	Research station located in the arctic, boreal or alpine areas, Long-term, open for external visitors and conducting some level om monitoring	Dropdown meny choice
		Institution	Institutions operating the research station	Dropdown meny choice
		Country	National appointed representative (often by government), coordinating national input	Dropdown meny choice
Operating period	Year when network started, and end if closed	Start year		Dropdown meny choice
		End year (if any)		Dropdown meny choice

Appendix 5. Short statement from POAwg for the Arctic Observing Summit 2022

POAwg Short Statement for Arctic Observing Summit 2022

Optimizing Polar Observing with Asset-Level Metadata Interoperability Across Networks

William Manley[1], Roberta Pirazzini[2] and other Members of the SAON Polar Observing Assets Working Group[3]

[1]University of Colorado, [2]Finnish Meteorological Institute, [3]https://polarobservingassets.org

There is broadly recognized need for an integrated Arctic observing system, including a means of identifying overlaps and gaps, a "knowledge map" to clarify directions, and ways to build capacity to better meet observing goals (e.g. AOS, 2020; ASM, 2021; IARPC, 2021; EU-PolarNet, 2022). However, a fundamental challenge exists: Observing assets such as sites, tracks, research stations, projects, and programs are deployed in a diverse and distributed fashion across hundreds of networks and initiatives. At this time, it is difficult to strategically assess, plan, or synthesize because the granular information needed - specific details on activities and infrastructures - is fragmented and incomplete. Most asset-related inventories, catalogs, and portals are limited in thematic or geographic scope. Furthermore, only a fraction of networks share structured information in a way that can be accessed, harmonized, and aggregated for a comprehensive perspective.

To help address this challenge, a new Polar Observing Assets Working Group (POAwg) has been formed under the SAON Committee on Observations and Networks (CON). This group builds upon steps taken by the polar data community for the interoperability of "dataset-level" metadata, but in this case for discovery-level details in "asset-level" metadata (see Table 1). POAwg will identify and promote community-based approaches for the use of relevant standards, controlled vocabularies, crosswalks, federated search, and linkages to operational or scientific datasets. In so doing, its broader goals are to make observing-related metadata - beyond the dataset level - more Findable, Accessible, Interoperable, and Reusable (FAIR; Wilkinson et al., 2016), as well as to help showcase and integrate the summed contributions of multiple systems. For more information, see https://www.polarobservingassets.org. POAwg has identified three tasks that are focused and achievable in the short term.

The first task is to create a registry of polar observing networks - focusing on interoperability parameters and documenting: Asset-related metadata standards (e.g., ISO 19115/19139, WIGOS, INSPIRE EF, etc.), semantic technologies (observing-related vocabularies and ontologies), transfer protocols (e.g., OAI-PMH, CSW, WFS, or custom APIs), and machine-readable endpoints that are currently in practice. Use cases for the registry have been identified and will guide the development process moving forward. The registry will have a frontend allowing users to browse, search, and filter for networks, potentially with a graphical interface illustrating patterns of implementation. As a start, the group has developed a crosswalk for elements across prior inventories by SAON CON and EU-PolarNet, and in a few existing network-level metadata models (e.g. DEIMS-SDR, INTERACT). Current efforts are to prioritize metadata elements and to

envise the user experience. The registry of polar observing networks will help to: Clarify best practices for observing-related metadata sharing; establish a basis for harvesting, aggregation, & federated search; better inform local communities of active efforts nearby; and guide network assessment & planning.

Table App5.1. Summary of discovery-level, observing related metadata elements

Network-Level	Project-Level	Site-Level
e.g., Global Terrestrial Network – Permafrost (GTN-P)	e.g., Thermal State of Permafrost (TSP)	e.g., borehole
Network Name	Funding Agency	Network Name
Network Description	Funding Program	Site Name
Discipline	Funding Country	Site ID
Observational Parameters	Project Title	Site Description
Organization	Project ID	Facility Type
Organizational Country	Discipline	Observed Properties
Time Range	Region	Country
Region	Subregion	Location
Subregion	Location	Latitude & Longitude
Spatial Extent	Latitude & Longitude	Elevation
Contact Info	Institution	Site Start Date
Asset Type	Contact Info	Site End Date
Metadata Standards Transfer	Project Start Date	Institution
Protocols	Project End Date	Contact Info
Links to organization, network, and data	Links to project summaries, sites, data, and more	Links to network, institution, data, and more

The second task is to build crosswalks and facilitate existing tools for translation across standards. In contrast to a broad range of established metadata standards in use to describe scientific datasets, there are relatively few that pertain to concepts such as observing sites, major infrastructure, transects, and field-based research projects (cf. Habermann, 2018; Wohner et al. 2020). And there are even fewer tools or resources to facilitate mapping of elements from one to another (for example, see ADlwg, 2017). This task will compile crosswalks across the most

common standards or custom schemas in use by networks, as identified in Task 1. Outcomes will significantly improve the ability to translate & harmonize for aggregation and federated search, and will inform the deliverable for Task 3.

The third task is to create recommendations for adoption and implementation of established standards and solutions. The practice of building and deploying asset-level metadata catalogs is still in its infancy. Many networks and related organizations have done so, primarily for their own internal goals of resource tracking, logistics, and operational management. However, in many cases these databases (or spreadsheets, or tables on webpages and PDFs) have been constructed from the ground up - with custom approaches that limit utility and impact. To address this, POAwg will create a guidance document for implementation of standards, protocols, vocabularies, crosswalks, open-source platforms, and more. This guide will draw from, and build upon, similar efforts acting outside the high latitudes (e.g., ENVRI-FAIR, 2021; IODE ODIS, 2021; el TER RI, 2022; JERICO-CORE, 2022; cf. Jones et al., 2021), but tailored to a polar observing audience. The end result will communicate an easier path for networks to populate, expand, and share metadata catalogs of observing assets - improving overall interoperability while saving considerable time and effort.

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

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