

## Polar Data Forum VI

### Book of Abstracts

20-24 October, 2025 - Hobart, TAS, Australia

[CSIRO Hobart](#) - 3-4 Castray Esplanade Battery Point Tas 7004





## Table of Contents

Keynotes	3
Session: Community-Led Research and Indigenous Data Sovereignty	3
Session: Data Story Telling	4
Session: Vocabularies and Semantic Interoperability	7
Session: Data Management	8
Session: Machine Learning /Artificial Intelligence	10
Session: Polar Modelling and Spatial Data	12
Session: Open Science	14
Session: Data Platforms and Repositories	16
Session: International Collaboration	19
Posters	22



## Keynotes

*The Eurasian red squirrel (Sciurus vulgaris) Data, Knowledge and Backcasting using Oral Histories*

**Speaker:** Tero Mustonen, Snowchange Cooperative, Finland

**Abstract:** The Eurasian red squirrel (*Sciurus vulgaris*) has played an important role in Finnish traditional culture and livelihoods since pre-historic times. This keynote summarizes recent science results and analyzes the current role, status, and trends of the red squirrel using both available scientific evidence and testimonies from oral historians who were immersed in Finland's boreal hunting societies during the mid-1900s. Red squirrels are not currently seen as being of great relevance to conservation efforts, despite their central role in spreading seeds and in boreal predator–prey food chains. If the animal is lost from Finland's remaining boreal timber forests, their absence may have consequences that are not yet understood. The keynote will discuss the role and scope of "data" of species in the boreal and the Arctic, cultural knowledge and the fusion of oral histories and science in backcasting and assessing the status and trends of this iconic animal of the Finnish boreal.

*Utilising Earth Observation Data to Improve Understanding of Polar Regions: Activities of ESA Polar Science Cluster*

**Speaker:** Martin Wearing

**Abstract:** Satellite Earth observation data provides a valuable resource for monitoring change in remote and inhospitable polar regions. In this presentation I will provide an overview of the activities and projects of the ESA Polar Science Cluster, with a focus on the generation of innovative data products and the insights they provide, as well as ongoing efforts to ensure data from multiple projects is harmonised and accessible for the benefit of the wider science community and upcoming international initiatives.

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### Session: **Community-Led Research and Indigenous Data Sovereignty**

**Title:** Empowering Indigenous Communities Through Collaborative Research: Enhancing Data Accessibility and Decision-Making with the Canadian Watershed Information Network

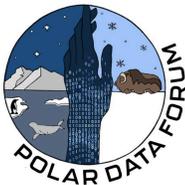
**Presenter:** Claire Herbert

**Affiliation:** University of Manitoba

**Additional Authors:** Yanique Campbell; Victoria Dearborn

**Presenting Format:** Online

**Abstract:** As funding for scientific research increasingly requires collaboration between Western scientists and Indigenous communities, challenges arise in ensuring that the data collected aligns with community needs and can be used effectively. Often, the community-driven research questions are secondary to the main scientific objectives, leading to insufficient support in developing appropriate protocols, methods, and data analysis. This can result in data that is not fit for the community's intended purpose or cannot be used for decision-making due to a lack of provenance, such as documentation of protocols and methods. Moreover, communities face difficulties comparing their data with that of others due to inadequate documentation. In response, the Canadian Watershed Information Network, in partnership with Indigenous rights holders, has developed a new landing page specifically for Indigenous communities. This platform centralizes research and publications relevant to specific community areas and offers "knowledge products"—curated compilations of datasets that present high-level, plain-language stories of the research. Additionally, it supports community-led research by providing key



information in one place, and it facilitates informed decision-making by cataloging various Community-Based Monitoring (CBM) data types, methods, and protocols, often in comparison with accredited labs. This initiative seeks to improve the quality and utility of Indigenous community-led research, ensuring data is both accessible and actionable.

**Title:** Amplifying Impact Through Collaboration: Knowledge Mobilization and Data Sharing in Arctic Research

**Presenter:** Chantelle Verhey

**Affiliation:** Carleton University, Geomatics and Cartographic Research Centre (GCRC)

**Presenting Format:** In-person

**Abstract:** Knowledge mobilization, actionable data, and data sharing are top priorities for researchers and communities of practice worldwide. While numerous initiatives are gaining momentum, Arctic research presents a unique challenge due to the region's diversity, interdisciplinarity, and the responsibilities that come with it. This presentation aims to showcase these initiatives at the international, national, and regional levels, specifically examining how they interconnect and build upon one another to amplify interoperability, impact, and looking to challenges related in knowledge mobilization and knowledge-to-action frameworks. The presentation will explore bottom-up approaches to the flow of data from spatiotemporal configurations, with examples from initiatives such as SmartICE, the Canadian Polar Data Consortium (CPDC), and the Polar Data Search (PDS). Furthermore, it will emphasize the contributions of these initiatives and how they have benefited from coordination efforts by organizations such as the Arctic Data Committee (ADC) and the World Data System - International Technology Office (WDS-ITO). The polar region embodies a multitude of perspectives, and collaboration between interdisciplinary fields is essential to addressing the challenges of the open data movement, including ensuring that Indigenous data sovereignty is incorporated and respected at all levels of open science frameworks.

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## Session: Data Story Telling

**Title:** Data Stories as a Tool for Enhanced Data Accessibility: Turning Scientific Data into Engaging Narratives

**Presenter:** Yanique Campbell

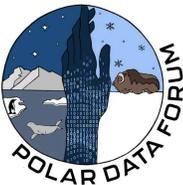
**Affiliation:** University of Manitoba

**Additional Authors:** Claire Herbert

**Presenting Format:** In-person

**Abstract:** Data sharing has evolved beyond merely distributing data files. Many data repositories now implement curation protocols that make data more understandable, visualizable, and reusable, turning these repositories into essential resources for researchers seeking publicly shared data. While repositories aim to serve data providers and researchers, we should also consider ways to engage users who are curious about research impacts but may not have the capacity or interest to analyze data themselves. Data stories serve as an effective approach to communicate research findings by integrating various data sources to present clear context, methodologies, and results in a way that is engaging and easily comprehensible. The aim is to make scientific data on environmental impacts accessible to all, regardless of their level of scientific knowledge.

Data stories fundamentally require data, but storytelling can take many forms. One method at the Canadian Watershed Information Network (CanWIN) involves using Canva for designing visual narratives and Flourish for creating interactive data visualizations, resulting in stories that are both captivating and



impactful. On the data side, we collaborate with researchers to gather key datasets, results, and background information related to their work. We then synthesize that information, creating meaningful charts, graphics and informational elements that provide a comprehensive overview of how various scientific variables influence humans and the environment.

Data storytelling increases scientific knowledge; it transforms abstract datasets into engaging narratives, enhancing understanding and interest in science. It serves as a powerful tool for outreach, connecting with audiences who are curious about science and its broader implications.

**Title:** Making the Most of your Data: Visualizing the Future of Researcher-Repository Collaborations

**Presenter:** Shannon McAllister

**Affiliation:** Arctic Institute of North America, University of Calgary; School of Interactive Arts & Technology, Simon Fraser University

**Additional Authors:** Sheelagh Carpendale

**Presenting Format:** In-person

**Abstract:** The volume of data being created and consumed globally is increasing exponentially. This includes research data which has proliferated due to advancements in digital technologies and data-generating instrumentation. Rapid increases in data volume have made the work of data repositories more valuable than ever before, ensuring that this data is findable, accessible, interoperable, and reusable (FAIR) as well as responsibly and ethically managed. This paper argues, however, that repositories can and should do more. As a storage facility and point of access for research data, repositories are able to act as a connector between research data and the non-research community, which ranges from educators to activists to policy makers. Considering data access and thinking about issues around how people can discover and explore these data repositories can open up the diversity of people who benefit. Investing in data training, both for researchers and non-researchers, science communication efforts, data visualization services, and data storytelling services will help spotlight repositories as more than just a storage facility, but a vital service for connecting data to the world.

**Title:** Using Compound Data Objects, Semantic Modelling and Multi-Level Software Architecture for Data-Driven Storytelling

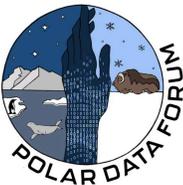
**Presenter:** Peter Pulsifer

**Affiliation:** Carleton University; Geomatics and Cartographic Research Centre

**Additional Authors:** Amos Hayes, Brendan Billingsley, Alex Gao, Chantelle Verhey

**Presenting Format:** In-person

**Abstract:** The Polar Regions are sometimes seen as remote, inaccessible and even irrelevant areas where unfamiliar Indigenous peoples and adventurers reside. A deeper look reveals that there are highly relevant, complex stories to tell about the Polar Regions and their place in global systems. Telling a complete and holistic story in an increasingly digital world is often well served by including data from many different sources. The complex nature of these stories may require data from social, physical, environmental, biological or other systems in many different forms including text, narrative represented by multimedia, observation databases, remote sensing, model output, and many others. Inclusion of multiple worldviews and perspectives, particularly Indigenous Knowledge of the Arctic, are now recognized as an important part of data storytelling. For almost twenty years, the authors have worked with partners to develop digital data stories using an integrated software framework called Nunaliit. As technology evolves, Nunaliit is being reimaged and redesigned to continue innovative storytelling. In this presentation, based on past experience and current application requirements, we outline how multiple database tools are being combined with semantic modeling and multi-level software architecture to address the challenges and



opportunities of Polar Region data storytelling.

**Title:** Cerulean Information Factory Storytelling Capability

**Presenter:** David Arthurs

**Affiliation:** Polar View

**Additional Authors:** Týna Doležalová

**Presenting Format:** In-person

**Abstract:** Storytelling is crucial in the realm of science because scientific data, while rich in information, can often be complex and challenging to communicate. By framing data within narratives, storytelling makes scientific concepts accessible, engaging, and memorable to a wider audience. It bridges the gap between the technical details of research and the public's understanding, fostering appreciation, curiosity, and ultimately, a deeper connection to the wonders of science. The Cerulean Information Factory (CIF) storytelling capability allows scientists to connect a narrative to their data results.

The CIF is based on the eodash ecosystem – an aggregation of tools offered with a permissive licenses. They are conceptualized around SpatioTemporal Asset Catalogs (STAC) that work in a federated way to integrate Earth Observation and related data into an overarching service package. The main tools are a web client dashboard library (eodash) and a catalog generator library that provide the basis for integration of many types of endpoints.

Storytelling is a tool provided by the CIF. It is an editor and renderer based on Markdown. It allows integration of the same widgets as used in eodash. The Markdown is extended by allowing special configuration expressions that are evaluated to setup and show the different widgets. The Markdown file can be displayed by any normal Markdown interpreter, so the stories written in CIF can be utilized in other applications.

**Title:** Shining a light on observing systems: how BENEFIT assessment supports data storytelling and open science

**Presenter:** Hazel Shapiro

**Affiliation:** UIC Science

**Additional Authors:** Sandy Starkweather

**Presenting Format:** Online

**Abstract:** The U.S. Arctic Observing Network (U.S. AON) is a collaborative initiative aimed at enhancing scientific observations in the Arctic. The U.S. AON has developed a method and tool for crowdsourcing information about Arctic observing and data systems called the BENEFIT assessment. BENEFIT assessment brings together Arctic experts to provide structured insights into how observing and data systems contribute to societal benefits and where they may fall short. For instance, U.S. AON collaborates with researchers to evaluate their support for fire management in Alaska, or with forecasters to enhance their prediction and communication of flooding risks. We work with these experts to illustrate the connections between their projects or programs and specific Arctic societal benefit areas, such as disaster preparedness, food security, or fundamental understanding. We then trace back from the final product, service, or outcome to the observing systems and data products they depend on. Throughout this process, we collect information on the performance of specific inputs and assess the importance of each input to the final outcome. This talk will introduce the BENEFIT assessment, focusing on its role in supporting data storytelling and open science, while also highlighting key challenges and opportunities for future collaborations.



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## Session: Vocabularies and Semantic Interoperability

**Title:** Semantic mapping services and tools at the Arctic Data Centre: the MET Vocabulary Server

**Presenter:** Lara Ferrighi

**Affiliation:** Norwegian Meteorological Institute

**Additional Authors:** Øystein Godøy; Magnar Martinsen; Massimo Di Stefano

**Presenting Format:** Online

**Abstract:** The Arctic Data Centre (ADC) is a service provided by the Norwegian Meteorological Institute (MET) and gives access to FAIR data through a distributed data management system. Metadata records are harvested from different sources and translated into the MET Norway Metadata Format Specification, which includes several controlled vocabularies. These vocabularies, represented in SKOS, are grouped in collections and published through the MET Vocabulary Server (METNOVS) using the Skosmos web based open source ontology browser. In addition, it hosts local copies of the Climate and Forecast standard names and Global Change Master Directory Science keywords, mapped to each other through internal and community efforts. The METNOVS is actively used for several purposes at the Arctic Data Centre: it aids metadata annotation, enriching and distribution. Through the defined relationships between concepts, it is possible to annotate and enrich metadata records facilitating searching for data in web portals and machine readable metadata catalogues. Through consistent translation to and from standard vocabularies, used by different communities, it enhances findability and interoperability of data, supporting the harvesting of external repositories as well as the distribution of metadata records. The content of the METNOVS are simple RDF files that can be easily extended to map to new vocabularies whenever needed, or to support new requirements from the (meta)data providers or users. The METNOVS content is openly available through its front end and can be integrated into software through SPARQL queries.

**Title:** Breaking Data Silos: An Oceanographic Dataset Interoperability Journey

**Presenter:** Chantelle Verhey, Yanique Campbell

**Affiliation:** Carleton University; Geomatics and Cartographic Research Centre (GCRC)

**Additional Authors:** Peter Pulsifer, Øystein Godøy, CCADI team

**Presenting Format:** In-person

**Abstract:** This project delivered a practical framework for enabling semantic interoperability and machine-actionable metadata in polar datasets by transforming NetCDF oceanographic data into JSON-LD using controlled vocabularies and established metadata standards. Using a WMO-compliant NetCDF file (representing buoy-based oceanographic data) as a test case, we implemented dataset crosswalking through ERDDAP services, mapping key variables to controlled vocabulary terms. The crosswalking process began with CSV-based mappings and was formalized into a domain-specific ontology. This allowed for structured transformations aligned with CF conventions, BODC vocabularies, and ISO metadata standards. Integration with KuzoDB facilitated the migration from spreadsheet mappings to a scalable, queryable linked data environment. ERDDAP was configured to support data discovery and access, while JSON-LD outputs enabled alignment with FAIR Data Object principles.

Collaboration with WMO, CPDC (fmrly: CCADI), and the GCRC team ensured that the mapping strategy adhered to international standards and addressed practical semantic issues. The result is a complete data-to-metadata transformation pipeline supporting metadata federation, use-level access, and long-term preservation via NetCDF, with alternate formats (CSV, JSON-LD) provided through transformation services. This work advances the third pillar of interoperability by operationalizing semantic alignment and cross-system data federation for polar and oceanographic research.



**Title:** May the data be with you: unlocking polar insights with large language models.

**Presenter:** Alice Cavaliere

**Affiliation:** Institute of Polar Sciences of the National Research Council of Italy (CNR-ISP)

**Additional Authors:** Angelo Lupi; Mauro Mazzola

**Presenting Format:** In-person

**Abstract:** This presentation introduces a generative search interface that integrates Large Language Models (LLMs) to transform how users access and explore polar data. The system integrates data from the Arctic and Antarctic data centers of the Institute of Polar Sciences of the National Research Council of Italy (CNR-ISP), leveraging metadata catalog and data components such as GeoNetwork and ERDDAP™. This integration enables intuitive, natural language, and multimodal interaction with complex polar datasets. The system supports three core capabilities to enhance information retrieval and dataset usability: (i) Natural Language Queries: Users can express information needs in everyday natural language without prior knowledge of the data structure or catalogs; (ii) Metadata Summarization: LLMs generate concise, readable summaries of metadata; (iii) Tabular Data Understanding: LLMs could be tasked with interpreting and reasoning over structured tabular data, enabling users to ask complex questions that span rows and columns.

By integrating retrieval-augmented generation (RAG) and model distillation—where knowledge from a larger language model is transferred to a smaller, more efficient one—and by eliminating reliance on external LLM APIs, the system reduces energy consumption and enhances overall sustainability. Together, these LLM-driven capabilities significantly broaden access to polar data for scientists, educators, policymakers, and the public. By simplifying dataset discovery, enabling intuitive exploration of time series data, and supporting context-aware interactions, the system advances our collective ability to monitor and respond to critical changes in polar environments. We acknowledge the CINECA award under the ISCRA initiative, for the availability of high-performance computing resources and support.

**Title:** Towards Place-Based Semantics for Polar Research: Uplifting the SCAR Gazetteer as a Foundation for Data Integration

**Presenter:** Brandon Whitehead

**Affiliation:** Bioeconomy Science Institute

**Presenting Format:** Online

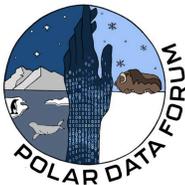
**Abstract:** Geographic context is essential to Antarctic science, yet many datasets remain hard to integrate due to inconsistent or underspecified place-based semantics. We propose to semantically enrich the SCAR Composite Gazetteer of Antarctica (CGA) to improve data discovery, integration, and synthesis in Antarctic science. The CGA is an authoritative, curated list of geographic features, widely used but underutilized in data infrastructure. By aligning it with standard ontologies we aim to transform it into a machine-readable, ontology-based knowledge graph. This semantic uplift will support automated reasoning and link datasets referencing places directly and indirectly, such as ecological records, glacial change, or station-based observations. The resulting semantic resource will improve data discovery, reproducibility, and interdisciplinary synthesis across Antarctic research domains.

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## Session: Data Management

**Title:** Physical sample management through the sample life cycle at BAS

**Presenter:** Mari Whitelaw



**Affiliation:** UK Polar Data Centre - British Antarctic Survey

**Additional Authors:** Petra ten Hoopen; Alice Fremand; Helen Peat

**Presenting Format:** In-person

**Abstract:** The British Antarctic Survey (BAS) is a multidisciplinary research institute whose physical sample collections reflect the diverse nature of the institute. Physical samples regularly collected and archived at BAS include plant specimens; geological specimens; peat, lake and marine sediment cores; ice cores, and a wide range of biological specimens.

The UK Polar Data Centre (UK PDC) is involved in the data management of physical samples through the whole sample lifecycle, from collection to publication. Integration of good data management practices has necessitated a shift in the working culture of all those involved in sample collection, from researchers to technicians. For these practices to succeed, scientists need to adapt their working practices, and supporting staff, such as technicians and laboratory managers, need to actively promote the new specimen metadata system that will, through increased discovery and reuse of samples, ultimately benefit scientific research. Key to success is working closely with stakeholders; seeking out and implementing their feedback in order to optimise the collection of metadata at the time of sample collection. To encourage adoption and minimise disruption, we have developed simple templates that align with existing collection workflows and allow easy integration into our domain specific databases. We are currently working to implement International Generic Sample Numbers (IGSN) across all sample types, mapping between domain-specific metadata standards and IGSN standard in order to allow better discoverability and long-term traceability of our samples.

**Title:** Cloud-based management of Ross Sea imagery to support machine learning applications

**Presenter:** Caroline Chin

**Affiliation:** National Institute of Water and Atmospheric Research (NIWA)

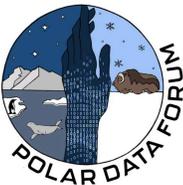
**Additional Authors:** Bryce Chen; Tilmann Steinmetz; Alan Tan; Jochen Schmidt

**Presenting Format:** In-person

**Abstract:** The Deep-Towed Imaging System (DTIS) is an underwater camera system developed by the National Institute of Water and Atmospheric Research (NIWA) in New Zealand. As one of NIWA's non-destructive sampling instruments, DTIS has contributed to the understanding and discovery of benthic communities across a large span of New Zealand's Exclusive Economic Zone and the Ross Sea, Antarctica. From 2008 to the present, DTIS has recorded high-resolution videos and still imagery during six Ross Sea expeditions traversing coastal waters, the continental shelf, and bathyal depths. To quantify and classify fauna, flora and substrate from DTIS video footage, the Ocean Floor Observation Protocol (OFOP) software (<https://www.emma-technologies.com>) is used both at sea and onshore, serving as a text-based data logging tool for ocean floor observations.

We discuss the challenges of historically managing DTIS video observation metadata derived from OFOP and following FAIR principles. Some of these challenges have since been addressed through the development of a marine imagery metadata platform using the cloud database service, Atlas MongoDB. Additionally, we demonstrate how other cloud providers like Amazon Web Services have been leveraged to manage video and still-imagery storage and enable linkages with OFOP metadata on Atlas MongoDB, as well as external annotation tools used for underwater image analysis such as BIIGLE 2.0 (<https://biigle.de>).

We also present the framework of our AI-integrated pipeline, where we apply an active learning workflow, using OFOP metadata and pre-trained object detection models to accelerate the development of models. Furthermore, we demonstrate the use of agentic AI, such as the Model Context Protocol (MCP), to explore OFOP metadata and enable complex queries and analytics. These AI-powered tools will help advance underwater image analysis and biodiversity pattern discovery, as well as help track



environmental changes in Antarctic marine ecosystems.

**Title:** Bedmap3: A Data Management Perspective

**Presenter:** Alice Fremand

**Affiliation:** UK Polar Data Centre - British Antarctic Survey

**Additional Authors:** Julien Bodart; Peter Fretwell; Hamish Pritchard

**Presenting Format:** In-person

**Abstract:** The SCAR Bedmap3 project delivers a new, high-resolution map of Antarctic ice thickness and bed topography, serving as a foundational dataset for the international glaciological and geophysical communities. Unlike its predecessors (Bedmap1 and Bedmap2), Bedmap3 embedded data management as a core component of the project, aligning with the FAIR principles—ensuring that all data are Findable, Accessible, Interoperable, and Reusable.

The project brought together over 80 international collaborators and integrated more than 82 million points, primarily derived from airborne radar surveys. These datasets were standardised using a dedicated data format and metadata schema specifically developed for Bedmap3. To support data quality assessment, statistical summaries were generated at a 500 m x 500 m resolution, allowing users to evaluate data density, consistency, and uncertainty at each grid point.

A dedicated data portal (<https://bedmap.scar.org>) was developed to support open access, data discovery, and transparency.

Importantly, the integration of data management was not only operationally effective but also widely recognized by the scientific community as a valuable contribution to the project's success. As a result, collaborators now actively seek guidance on data stewardship and are incorporating similar practices into their upcoming research initiatives. This cultural shift highlights the growing appreciation for embedded data expertise in large-scale scientific collaborations. As part of the presentation, we will present the Bedmap3 as a potential data management model and a scalable framework for future initiatives.

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## Session: Machine Learning /Artificial Intelligence

**Title:** Polar TEP Machine Learning Workspace

**Presenter:** David Arthurs

**Affiliation:** Polar View

**Additional Authors:** Týna Doležalová

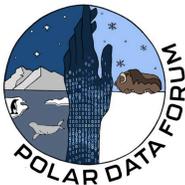
**Presenting Format:** In-person

**Abstract:** Given the large amount of EO data of high spatial resolution at high revisit frequency and across multiple sensors in the polar regions, ML techniques are needed to enable the automatic identification of complex patterns. Monitoring of the polar regions using ML is supported by the advanced computing infrastructure of Polar TEP that hosts training data, algorithms, and results, and provides machine learning computation resources.

The Polar TEP service offering addresses the need for an ML platform to serve the polar user communities. The Polar TEP ML service offering consists of three components:

- \* MLflow – With MLflow, users can track individual ML experiment runs to record and compare parameters and generated results. It also allows storing models in a central place with capabilities for versioning and annotating to capture the models' full lifecycle stage transitions, as well as sharing with internal and external users

- \* DVC – Functional complementarity to MLflow is provided through DVC to track and version potentially huge data sets and intermediate files together with code (and optionally ML models) using



common Git workflows.

\* Polar Dashboard – The ability to visualize and tell stories about ML results is provided by the Polar Dashboard. Here you can browse datasets and use interactive features, including maps, charts, and tables.

The service offering provides the following benefits:

- \* Easy collaboration with team members working on the same use case such as sharing of execution environments (conda environments).
- \* Versioning and annotating of any ML artifacts for proper lifecycle tracking.
- \* Sharing of any ML artifacts:
  - within a use case team
  - with interested external collaborators
- \* Tracking of individual ML experiment runs to record and compare parameters and generate results.
- \* Comparing ML experiment runs and finding the best model and parameter set.
- \* Serving and potentially selling trained ML models as algorithms (BYOA, marketplace).

**Title:** Reconstruction of Antarctic sea ice thickness from sparse satellite laser altimetry data via deep learning

**Presenter:** Yafei Nie

**Affiliation:** Southern Marine Science and Engineering Guangdong Laboratory (Zhuhai)

**Additional Authors:** Ziqi Ma; Qinghua Yang; Hao Luo

**Presenting Format:** In-person

**Abstract:** The persistent lack of spatially complete Antarctic sea ice thickness (SIT) data at sub-monthly resolution has fundamentally constrained the quantitative understanding of large-scale sea ice mass balance processes. In this study, a pan-Antarctic SIT dataset at 5-day and 12.5 km resolution was developed based on sparse Ice, Cloud and Land Elevation Satellite (ICESat; 2003–2009) and ICESat-2 (2018–2024) along-track laser altimetry SIT retrievals using a deep learning approach. The reconstructed SIT was quantitatively validated against independent upward-looking sonar (ULS) observations and showed higher accuracy than the other four satellite-derived and reanalyzed Antarctic SIT datasets. The temporal evolution of the reconstructed SIT was further validated by ULS and ICESat-2 observations. Consistent seasonal cycles and intra-seasonal tendencies across these datasets confirm the reconstruction's reliability. Beyond advancing the mechanistic understanding of Antarctic sea ice variability and climate linkages, this reconstruction dataset's near-real-time updating capability offers operational value for monitoring and forecasting the Antarctic sea ice state.

**Title:** Frozen Constraints, Fluid Uncertainty: A Physics-informed Probabilistic Machine Learning Method for the Antarctic Ice Sheet

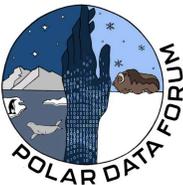
**Presenter:** Kim Bente

**Affiliation:** The University of Sydney

**Additional Authors:** Roman Marchant; Fabio Ramos

**Presenting Format:** In-person

**Abstract:** Fundamental physical laws, such as mass conservation, govern many geophysical processes, including ice sheet dynamics. Integrating such prior knowledge into models enhances physical consistency and predictive performance, particularly in data-sparse polar regions. We indirectly address Antarctic ice thickness interpolation by modelling the associated divergence-free ice flux vector fields under simplified flow assumptions. This is informed by dense satellite-derived InSAR ice velocity maps from NASA MEaSUREs and sparse thickness data from the Bedmap3 data collection. While existing



physics-informed ML models like PINNs may violate conservation laws, hard-constrained models such as Hamiltonian Neural Networks ensure physical consistency, yet none of these models are designed to quantify uncertainty. Nonetheless, uncertainty quantification is crucial when working with sparse and noisy measurements from various sources. To close this gap, we propose divergence-free Neural Gaussian Processes (dfNGPs), a class of hard-constrained Bayesian models that incorporates an expressive divergence-free Neural Network mean function into a divergence-free Gaussian Process framework. We demonstrate how dfNGPs produce realistic posteriors and strictly enforce mass conservation, while admitting spatially varying uncertainty, on both complex simulated interpolation tasks and real-world data from Antarctica's Byrd glacier. Bayesian models like our dfNGPs can generate ensembles of diverse, physically plausible ice thickness realisations as initialisations of ice sheet models. They can also inform efficient data acquisition strategies, making them practical, physically grounded, and data-efficient tools for geoscientific modelling and decision making.

**Title:** Legal and Ethical Considerations of Using AI in Polar Research

**Presenter:** Munish Madan

**Affiliation:** University of Calgary; Arctic Institute of North America

**Presenting Format:** Online

**Abstract:** Artificial intelligence (AI) offers polar scientists many new and exciting tools for data analysis, writing assistance and predictive modeling, that can speed and streamline research. However, while AI may generate valuable insights, scientists alone are responsible and accountable for generated results. Accordingly, before using AI to its fullest potential, scientists need to understand various legal guidelines and ethical considerations. For example, legal guidelines may include intellectual property laws, data protection regulations (e.g. GDPR in the EU) and other privacy legislation. Ethical considerations may include environmental responsibility, authorship attribution, human safety, cultural implications, unintentional bias and fairness. These issues may come into play using generative AI, computer vision techniques, pattern recognition algorithms, natural language processing frameworks and many other applications that may be relevant to polar research. Further scientists need to understand how new and emerging interconnected legislation from numerous jurisdictions may affect their research in the future. For instance, Canada's "artificial intelligence and data act" (AIDA), the European Union AI Act, the AI Assurance Framework in Australia and the American National Artificial Intelligence Initiative Act of 2020 may all place constraints on scientific research. An overview of these topics will be provided, specifically geared to the needs of polar science researchers.

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## Session: Polar Modelling and Spatial Data

**Title:** Seamap Antarctica: Advancing a Unified Understanding of the Antarctic Seafloor

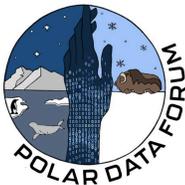
**Presenter:** Vanessa Lucieer

**Affiliation:** Institute for Marine and Antarctic Studies, University of Tasmania

**Additional Authors:** Emma Flukes; Jacquomo Monk; Nicole Hill; Jan Jansen; Emiliano Cimoli; Vonda Cummings.

**Presenting Format:** In-person

**Abstract:** Antarctic seafloor data collection is advancing rapidly, with growing international collaboration and new technologies enabling access to previously unmapped and understudied regions. Increasing volumes of bathymetric, benthic imagery, and ecological data are becoming available, offering unprecedented insights into seafloor environments. However, these data remain dispersed across institutions, formats, and disciplines, limiting their collective impact. As research momentum builds and



pressures from climate change and human activity continue to grow, the opportunity—and need—to bring these datasets together into a single, easily accessible and discoverable spatial platform has never been greater.

Seamap Antarctica is an Australian-led initiative designed to transform how we access, integrate, and understand Antarctic seafloor data. This project aims to unify seafloor habitat mapping by aggregating diverse Antarctic datasets—ranging from seabed geomorphology and bathymetry to ecological and imagery-based observations—into an accessible, standardised framework that could transform our ability to monitor and manage the Antarctic marine environment across overlapping jurisdictional boundaries governed by the Antarctic Treaty System and CCAMLR.

More than a mapping initiative, Seamap Antarctica provides a foundation for science-based decision-making, enabling marine spatial planning, habitat vulnerability assessments, and cross-jurisdictional conservation efforts. A key feature is the use of the Squidle+ platform to consolidate seafloor imagery, offering researchers, policymakers, and the public a unique, interactive view of Antarctic benthic ecosystems.

By fostering collaboration across international research efforts, Seamap Antarctica will support a shared understanding of seafloor conditions and contribute to a more coordinated global strategy for protecting the Southern Ocean's unique marine environments.

**Title:** Unifying Historical Antarctic Biogeographic Data using SCAR Gazetteer and a Discrete Global Grid System

**Presenter:** Brandon Whitehead

**Affiliation:** Bioeconomy Science Institute

**Additional Authors:** Charles Lee

**Presenting Format:** Online

**Abstract:** Projecting climate change impacts on Antarctic biodiversity requires spatially explicit ecological models, yet legacy data often lack geospatial consistency. While modern studies use coordinates, many older records rely on location names, complicating data integration. We developed a system to standardize biogeographic data from ~5,000 publications (1970s–present), accommodating varying spatial precision. The system combines a Discrete Global Grid System (DGGS) of hexagonal cells with the SCAR Composite Gazetteer of Antarctica (CGA) to assign observations to grid cells based on coordinates or interpreted named locations. Each data point is assigned to a grid cell based on its estimated spatial uncertainty, ensuring that even vague or broad references can be meaningfully included in downstream analyses. The framework supports scalable, multiresolution analysis—from regional to sub-centimeter—enabling integration of legacy and modern datasets. Outputs are probability-based occurrence maps suitable for ecological modeling and future biodiversity forecasting.

**Title:** Optimizing Metadata

**Presenter:** Jonathan Kool

**Affiliation:** Australian Antarctic Data Division

**Presenting Format:** In-person

**Abstract:** Although great strides have been made towards the Findable and Accessible components of FAIR data, Interoperability and Reusability remain relatively challenging due to the broad diversity of data structures, formats, and subjects, compounded by incompleteness and inconsistency in metadata. Although standardization offers a way of addressing this, the amount of person-hours required to review collections tends to be prohibitive in the face of available resources. With recent advances in the development of generative AI, there are new opportunities for using machine learning to review and standardize metadata in a way that supports broad human and machine-readability. The Australian



Antarctic Data Centre (ADC) together with the University of Tasmania has developed new open-source software that is able to work with data collections to automatically recognize dataset content (e.g. from tables and publications), and generate metadata accordingly, which can be reviewed and edited by the provider. This offers significant potential for reducing the data submission burden on researchers, while also improving metadata quality and data interoperability.

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## Session: Open Science

**Title:** EarthCODE

**Presenter:** David Arthurs

**Affiliation:** Polar View

**Additional Authors:** Stephan Meißl

**Presenting Format:** In-person

**Abstract:** ESA's EarthCODE is a dynamic Collaborative Open Development Environment created to transform Earth System Science by embedding FAIR and Open Science Principles into the scientific development process. By providing tools, expertise, and opportunities, EarthCODE enables science teams to seamlessly adopt open science practices as part of their workflows. EarthCODE integrates the Open Science Catalogue, making it effortless to discover novel research outcomes from ESA Science Clusters activities and beyond. With seamless access to commercial platform services and a wealth of community resources and tools, EarthCODE empowers scientists to collaborate, innovate, and adhere to open research practices, driving the next wave of discovery in Earth Science.

**Mission statement:** Our mission is to develop an open-source solution that empowers scientists to adopt FAIR and Open Science principles, whether conducting research on cloud environments accessible via the EarthCODE Portal or their own infrastructure. To maximise the discovery and reuse of FAIR scientific data, workflows, and documentation, we develop EarthCODE as a hub for research management, dissemination, community engagement, and learning.

**Vision statement:** To accelerate scientific discovery and support Earth Action by making Earth science data and methods FAIR, Open, and reproducible. Leveraging cutting-edge cloud computing technologies, AI, and open-source solutions, we empower collaboration and innovation for a sustainable future.

**Goals overview:** EarthCODE is designed to deliver a user-centric, advanced open science environment tailored to the needs of EO scientists. By focusing on usability and engagement, EarthCODE ensures researchers can efficiently conduct FAIR, reproducible, and sustainable Earth Science research within the ESRIN Science Hub and ESA Science Clusters.

**Title:** Data migration from conventional server into Open Data Access Protocol type: Amundsen-Science-ERDDAP

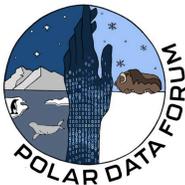
**Presenter:** Tahiana Ratsimbazafy

**Affiliation:** Amundsen Science

**Additional Authors:** Jessy Barrette ; Pascal Guillot ; Anne-Sophie Ste-Marie ; Alexandre Forest

**Presenting Format:** In-person

**Abstract:** Over the past two decades, scientific data has become increasingly accessible, supporting open science principles. The Open Data Access Protocol (OpenDAP) plays a pivotal role, enabling public and government institutions to manage and share data effectively. The Canadian Coast Guard Ship (CCGS) Amundsen has supported the scientific community by sharing oceanographic data from the Canadian



Arctic through its Annual Scientific Expeditions since 2003. Amundsen Science, a non-profit organisation, manages the scientific mandate of CCGS Amundsen, supporting researchers across disciplines and sectors.

This paper shares Amundsen Science's experiences in adopting OpenDAP as its primary data-sharing platform. Various data types with distinct structures are standardized according to international standards. Climate Forecast (CF) conventions are applied to mooring data, while CTD and MVP (Moving Vehicle Profiler) ocean data profiles, along with Thermosalinograph data are adapted to the British Oceanographic Data Centre (BODC) standard. Additional data, such as ROV (remote-operated vehicle) photographs and videos, are planned for future integration into official publications.

Amundsen Science collaborates with the Saint-Lawrence Global Observatory and Université Laval to make data discoverable within the Canadian Integrated Ocean Observing System (CIOOS). Through this collaboration, Amundsen Science has enhanced its autonomy in open data sharing by installing lightweight tools forming the CIOOS data ecosystem: 1) an ERDDAP™ server developed by the National Oceanic and Atmospheric Administration (NOAA) for publishing data from CCGS Amundsen instruments, 2) an open data catalogue (using CKAN) for user-friendly metadata searches, and 3) the CIOOS Data Explorer, integrating CCGS Amundsen data into the Canadian ocean data landscape.

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

**Presenter:** Shannon McAllister

**Affiliation:** Arctic Institute of North America, University of Calgary

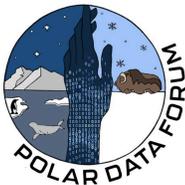
**Additional Authors:** William Manley; Halldór Jóhannsson; Arundeeep Singh; Anseok Joo; Jan Rene Larsen; and Members of the Polar Observing Assets Working Group

**Presenting Format:** In-person

**Abstract:** 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. At this time, it is difficult to strategically assess status, overlap, and gaps because most inventories of such “observing assets” are limited in scope. To help address this challenge, a new Registry of Polar Observing Networks (RoPON) has been released (<https://polarobservingregistry.org/>). This 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. RoPON also displays portals or initiatives that are not observing networks per se, but which compile and share structured information about observing activities and infrastructures. This resource was created by the Arctic Portal in collaboration with the SAON Polar Observing Assets Working Group (POAwg), which has a goal of making asset-level metadata more findable, accessible, interoperable, and reusable. Moving beyond a prototype, recent efforts include refinement of use cases and a network metadata model, a new frontend to meet user needs, and a new technology architecture with CMS, metrics, secure login, and a RoPON Dashboard for Network Representatives to add and edit network landing pages. The registry will be further improved, and feedback is appreciated. RoPON is designed to help: Co-locate and optimize limited resources; avoid duplicated effort; better inform local communities of activities nearby; guide network assessment & planning; clarify best practices for asset-level metadata sharing; and establish a basis for information exchange through harvesting, aggregation, & federated search.

**Title:** International Journal for Publishing Polar Data

**Presenter:** Masaki Kanao



**Additional Authors:** Akira Kadokura

**Affiliation:** National Institute of Polar Research / Research Organization of Information and Systems

**Presenting format:** In-person

**Abstract:** "The "Polar Data Journal" (ISSN 2432-6771; <https://pdr.repo.nii.ac.jp/>, PDJ) is a free-access, peer-reviewed online journal published by the National Institute of Polar Research (NIPR), Japan (launched in January 2017). It aims to publish original research data/dataset, furthering reuse of the high-quality data and benefit to polar sciences. So far in April 2025, over 60 papers have already been published online.

The PDJ covers a broad branch of research disciplines in polar regions, especially earth and life sciences. The Journal primarily publishes the data papers that provide detailed descriptions of research data/dataset (e.g. methods, data records, technical validation). The PDJ does not necessarily require new scientific findings, therefore the Journal also welcomes paper submissions describing valuable past data/dataset which has not been published yet.

To ensure the data quality, PDJ requires a peer-review process prior to the final publication. Before submitting manuscripts, the authors are required to deposit their data/dataset to the trustworthy data repository. DOIs are also given to both the paper article and related dataset simultaneously when the paper is accepted. Data authenticity is also guaranteed by publishing reports of all review processes, which will be published online with the paper manuscript.

On behalf of the editorial board, we are pleased to inform you that PDJ is open for submissions from all scientists involving polar research. The manuscript can be submitted through the Editorial System (EM) of the PDJ (<https://www.editorialmanager.com/pdj/default.aspx>). Detailed information on preparing paper submission are described in the Journal website (<https://pdr.repo.nii.ac.jp/>)."

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## Session: Data Platforms and Repositories

**Title:** Lessons learnt in establishing the South African National Antarctic Data Centre

**Presenter:** Anne Treasure

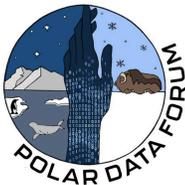
**Affiliation:** South African Polar Research Infrastructure (SAPRI)

**Additional Authors:** Leo Chiloane; Shaun Swanepoel; Belinda Nhesvure; Persephone Leigh Singh; Juliet Hermes

**Presenting Format:** In-person

**Abstract:** The establishment of a National Antarctic Data Centre (NADC) is a critical component in fulfilling a country's obligations under the Antarctic Treaty System and ensuring adherence to the Scientific Committee on Antarctic Research (SCAR) Data Policy. The development of the South African NADC marks a significant milestone in the country's commitment to responsible stewardship and open access to polar science data. This presentation shares key lessons learned from the process of developing the South African NADC as part of the recently established South African Polar Research Infrastructure (SAPRI).

We address the practical, technical, and strategic challenges and opportunities encountered, including stakeholder engagement, defining governance structures, capacity, infrastructure and systems aspects, and ensuring interoperability with international data systems. We also reflect on the importance of promoting a culture of data sharing, building user trust, supporting data literacy among Antarctic researchers, and aligning national policies with FAIR (Findable, Accessible, Interoperable, and Reusable) data principles.



By documenting South Africa's journey, we aim to inform and inspire other countries seeking to develop their own Antarctic data infrastructures, while reinforcing the value of equitable participation in the international polar research community. An important component of the SAPRI mission is coordination and collaboration with the international Antarctic community. This presentation therefore forms the basis for SCAR's Standing Committee on Antarctic Data Management's (SCADM) planned guidance and best practices for establishing a NADC using South Africa as a test case.

**Title:** POLARIN Data Hub: Advancing International Collaboration and Open Science through a Federated Polar Data Infrastructure

**Presenter:** Daan Kivits

**Affiliation:** SIOS Knowledge Centre

**Additional Authors:** Ilkka Matero; Heikki Lihavainen; Øystein Godøy; Lara Ferrighi; Alice Cavaliere; Giulio Verazzo; Chiara Ripa; Vito Vitale; Mariaclaudia Paolini; Antonio Novellino

**Presenting Format:** In-Person

**Abstract:** POLARIN is an international network of polar research infrastructures and services that comprises a wide array of high-quality research infrastructures (RIs), including research stations, vessels, icebreakers, observatories, and data repositories for ice and sediment cores. By offering access to these resources, POLARIN supports interdisciplinary research to address the complex scientific challenges of the Arctic and Antarctic.

The POLARIN Data Hub aims to make research data collected using the infrastructures that are part of the project openly accessible in a unified, semantically consistent manner and serves as the single access point for these data. The approach will be tested on selected relevant polar research data. The hub supports both interactive web-based discovery with AI-based querying functionality and machine interoperability through machine-readable interfaces, allowing for seamless integration into other data access portals, decision support systems, and Virtual Research Environments. The hub uses a distributed data approach, meaning that instead of being hosted in a central database, data is kept at the authoritative source and its metadata is harvested and pulled into a common metadata catalogue. This allows for streaming data directly from the source and simplifies the end-to-end (meta-)data traceability.

The presentation will showcase how the POLARIN Data Hub aims to bridge fragmented data ecosystems using an Open Science approach and how the POLARIN data policy makes polar research data more findable, accessible, interoperable, and reusable, to facilitate innovative pan-Arctic and Antarctic research. We will also highlight lessons learned from developing the SIOS Data Management System and Observation Facility Catalogue, and how these can be applied in the future development of federated polar data infrastructures such as the POLARIN Data Hub.

**Title:** The Spanish Polar Data Centre (CNDP): Supporting Open and FAIR data

**Presenter:** Marc Casas

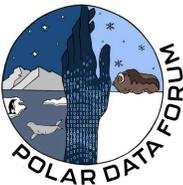
**Affiliation:** Spanish Polar Data Centre, CNDP (UTM-CSIC)

**Additional Authors:** Susana Diez; Guillermo Garriga; Alberto Hernández; Elsa Martínez; Xavier Rayo

**Presenting Format:** Online

**Abstract:** The National Polar Data Centre (CNDP), coordinated by the Marine Technology Unit of the Spanish Research Council (UTM-CSIC), plays a central role in supporting the Spanish polar research community. Operating under the Spanish Polar Committee's guidance, the CNDP provides a robust, interoperable infrastructure for managing, preserving, and sharing scientific data from polar environments.

At the core of the CNDP is its Access Portal, designed to simplify both discovery and contribution of datasets. It enables users to search, access, and document data through intuitive tools for



metadata exploration and submission. Moreover, the CNDP Metadata Catalogue supports metadata creation aligned with international standards such as ISO 19139 and the GCMD vocabulary. Researchers receive guidance to ensure records are well-documented and reusable, in line with FAIR data principles.

The CNDP promotes both long-term preservation and timely access to key datasets. While restricted data is archived for future release, many records like underway data are openly available from acquisition. All datasets have Digital Object Identifiers (DOIs), ensuring persistent citation and recognition of data as a formal research output.

Additionally, the CNDP offers real-time data monitoring and visualization tools. These include a live dashboard tracking renewable energy use at the Spanish Antarctic base Juan Carlos I, and a QFIELD-based system for safe routing and sample geolocation. During recent Antarctic fieldwork on avian influenza, the CNDP deployed a near real-time mapping tool to visualize detected cases and support data coordination.

Through synchronization with international catalogues like the Antarctic Metadata Directory and promotion of open, standardized access, the CNDP boosts the visibility and impact of Spanish polar science. Our infrastructure reflects a strong commitment to FAIR principles and open science, supporting collaborative research in extreme environments.

**Title:** Empowering Antarctic End-Users: A New Era Of Satellite Data Accessibility

**Presenter:** Kimberlee Baldry

**Affiliation:** Geoscience Australia

**Additional Authors:** Alix Post; Alex Bradley; Caitlin Adams; Alex Fraser; Anthony Doulgeris; Pat Wongpan; Gabriele Burke; Mariapina Vomero Johnathan Mettes; Norman Mueller

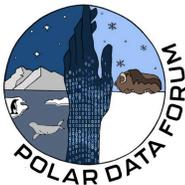
**Presenting Format:** In-person

**Abstract:** Digital Earth Antarctica is an exciting new platform being developed by Geoscience Australia, funded through an Australian government commitment to support Earth Observations into the future. The platform will provide easy access to analysis ready, continental-scale satellite data for Antarctica and its sea ice. End-users currently require a high level of technical skill to apply satellite imagery over Antarctica due to insufficient data quality from global providers. To make data more accessible we are lowering the technical skill required of end-users by implementing open data cube technology and improving data quality with processing techniques that are tailored to Antarctic conditions. Our initial work with the USGS/NASA's Landsat and ESA's Sentinel 1/2 satellites will unlock decades-long radar and optical time-series datasets and empower environmental managers, researchers and policy makers to maximise data potential.

This presentation will introduce the Polar Data community to Digital Earth Antarctica and how it empowers end-users within the Antarctic data ecosystem; illustrated using our newly released Sentinel-1 synthetic aperture radar (SAR) data products. Sentinel-1 imagery is important in the Antarctic context due to radar's ability to penetrate cloud and polar darkness, enabling year-round monitoring of the Antarctic ice sheet and surrounding areas of sea ice. However, global providers do not currently produce analysis ready radar data for Antarctica within existing datasets, likely due to the complexity of ice motion and the heavy reliance on an accurate DEM. To deliver an analysis-ready product tailored to Antarctica, we have worked with end-users, international experts, global data providers and researchers to ensure our data is high quality and fit-for-purpose. With this product, the program has begun to empower end-users to map the distribution of stationary sea ice ('fast ice'), icebergs and melt ponds around the Antarctic continent.

**Title:** TaiPI Data Repository: An Asia-based, Community-driven Platform for Open Polar Research

**Presenter:** Whyjay Zheng



**Affiliation:** Taiwan Polar Institute & Center for Space and Remote Sensing Research, National Central University, Taiwan

**Additional Authors:** Ilham Adi Panuntun; Chuen-Fa Ni

**Presenting Format:** In-person

**Abstract:** The Taiwan Polar Institute (TaiPI) was launched in 2023 with a mission to contribute to the global effort in understanding and mitigating the impacts of climate change. As such, TaiPI has released its first public service titled “TaiPI Data Repository” (TaiPI Data) as a platform to host and publish various data for polar research, including satellite observations, field data, and modeling results. As a community-driven site, TaiPI Data accepts user submissions and works with data authors to ensure the principles of findability, accessibility, interoperability, and reusability (FAIR). TaiPI Data is designed in accordance with the FAIR (Findable, Accessible, Interoperable, and Reusable) guidelines and practices, including the Digital Object Identifier (DOI) service, metadata assessment, and API-based access to data for programmatic readability. To facilitate data exploration, users can also utilize the interactive map service to navigate to each dataset and manually subset the data using intuitive, GUI-based spatial queries. For data analysis in the cloud, we introduce TaiPIHub, a browser-based virtual environment built with JupyterHub as one of TaiPI Data’s online services. TaiPIHub offers processing kernels in various languages, such as Python, R, and Julia, and is readily customizable when necessary. We expect that the TaiPI data repository will lower the threshold for data access and accelerate knowledge exchange in polar science. We are dedicated to expanding the repository with more datasets and integrating more tools for data visualization and analysis in the future.

**Title:** Archiving your Antarctic meteorological data with the AMRDC Data Repository

**Presenter:** Matthew G. Noojin

**Affiliation:** Antarctic Meteorological Research and Data Center

**Presenting Format:** Online

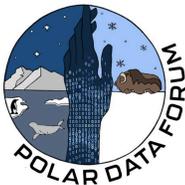
**Abstract:** Disciplinary scientific data archives play an essential role in facilitating data storage, open access, and the research publication process. While the benefits of community-led archives are widely understood, initiating the process of submitting your data as an unaffiliated researcher might seem daunting. The Antarctic Meteorological Research and Data Center was established to directly assist researchers in ensuring the long-term viability of their data. The AMRDC Data Repository contains over 5,000 datasets with digital object identifiers and robust metadata. The repository also indexes external datasets to encourage international collaboration and data sharing. Now in its fourth year of operation, the repository serves thousands of users per month, and is now the US National Science Foundation’s officially recommended disciplinary repository for Antarctic meteorology. The AMRDC welcomes a wide range of data types and formats from individuals and groups across the Antarctic research community. This presentation will provide a user-friendly introduction to submitting your Antarctic meteorological research dataset to the AMRDC Data Repository with examples from our growing catalog.

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### Session: International Collaboration

**Title:** Where Have We Been and Where Are We Going? a systematic review and synthesis of polar data literature

**Presenter:** Peter Pulsifer



**Affiliation:** Carleton University; Geomatics and Cartographic Research Centre (GCRC)

**Additional Authors:** Chantelle Verhey

**Presenting Format:** In-person

**Abstract:** For at least seventy years the polar data community has taken a leadership role in global data management and stewardship. The International Geophysical Year of 1957-58 ultimately resulted in the establishment of the World Data Center program, now the World Data System. As digital data collection, management and analysis evolved, new polar data centres were established. With the new possibilities for data sharing afforded by the advent of the World Wide Web and mainstream connection to the Internet in the nineteen nineties, polar data coordinating bodies emerged. These bodies headed major advancements in coordinated data management, interoperability and recognition of Indigenous data as part of the Fourth International Polar Year 2007-09 (IPY). As the polar data community prepares for the Fifth IPY (2032-33), this paper provides the results of a systematic review of gray and peer reviewed literature from the 1950s to present. Key milestones, themes, and patterns are presented and discussed., framed by the concept of the Polar Data Ecosystem. The presentation concludes with recommendations for key priorities and activities leading into the Fifth IPY.

**Title:** International Collaboration in Polar Data: Building an Inclusive Archival Network for the Polar Humanities

**Presenter:** Ria Oliver

**Affiliation:** Antarctic Legacy of SA - Stellenbosch University

**Presenting Format:** In-person

**Abstract:** In the polar environment, fostering international cooperation in sharing and management is critical. A diverse group of researchers, archivists, and policy communities to address the need for an accessible and inclusive platform dedicated to polar humanities convened in March '25. This collaborative effort underscores the importance of bridging disciplines, nations, and institutions to preserve polar knowledge for the future.

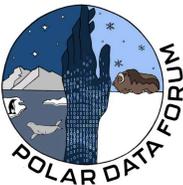
Participants emphasized that effective international collaboration must rest on shared standards and mutual respect for linguistic, cultural, and disciplinary diversity. The envisioned platform will serve as both a data hub and a collaborative workspace, integrating collections, museum networks, and libraries while ensuring equity of access. Key challenges addressed included language accessibility, legal and ethical frameworks, interoperability, and sustainability. Specific recommendations included standardization of terminology, creation of a shared glossary, contributor metadata protocols, and the incorporation of Indigenous perspectives.

A periodic assessment model and alignment with global initiatives, such as the IPY and SCAR's Open Science Conference in 2026, were proposed to ensure accountability and relevance. A roadmap includes: Establishing an Action Group to guide development; Creating a communication plan; Drafting funding proposals; and Proposing initial online training workshops and manuals. The platform will feature metadata search functions, analytics and usage statistics, accessibility features for disabled users, and integrated social media outreach to broaden participation.

Endorsed by SCAR, SCADM, and SCHASS, this initiative represents a foundational step toward a collaborative, inclusive, and sustainable future for polar humanities data management. Through continued dialogue and collective action, the Polar Archival Network aims to set a standard for global cooperation in preserving and advancing polar humanities.

**Title:** EU-PolarNet2 White Paper with 80 recommendations for strengthening international collaborative Polar observations

**Presenter:** Gaël Lymer



**Affiliation:** Royal Belgian Institute of Natural Sciences

**Additional Authors:** Serge SCORY; the EU-PolarNet2 White Paper team

**Presenting Format:** Online

**Abstract:** Global climate change is manifesting with alarming speed and severity, but nowhere are these changes more pronounced than in the polar regions.

Yet polar observations are currently sparse, with observing networks fragmented and lacking large-scale coordination. Identified gaps in current observation strategies open prospects for improvement in climate system understanding, funding strategies, prioritisation of observation, and in polar data management and sharing.

This talk will introduce the EU-PolarNet2 (funded by the EU-H2020) White Paper with 80 actionable policy-level recommendations, delivered to the European Commission in March 2024.

The integration of existing initiatives from each pole is designed to align with societal needs while ensuring a cooperative approach to polar observations. The provided recommendations, tailored primarily for decision-makers, but also relevant for the scientific polar community, have been formulated through extensive workshops, meetings, and consultations involving a diverse range of experts, stakeholders and rights holders within the polar communities.

Each 'pillar' identified represents an area of natural common interest between the Arctic and the Antarctic. Actionable recommendations formulated in each pillar are presented, with some recommendations specifically formulated regarding the prioritisation, acquisition, standardisation, management, and sharing of data supporting polar science.

The EU-PolarNet2 White Paper (<https://doi.org/10.5281/zenodo.10929817>), alongside a summary of the White Paper published under the form of a Policy Brief (<https://doi.org/10.5281/zenodo.13453254>), are openly accessible online and constitute a comprehensive guide for advancing international collaboration and efforts in polar observation.

**Title:** Expanding spatial gap analyses across polar domains: integrating data streams to address knowledge gaps

**Presenter:** Efrén López-Blanco

**Affiliation:** Department of Ecoscience and Arctic Research Centre, Aarhus University, Roskilde, Denmark & ; Department of Environment and Minerals, Greenland Institute of Natural Resources, Nuuk, Greenland

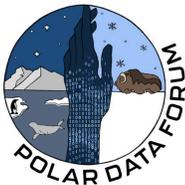
**Additional Authors:** Elmer Topp-Jørgensen; Jonas Koefoed Rømer

**Presenting Format:** In-person

**Abstract:** Polar regions are among the most challenging environments for ecosystem monitoring, with critical gaps in spatial data coverage limiting our understanding of rapid change. As part of the EU HORIZON POLARIN project, we are expanding spatial gap analyses to both Arctic and Antarctic domains and a broader suite of ecosystem variables, including marine as well as terrestrial systems. POLARIN is structured around six core natural science themes: Carbon Balance and Permafrost, Polar Ecosystems and Biodiversity, Sea-Ice and Polar Oceans, Sea Level and Glacier Stability, Atmosphere Dynamics, and (Paleo)climate Processes.

Our approach uniquely combines in-situ observations, remote sensing products, and Earth System Model outputs to systematically identify where observational gaps persist and where research infrastructure can have the greatest impact. By directly comparing in-situ sites with remote and modelled data for variables such as above-ground biomass, soil organic carbon, and emerging marine indicators like ocean color, we reveal underrepresented regions and value ranges across polar domains.

A key innovation is linking our gap analysis to a dedicated Work Package that informs upcoming Transnational Access calls, prioritizing regions and variables with high uncertainties. This enables researchers to gather new data where it is most needed, directly addressing knowledge and data gaps



identified in our analyses.

Our findings demonstrate the power of harmonizing in-situ, remote sensing, and modelling data to guide targeted observations and optimize infrastructure use. We particularly seek to strengthen collaborations with Antarctic research initiatives and apply our methods to understudied regions, enhancing data coverage across both poles. We invite collaboration to expand variable coverage and enhance open data integration, directly supporting the goals of Polar Data Forum VI and the broader polar research community.

**Title:** The Evolution of the Polar Data Ecosystem – Lessons learned from and since the last IPY for the next IPY

**Presenter:** Mark Parsons

**Affiliation:** CODATA

**Additional Authors:** Matt Jones; Peter Pulsifer; Øystein Godøy

**Presenting Format:** In-person

**Abstract:** The IPY 2007-8 Data Policy was a forward looking and influential document promoting ethically open data and more specific requirements ranging from data citation to respectful use of Indigenous knowledge. Moreover, IPY 2007-8 led to more polar data repositories, the formation of the Arctic Data Committee, greatly increased collaboration around data, and a general realization that data flow through a complex ecosystem involving players well beyond researchers and repositories. These developments have echoes beyond the polar regions with initiatives such as the FAIR and CARE principles, establishment of international data collaboratives such as the Research Data Alliance, and the broad promotion of Open Science at all levels.

IPY 2007-8 marked a step change in polar data management and sharing, and it had a global influence, but it was not an unqualified success. Indeed, much of the data collected during IPY 2007-8 are still not broadly available. This presentation will review the successes and failures of IPY data management and, more importantly, how data systems and cultures have evolved over the last 20 years. Polar data are now much more open, discoverable, and accessible. Rapid advances in technology, standardization, and cooperation have made data more useful and usable despite increasing complexity. Nonetheless fundamental challenges remain in data preservation and stewardship and especially in making data discoverable, interoperable, and genuinely useful across different disciplines and ways of knowing. IPY 2032-3 should mark another major advance in polar understanding through greatly improved data stewardship, sharing, and use, provided preparations start now.

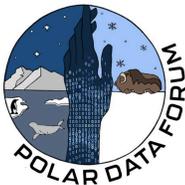
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## Posters

**Poster Title:** Digitisation of Cultural Heritage: The Case of the Antarctic Legacy of South Africa (ALSA)

**Authors:** Dana Jellin

**Affiliation:** Antarctic Legacy of SA- Stellenbosch University



**Abstract:** This poster presentation draws from a Master's dissertation that explored the digitisation approaches and challenges of the Antarctic Legacy of South Africa (ALSA), focusing on how tools and metadata practices can support cultural heritage preservation and access within the polar data ecosystem. ALSA plays a key role in preserving and providing access to South Africa's Antarctic involvement through a dedicated digital archive. Guided by the Theory of Constraints and rooted in a qualitative, interpretive case study approach, this research aimed to answer key questions: Why is ALSA digitising cultural heritage materials? What digitisation approaches does ALSA use? What challenges are encountered, and how might they be addressed?

Data were collected through thematic analysis of ten ALSA documents and interviews with six individuals involved in ALSA's operations. Findings highlight ALSA's systematic yet evolving digitisation practices, revealing challenges related to workflow capacity, metadata consistency, and long-term sustainability. Since completing the dissertation, ongoing work at ALSA has begun to engage more directly with vocabulary-related issues, particularly through the addition of subject keywords and descriptive tags for digital archive items. This has underscored the need for a standardized vocabulary framework to improve metadata quality, interoperability, discoverability, and alignment with other polar data initiatives.

This presentation will discuss the importance of adopting controlled vocabularies and ontologies to support metadata standardization and semantic interoperability in polar heritage archives. Recommendations include developing a formal digitisation policy, adopting shared vocabularies aligned with polar and heritage data standards, and exploring user interaction with ALSA's digital archive. The ALSA case offers insights for institutions aiming to enhance data accessibility and reusability through semantic technologies.

**Poster Title:** SPANISH ANTARCTIC STATION TIME SERIES

**Authors:** Alberto Hernández, Marc Casas, Susana Diez, Guillermo Garriga, Elsa Martínez, Xavier Rayo, Juan Luis Ruiz

**Affiliation:** Spanish Polar Data Centre, CNDP (UTM-CSIC)

**Abstract:** This infrastructure enables the continuous flow of scientific and technical data generated at the Spanish Antarctic Station "Juan Carlos I" (BAE JCI) to the headquarters of the Marine Technology Unit of the Spanish National Research Council (UTM-CSIC) in Barcelona. The system supports the generation, transmission, processing, storage, and visualization of near-real-time data throughout the year, even during the Antarctic winter when the station is unstaffed. A network of scientific and technical instrumentation continues to operate autonomously thanks to a renewable energy-based power system, consisting of solar panels and wind turbines, which ensures a power supply. The instrumentation remains connected to a dedicated winter LAN and linked to a low-bandwidth satellite communication system based on INMARSAT technology. The data is locally stored by the ADELIA server, which acts as the central collection node at BAE JCI. The CNDP server at UTM-CSIC periodically connects via satellite to retrieve this data.

This process is fully automated and carried out using a series of bash scripts that ensure the integrity and continuity of the time series. Among these, syncJCI and syncDay are responsible for performing hourly synchronizations (once every hour) to maintain near-real-time data availability, and syncSADO executes a full daily synchronization as a backup in case of connection failures. Once the data is retrieved from the Station the processCSV script processes it, applying a standard format and



structured storage in the /serie directory. The readDatagram script extracts the last received data and makes it available in getLast, simulating real time. PHP web services, getSerie and getDays, have been developed to serve as an interface between the data repository and the web-based visualization applications. The entire data access and visualization system is integrated into an open-access web platform, publicly available at: <http://cndp.utm.csic.es/hub>.

**Poster Title:** Subsurface Stratigraphy and Basal Conditions Between Dalk and Polararboken Glaciers: A Ground-Penetrating Radar Study in East Antarctica

**Authors:** Deepak Yuvraj Gajbhiye, Pradeep Kumar; Surendra Jat; Mukut Singha Konwar; Abhishek Verma; Vikash Chandra

**Affiliation:** Geological Survey of India

**Abstract:** Over the past few years, concerns about the stability of East Antarctic glaciers have grown, particularly in areas where bedrock is shallow and surface conditions are highly variable. This study emerged from field-based efforts to understand how ice behaves over rugged terrain between the Dalk and Polararboken Glaciers in the Larsemann Hills. The goal was to get a clearer picture of subsurface layering and identify zones where ice may be thinning or melting at the base.

Using sled-mounted ground-penetrating radar (GPR) equipment, we surveyed more than 27 km of glacier surface. Antennas of varying frequencies—25 to 400 MHz—were used to image both the deep ice and upper firn layers. The thickest ice observed was around 125 meters. In areas where the bed was deeper, internal layering looked clear and well-bedded. But over shallow rocky ground, those layers became faint or broken, hinting at disturbance in the ice structure.

To estimate depth, we used existing firn density data and matched it with a velocity model. Additional CMP (Common Midpoint) tests gave an average wave velocity near 0.18 m/ns. One of the most notable findings was around WP146–147 and near the SN1 and SN13 stake sites, where reflectors were especially strong and layered structures were noticeably distorted. This likely points to some meltwater presence at the ice-bed interface.

Overall, the results point to a close link between bedrock shape and the way internal ice layers are formed or deformed. These findings will support further work that connects GPR data with GPS measurements and seismic imaging, especially as we keep tracking glacier changes in this part of East Antarctica.

**Poster Title:** Southern Ocean Phytoplankton under Changing Future Climate Scenarios

**Authors:** Lillina Ruiters, Thomas Ryan-Keogh; Sandy Thomalla

**Affiliation:** Southern Ocean Carbon-Climate Observatory & University of Cape Town

**Abstract:** The Southern Ocean is a critical component of the global carbon cycle and climate regulation, absorbing significant amounts of atmospheric CO<sub>2</sub> and excess heat. However, future climate change scenarios predict substantial alterations in oceanic conditions, potentially impacting phytoplankton physiology and biogeochemical processes. This research aims to investigate the impacts of varying environmental parameters on phytoplankton in the Southern Ocean under present and predicted future conditions. The study will focus on the effects of temperature, light and nutrient availability on phytoplankton physiology, primary production, and nutrient uptake through multiparameter experiments. Data will be collected from various biogeochemical regimes, including different frontal zones and areas upstream/downstream of subantarctic islands, during several research voyages. These multi-stressor experiments will be conducted under controlled conditions, reflecting potential future environmental scenarios, with parameters such as temperature, light intensity and nutrient supply being manipulated. Physiological rates, including primary production and nutrient uptake, will be measured to understand the potential production capacity of phytoplankton under future climate scenarios. This research will combine



these findings with the NEMO-PISCES-BYONIC model to improve model parameterization and assess potential future responses of the Southern Ocean ecosystem. The outcomes will provide valuable insights into the future state of the Southern Ocean and its role in the global carbon cycle, informing policy and management strategies to protect and sustain ocean health.

**Poster Title:** Fostering International Collaboration to Advance Stakeholder-Driven Design of SMART Subsea Telecommunications Infrastructure

**Authors:** Pamela Fletcher, Kathryn Costa

**Affiliation:** Global Broadband Solutions

**Abstract:** Stakeholder engagement is a critical component for designing subsea telecommunications infrastructure with Scientific Monitoring And Reliable Telecommunications (SMART) elements, that is, a science-enabled telecommunications cable. Global Broadband Solutions, LLC (GBS) has been a leader in designing, installing, and maintaining submarine fiber optic cable systems since 1998. In 2022, GBS led the development of a desktop study for a submarine fiber optic cable to Antarctica. The proposed SMART subsea cable concept and architecture uses results from stakeholder input including, but not limited to: Antarctic Subsea Cable Workshop: High-speed Connectivity Needs to Advance US Antarctic Science, science webinars, etc. In 2023, GBS participated in the Polar Data Forum to listen and learn from participants and present Gathering Stakeholder Input to Inform Science-enabling Subsea Telecommunications Infrastructure. In 2024, a science webinar about the proposed SMART cable and Request For Information was conducted. In 2025, GBS continues to broaden stakeholder participation, listen, learn, analyze and share. GBS uses publicly available reports and assessments gathered from diverse scientific perspectives to illustrate evolving data needs across disciplines such as oceanography, ecology, climate science, and geophysics. In this way, GBS (industry) integrates science community input to guide infrastructure planning incorporating the most impactful sensor placement, data transmission strategies, etc. This collaborative process supports the development of resilient, interoperable subsea networks that enable near-real-time environmental monitoring and rapid data sharing among international research communities. GBS seeks to foster open communication and align infrastructure design with user priorities. Collaborations with the Forum/others contribute to building robust, accessible polar data systems crucial to overcoming complex challenges in rapidly changing polar environments.