



The Canadian Consortium for Arctic Data Interoperability: An Emerging Polar Information Network

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Abstract

Established in 2015, the Canadian Consortium for Arctic Data Interoperability (CCADI) is an emerging initiative to develop an integrated Canadian arctic data management system that will facilitate information discovery, establish metadata and data sharing standards, enable interoperability among existing data infrastructures, and that will be accessible to a broad audience of users.

Key to the CCADI vision are: standards and mechanisms for metadata interoperability and semantic interoperability; a distributed data exchange platform; streamlined data services with common entry, access, search, match, analysis, visualization and output tools; an intellectual property and sensitive data service; and data stewardship capacity. This will be a particularly challenging set of tasks given that the data planned for inclusion is multidisciplinary, in multiple types that range from sensor data to material artifacts, and, in some cases, confidential.

Current members of the consortium include the University of Calgary (Arctic Institute of North America, GeoSensor Web Lab, Innovis); Carleton University (Geomatics and Cartographic Research Centre); Université Laval (Centre d'études Nordiques, Amundsen Science); University of Manitoba (Centre for Earth Observation Science); University of Ottawa (Faculty of Law); University of Waterloo (Canadian Cryospheric Information Network, Polar Data Catalogue); Inuit Tapiriit Kanatami; Inuvialuit Regional Corporation; Polar Knowledge Canada; Natural Resources Canada; Cybera Inc., SensorUp Inc., and Polar View.

This talk will provide an overview of the CCADI, current progress toward its vision, and a specific focus on the Arctic Science and Technology Information System (ASTIS) as the main source of bibliographic data within the consortium.

The CCADI and Current Membership

Established in 2015, the Canadian Consortium for Arctic Data Interoperability (CCADI) is an emerging initiative that aims to advance the collaboration of Canadian Arctic data centres through the development of a cohesive Canadian arctic data management system that facilitates information discovery, establishes metadata and data sharing standards, enables interoperability among existing data infrastructures including Inuit Knowledge, and is accessible to a broad range of users¹.

Current partners include the Arctic Institute of North America, GeoSensorWeb Lab, and InnoVis Lab at the University of Calgary; the Geomatics and Cartographic Research Centre at Carleton University; the Centre for Earth Observation Science at the University of Manitoba; Centre d'études Nordiques and Amundsen Science at Université Laval; Polar Data Catalogue and the Canadian Cryospheric Information Network at the University of Waterloo; the Faculty of Law at University of Ottawa; Inuit Tapiriit Kanatami; the Inuvialuit Regional Corporation; Polar Knowledge Canada; Natural Resources Canada (NRCan); Polar View; Cybera Inc.; and SensorUp Inc.

Many of these partner organizations have their own individual Arctic or Polar data management system. Between them, these systems contain a diverse range of data that includes both qualitative and quantitative data, and a variety of metadata and raw data from different disciplines.

CCADI Governance

At present, the CCADI's governance is led out of the University of Calgary with Dr. Maribeth Murray acting as Chair in her role as Principle Investigator for the consortium's funding applications. Decisions are made in regular meetings by group consensus. However, as noted in *Figure 1*, plans are in place for a more robust governance structure that include an external advisory board, consultation with the broader international polar data community, and various partners tasked with leading specific objectives².

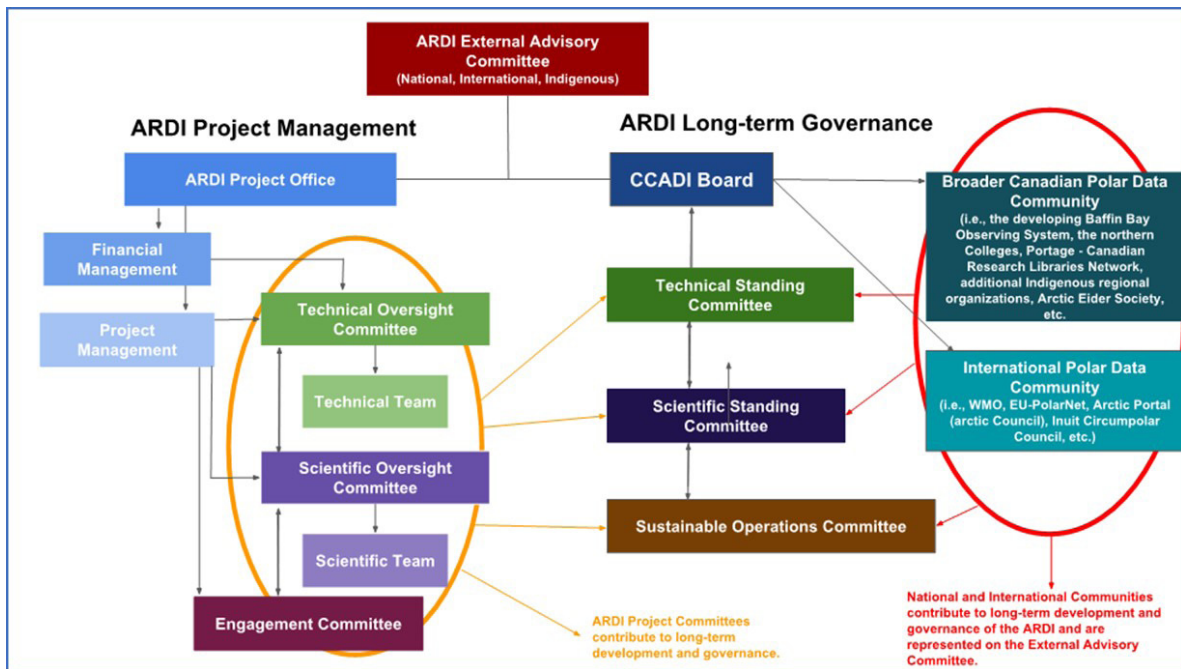


Figure 1. Arctic Research Data Infrastructure (ARDI) Project Management and CCADI/ARDI Long-term Governance Model. (Diagram courtesy of Maribeth Murray).

CCADI Objectives

Many groups, within Canada and internationally, generate arctic data, each with different needs and approaches to collection, analysis, access, and sharing^{3, 4}. This arctic data is costly to collect, difficult to replicate, and Indigenous-specific data may be proprietary or sensitive, requiring special considerations for access and availability⁵. Although significant investment has been made to support data collection within Canada, much of it still remains disconnected, disassociated, and difficult for users to discover, with metadata held in one database, primary data in another, and reports and publications in yet another. The dissociation of this related information slows the progress of research and knowledge transfer. Further, very little of this information is communicated back to the originating region in a usable form, making evidence-based decision difficult for Inuit and other northern Indigenous organizations⁶. This, combined with the impact of a changing Arctic climate, presents a data stewardship issue of global importance^{7, 8, 9}.

The CCADI is developing an Arctic Research Data Infrastructure (ARDI) that will facilitate the discovery of information across numerous data types, both qualitative and quantitative; enable interoperability among existing arctic data infrastructures, both Canadian and international; establish metadata and data sharing standards for Canadian arctic data that will facilitate international data sharing; and that is accessible to a broad audience of users².

Key to these objectives are:

- Standards and mechanisms for metadata interoperability, semantic interoperability and implementation of these;
- distributed data exchange platform for contributors, users and repositories;
- streamlined data services with common entry, access, search, match, analysis, visualization & output tools;

- intellectual property and sensitive data service, specific to the inclusion of Inuit and other Arctic Indigenous perspectives;
- Data stewardship capacity¹.

Proposed CCADI Architecture and Deployment

The Arctic Research Data Infrastructure is being constructed using international open standards. The consortium will develop and enhance arctic profiles of these standards to enable interoperability among its partners' nodes and, over the longer term, with other national and international partners. At a high level, this ARDI will contain five components²:

1. Data as a Service (DaaS): On-demand data sharing through discovery, access, and transportation.
2. Information as a Service (InaaS): Ability to provide standardized and secure methods to create, manage, exchange, and extract information from data in the right format at the right time.
3. Software as a Service (SaaS): Delivery and management of applications and tools by the platform or its users that are used remotely on the platform. Provides users with the capability to deploy user-created or acquired applications.
4. Infrastructure as a Service (IaaS): The provision of computing resources, complemented by storage and networking capabilities, as shared resources, scalable on-demand, and cost efficient.
5. Community as a Service (CaaS): Collaborative tools to publish, share and discuss results, information, data and software/code on the platform. Social networking makes a new level of online collaboration among communities of practice possible.

At a more practical level, the ARDI will be developed through seven work packages that will cover governance, foundational protocols, data management, the creation of: 1) a data analysis platform, 2) a data mediation platform and 3) user interfaces and visualization tools². The ARDI will also build on existing national and international research data infrastructure, using at its core, a Canadian instance of the Polar Thematic Exploitation Platform or Polar TEP (polar.tep.io), developed by CCADI partner, Polar View.

Ethically Open Data and Inuit Knowledge Objectives

CCADI members, including Inuit Tapiriit Kanatami and Inuvialuit Regional Corporation, a rights-based land claim organization, work closely with Inuit communities and northern peoples to ensure that Inuit Knowledge is appropriately represented; that Inuit are involved in the design and development of cyber-infrastructure involving their data and that they have stewardship over its distribution; and that Inuit Knowledge and western science can be explored for synergies and areas of interoperability. In support of this work, the CCADI follows the International Arctic Science Committee's precepts for "ethically open data" as outlined in their Statement of Principles and Practices for Arctic Data Management¹⁰:

Data are made available fully, freely, and openly with minimal delay. The only exceptions to this requirement of full, free, and open access are:

- where human subjects are involved, confidentiality shall be protected as appropriate and guided by the principles of informed consent;
- where local and traditional knowledge is concerned, rights of the knowledge holders shall not be compromised;
- where data release may cause harm, specific aspects of the data may need to be kept protected (for example, locations of nests of endangered birds or locations of sacred sites).

Additionally, the CCADI partnership will be holding a series of workshops that will explore the following objectives, identified as priorities by our Inuit members:

- Achieve better understanding of opportunities for and barriers to ICT (information and communication technology) use by Inuit and others;
- Achieve better understanding of how existing Arctic data infrastructure is used, and how co-design can transform it to support Inuit, academic, and other needs;
- Establish a pathway to resolving inequities in information access to by identifying best practices for ICT development that meet Inuit needs and facilitate use;
- Develop an ethical framework for information sharing that respects Inuit rights, protects sensitive data, and advances integration of social/natural science data with Inuit Knowledge (IK).

These workshops will be hosted and mediated by Inuit organizational members of the CCADI with other partners participating in areas for which they have appropriate expertise or experience.

The CCADI and the Arctic Institute of North America

The Arctic Institute of North America (AINA) is, as previously noted, a foundational member of the CCADI initiative and is also a long-term member of the Polar Libraries Colloquy. AINA's Arctic Science and Technology Information System (ASTIS, www.aina.ualgary.ca/astis) is one of the few services in CCADI that is primarily bibliographic, making it an interesting outlier in the proposed ARDI platform. For ASTIS to have full interoperability with this platform, the system records will need to be transferred to an internationally standardized bibliographic format and the system will also have to switch over to CCADI's controlled vocabulary.

In addition to these changes, ASTIS will also be receiving upgrades that will allow it to include art, artefacts, and audio-visual material, in addition to its bibliographic records; new features that will permit users to search for items more easily and store or export their searches as desired; the ability for AINA personnel to develop virtual exhibits from disparate material in the database; a designated area for K-12 educators and students; and a change in name that will more accurately reflect the updated contents of the database which highlight social science and cultural materials, as well as science and technology.

AINA's ArcticConnect platform (www.arcticconnect.org) will also be connected to the ARDI. ArcticConnect is already compliant with Open Geospatial Consortium standards¹¹, but it will be updated to have better connectivity with ASTIS records and to connect with selected records of CCADI partner organizations. It will also be updated to include live sensor data. To date, it has only included archival sensor material.

Conclusion

The Canadian Consortium for Arctic Data Interoperability, or CCADI, is a significant conglomerate of Canada's best arctic researchers from five academic institutions, Inuit research organizations, federal agencies, and the non-profit sector. These partners are already key contributors to the international Arctic Data Committee (supported by the International Arctic Science Committee and Sustaining Arctic Observing Networks), the International Study of Arctic Change and the Arctic Observing Summit, Open Geospatial Consortium, the Research Data Alliance, World Data System, and the Polar Libraries Colloquy. Within their own organizations and under the CCADI umbrella, our members have also been active promoters of good data management, data citation, ORCID registration, open access, and best practices for data stewardship.

The CCADI has grown significantly since its inception in 2015 and we are expecting it to grow even further before the next Polar Libraries Colloquy in 2020. The consortium does have challenges, such as managing growth within funding parameters and dealing with proprietary systems, but overall, it is well-positioned to make important advancements for arctic data and information sharing within Canada and internationally over the next five years.

For further information on the CCADI, please visit our website for updates: www.ccadi.ca.

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