REPORT OF THE 2ND CANADIAN POLAR DATA WORKSHOP

A Road Map to the Future of Polar Data Management in Canada

> 30 - 31 May 2017 Ottawa, Ontario









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CCADI = Canadian Consortium for Arctic Data Interoperability CCIN = Canadian Cryospheric Information Network PDC = Polar Data Catalogue

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EXECUTIVE SUMMARY

The 2nd Canadian Polar Data Workshop (CPDW), held in Ottawa, May 2017, focused on areas where polar data management in Canada and the use of Canadian polar data can be improved with respect to collaboration, coordination and governance, interoperability, engagement, policy and funding.

Workshop participants included researchers, representatives from Indigenous organizations, the federal government, the private and non-profit sectors, and data managers. Plenary presentations provided participants with relevant background information, an assessment of the current state of polar data management nationally, an overview of international polar data initiatives and programs, and several examples of successful collaboration and coordination in the Canadian context. All participants engaged in working groups to address specific issues relevant to one or more of the workshop focus areas.

OUTCOMES

- A recognition that there are different levels of understanding of what is required for the technical, financial, and the human aspects of polar data management;
- A recognition that there are different levels of knowledge about the polar data landscape and initiatives underway within Canada and in the international arena;
- Increased literacy on the subject of polar data management through networking and knowledge mobilization;
- A stronger network of those involved in Canadian polar data collection, use and management and an enhanced understanding of the related challenges and required direction forward;
- An agreement that there is a need for a national governance structure for polar data management in Canada;
- Formation of the Canadian Polar Data Coordinating Committee (CPDCC), which is charged with the responsibility to recruit individuals and groups to collectively design a polar data governance structure for Canada.

CALL TO ACTION

- Develop an accessible 'dictionary' that defines and disambiguates terms (governance, interoperability, semantic interoperability, etc.) to support broader understanding and engagement;
- Develop an accessible and iterative inventory or 'environmental scan' of existing efforts or initiatives relevant to the focus areas of the workshop;
- Develop short-term and long-term plans for supporting polar data management in Canada;
- Develop a comprehensive strategic plan that addresses Canada's needs for polar data management, and that includes a cost-benefit analysis, financial requirements, and an implementation strategy for a distributed, connected, national data system that links to international efforts and supports networks and initiatives such as the developing Arctic Observing System;
- Continue to expand participation in Canadian and International polar data activities, with particular emphasis on building capacity, opportunities and resources to include Indigenous and northern organizations and collaborators in future governance and activities.

Workshop participants and other contributing members of the Canadian polar data community have defined a collective vision for polar data management in Canada as follows:

Canada, as a global leader in polar research, shares polar research data and products with Canadians and the rest of the world and, through collaboration at home and abroad, supports and informs the development of relevant policy and the technical and human systems that will improve all aspects of data management from acquisition and curation to dissemination and use.

The outcomes and action items from the 2nd CPDW are an important step towards realization of this vision and members of the Canadian polar data community have agreed to take up the Call to Action over the coming months and years.

A VISION FOR POLAR DATA MANAGEMENT IN CANADA

This report provides background information on the development of a national polar data management initiative for Canada and presents the outcomes of the 2nd Canadian Polar Data Workshop - a national vision for polar data management and a process for realizing this vision.

VISION STATEMENT

Canada, as a global leader in polar research, shares polar research data and products with Canadians and the rest of the world and, through collaboration at home and abroad, supports and informs the development of relevant policy and the technical and human systems that will improve all aspects of polar data management from acquisition and curation to dissemination and use.

To achieve this vision, Canada's polar data community commits to the following actions:

- **Establishing** a national governance structure, and implementing a plan to facilitate coordination of polar data activities and to enhance technical and human interoperability through a robust Arctic research data infrastructure.
- **Collaborating** with all interested Canadian stakeholders and rights holders and facilitating the participation of Indigenous Canadians in all aspects of polar data management.
- **Co-developing** with Indigenous peoples and organizations the resources to support Indigenous-led data stewardship efforts and ensure Indigenous access to polar data and information, and Indigenous Knowledge.
- **Continuing** to strengthen links with international partners, civil society, and the private sector to accelerate progress toward the common goals of polar data management.
- **Identifying and diversifying** funding and other resources to support this polar data initiative.
- **Functioning** via the governance structure that is ultimately established.

BACKGROUND TO THE 2017 WORKSHOP

The Polar regions are experiencing dramatic environmental transformations and, in the Arctic, there are also many concurrent and challenging societal transitions. Polar change is well documented in numerous reports, assessments, academic research and the publications and products of Indigenous organizations [3-8]. It is also widely reported in the media. As we move further into the Anthropocene, the nature of changes and their influence on local, regional and earth systems is ever more important to understand, particularly for mitigating change, projecting and managing future conditions, and meeting sustainable development goals among others. There are also important needs to be met through the appropriate mobilization of social, economic, health, political and cultural data and information [9-13]. As such, over the past two decades, the polar research community has increased the scope and scale of its' activities, including efforts to obtain, manage, use, and steward relevant data. In Canada, research and Indigenous Knowledge are the basis for the evidence-based decision making that is needed to improve the lives of northerners and all Canadians and for understanding the Arctic system, its connections to the global system, future trajectories of change, and ways to reduce and mitigate the negative impacts of environmental and other changes. Simultaneously, Canadian scientists engage in Antarctic research to advance our knowledge of system dynamics at the southern pole and the relationship of the Antarctic system to the global system and to global change [14, 15].

In this context, the Canadian polar research community has grown in size, capability, and complexity, enhancing the need to identify and connect the various individuals, groups, and organizations which produce, use, and steward polar data. With the need to design and establish an effective research data management network in mind, in 2015, the 1st Canadian Polar Data Workshop (CPDW1) was an initiative led by the academic sector to address the siloed nature of polar data management in Canada. CPDW1 brought the Canadian polar data management community together to begin discussions on national-scale coordination of management activities, including project planning, governance, and collaboration with stakeholders and rights holders.

The CPDW1 agenda was crowd-sourced through a six-week national consultation in the form of an online survey in which 30 organizations participated. Fifty participants attended the workshop, and the following challenges and opportunities were identified, with recommendations for moving forward.

2015 IDENTIFIED CHALLENGES

- Obtaining financial support and maintaining sustainability of archives and services.
- Establishing rights of data providers and data users.
- Establishing technical interoperability of archives and data formats.

2015 IDENTIFIED OPPORTUNITIES

- A keen desire to collaborate and coordinate activities on polar data management for effectiveness and benefits to Canada.
- Upcoming funding opportunities to finance activities.
- Engagement of national funding agencies in polar data management initiatives.
- Partnering with related international initiatives

2015 WORKSHOP RECOMMENDATIONS

- Develop a database for Canadian polar research projects.
- Develop a guide on ways to participate in the polar community in Canada to better leverage funding and encourage collaboration.
- Develop the Arctic Spatial Data Infrastructure

Prior to the CPDW1, related efforts with a broader-than-polar scope include the 2011 Canadian Research Data Summit [16], advancement of the Canadian Open Government portal [17], the development of the Open Science Action Plan[18], the establishment of the Leadership Council for Digital Research Infrastructure[19] and of Research Data Canada[20].These activities began to provide a vision for defining roles and building a national research data management infrastructure and policy environment in Canada. Indeed, in 2015 Canada was behind many other nations in this respect.

From 2015 to present, activities to coordinate and advance polar and non-polar data management in Canada include development of: 1) the Canadian Consortium for Arctic Data Interoperability[21]; 2) the Marine and Arctic Spatial Data Infrastructures[22]; 3)

the Canadian Geospatial Data Infrastructure [23]; 4) the Federal Geospatial Platform at the Department of Fisheries and Oceans Canada; 5) the Portage Network [24] of the Canadian Association of Research Libraries (CARL); 6) the Tri-Agency Open Access Policy on Publications [25]; (7) the Tri-Agency Statement of Principles on Digital Data Management [26]; and 8) the Leadership Council for Digital Research Infrastructure [27]; among others.

Internationally, polar-data-focused activities include: 1) the creation of the Arctic Data Committee [28] (Figure 1), an initiative of the the International Arctic Science Committee (IASC) and the Sustaining Arctic Observing Networks (SAON) program; 2) the gathering of the international Arctic and Antarctic data communities at the Polar Data Forum I in 2013 [29]; and again at 3) the Polar Data Forum II in 2015 [30]; the ADC Interoperability Workshop and Assessment Process [31]; the Polar Data Planning Summit 2018 [32]; and the 4th Meeting of the Arctic Data Committee [33] which took place in Montreal in 2017 and was a precursor to the 2nd Canadian Polar Data Workshop the outcomes of which are reported here.

Canada is wellrepresented in international polar-datarelevant venues, participating on the ADC, the Standing Committee on Antarctic Data Management (SCADM) of the Scientific Committee on Antarctic Research (SCAR) and the Research Data Alliance. Canadian polar data organizations are also members of the World



Figure 1. Arctic Data Committee: An initiative of the International Arctic Science Committee and Sustaining Arctic Observing Networks.

Data System of the International Council for Science (ICSU) and the Open Geospatial Consortium (OGC). Canadian polar data community members are involved in many activities to connect Canada to international data management systems. These include the World Meteorological Organization (WMO) Integrated Global Observing System (WIGOS) metadata initiative, and the intergovernmental Group on Earth Observations (GEO) Cold Regions Initiative (GEOCRI). Canadian scientists and data managers are also engaged in projects such as the European Commission-funded Integrated Arctic Observation System (INTAROS) project and the International Network for Terrestrial Research and Monitoring in the Arctic (INTERACT) both of which have significant data management and data use components.

As a result of these many national and international consultations, workshops, and initiatives there is significant increase in collaboration and substantial progress on identification of polar data management needs, ways to address those needs. However, a national, integrated data network and governance structure are still necessary for Canada. Thus, the 2nd CPD Workshop was convened in 2017 in Ottawa.

THE 2ND CPD WORKSHOP: PURPOSE, CRITICAL ISSUES, GOALS

The 2nd CPD Workshop (CPDW2) was organized with the dual purpose of expanding the polar data community to include Canadian data producers and data users from across the spectrum and addressing the critical issues for data management identified at the CPDW1. Workshop goals were to identify relevant actionable items and assign responsibility for coordinating and/or implementing these action items.

WORKSHOP STRUCTURE

Sixty-two people participated including representatives from data repositories, Indigenous and northern organizations and communities, funding agencies, federal agencies with northern and polar mandates, researchers from academia, and individuals from the private and the non-profit sectors. A "Canadian Polar Data Community Position Paper" was circulated to this group prior to the workshop. Participants provided comments as to where and how this paper might be further developed and for which audience(s). That work is incorporated into this report.

Plenary presentations set the stage for discussions, providing information on the current state of the polar data landscape including workshop focus areas. Twenty lightning talks addressed new data initiatives, tools for data management, data analysis, relevant policy options and Indigenous perspectives on data management.

Subsequent breakout sessions focused on the critical issues of coordination, collaboration and governance, interoperability, engagement, policy and funding, as group participants were charged to develop priority actions and a plan for moving forward on those.

COLLABORATION, COORDINATION AND GOVERNANCE

As the community of polar data producers, users and stewards has grown substantially over the past decade, so has the need to identify and connect these groups and to produce a national plan for coordination of Canadian polar data activities and systems. The polar data landscape, while complex, is also increasingly organized with a move away from centralization towards a system of systems approach. Information is shared across scales and knowledge domains and the ecosystem model provides a good metaphor (Figure 2). There are many successful examples of collaboration and coordination within this



Figure 2. The Data Ecosystem Metaphor [1].



Figure 3. Inuvialuit Indicators [2].

ecosystem such as Inuvialuit Indicators (Figure 3), and the Canadian Consortium for Arctic Data Interoperability, (Figure 4).

Canada is well-placed to create and execute a governance model for the country. There is commitment and a vision, and a principles and guidelines document already in place - <u>Data Management</u> <u>Principles and Guidelines</u> for Polar Research and <u>Monitoring in Canada</u>, which was published online in 2017, and can inform the governance structure.



Figure 4. Canadian Consortium for Arctic Data Interoperability strives to establish a national governance structure and facilitate discovery of and access to Arctic data; implement standards and policies for data interoperability and data sharing, and the creation of platform-integrated analysis and mapping tools.

Defining a governance structure is key to moving beyond a project-specific approach to collaboration and coordination. It is a community-scale process requiring established and agreed upon principles and core values. Engagement with governance and planning requires resources; some individuals or organizations are more easily engaged than others. Thus, to avoid uneven representation, it is imperative to use a process that offers ample opportunity for diverse input through mechanisms such as community review and consensus building. Examples of entities and organizations that should be engaged in the governance building process are shown in Figure 5. Establishing fundamental principles of operation and the core values of the governance system and structure are key to broad acceptance by the Polar data community.

Indigenous Organizations	Territorial and Federal	Funding Organizations with Arctic	Relevant National and International Data
	Governments	Investments	Management Entities
Regional Inuit Organizations	Territorial Science Advisors	Canada Foundation for Innovation	Research Data Canada
Inuit Tapiriit Kanatami	Federal departments with Polar responsibilities	Social Science and Humanities Research Council of Canada	Research Data Alliance
Inuit Circumpolar	Federal Canadian Council	Natural Sciences and	Arctic Data Committee
Council Canada	on Geomatics	Engineering Council of Canada	
Arctic Athabascan	Federal Committee on Earth	Canadian Institutes for Health	Group on Earth Observations Cold
Council	Observations	Research	Regions Initiative
Gwich'in Council International	Operational agencies		Standing Committee on Antarctic Data Management

Figure 5. Potential participants in a governance structure for Polar data management in Canada in addition to the academic community.

INTEROPERABILITY

Interoperability is an immense challenge encompassing, as it must, both the technical and the human. The polar data community covers a diverse universe, with many domains and areas of expertise spanning the physical, biological, health and social sciences, and in the Arctic, Indigenous Knowledge. There are diverse semantics (linguistics and logic), and data collection and management methods. Here, emphasis is placed on technical interoperability (Figure 6) reflecting the expertise of those present at the workshop.



Figure 6. http://datainteroperability.org

Interoperability is often addressed in silos (i.e., interoperability of single datasets), but ultimately it needs to cut across types and categories of data. This challenge is not inconsequential. Data will continue to be collected, new data types will emerge, data rescue will progress, data repositories themselves will also continue to be established and to grow, and the needs for data will become increasingly diverse with timely and easy access ever more important. The actions towards establishing interoperability are, and must be, iterative, and they must be maintained through multi-decadal support from many sources. There is a special importance and obligation to ensure the effective preservation and archiving of data for future use, and long-term care is a shared responsibility among Federal, Territorial, Academic and Indigenous partners.

ENGAGEMENT - DATA PROVIDERS AND END USERS

The end user communities for polar data are vast and varied, and any given user may be looking for data that is project specific, issue specific, or for a particular class or classes of data that may have been obtained in a number of different ways under assorted projects or programmes. Thus, end users have different needs, expectations, and desired outcomes when they seek to access and use polar data. Both data providers and end users need to be informed about the direction the polar data management community is heading with respect to matters of data citation, open access, interoperability, and open source code among other matters. While many data providers are already on board, still many others have questions and concerns about the changes coming both with respect to policy and technical developments. Involving providers and users in data workshops, and specifically in technical workshops, through the application of a use-case approach has proven beneficial in other contexts and could work equally well in Canada provided there is sufficient time and resources for follow through by all actors. Much remains to be done in this regard.

POLICY AND FUNDING FOR SUSTAINING DATA MANAGEMENT

The level of funding for Canadian polar projects and polar data management is somewhat unclear. A recent effort to determine Tri-Council investment in Arctic research illustrates the difficulties of assessing support for basic research exclusive even of infrastructure funding and data management [34]. The cost of data management needs to be established and considered for the long-term, including such issues as: the Tri-Agency digital data management policy, Canada's commitment to the Arctic Council Agreement on Scientific Cooperation in the Arctic, and Indigenous data policy requirements. In addition, it is necessary to assess how the implementation of specific data policies may be leveraged to either reduce costs, or provide value added to current and past investments in the collection of polar data.

In Canada, for polar data management, and polar research in general, we encourage long-term planning (10-15 years or more) for projects that includes, where appropriate, partnerships with agencies and organizations that have a vested interest in successful, sustained data management (for example the Coast Guard, weather services, etc.). Even though most research is funded in 3-5-year cycles, there are opportunities for extended support and the community needs to begin to leverage non-traditional sources such as from operational agencies and others who require continuing access to polar data (Figure 7).

Ultimately, the Community must make inroads with decision makers to ensure the necessary long-term support that is needed to manage Canada's polar data to best meet the needs of the broad user community. The recent *Joint Statement of Ministers on the Occasion of the 2nd Arctic Science Ministerial* specifically commits to enhance and develop collaborative activities under three themes, the first of which is "Strengthening, Integrating and Sustaining Arctic Observations, <u>Facilitating Access to Arctic Data</u>, and Sharing Arctic Research Infrastructure." This bodes well for the future of polar data management in Canada, and the Canadian community should be prepared to address opportunities here as they arise, as well as to speak to this commitment from Canada as

Duration of Support	National	International	need
Short Term (1-5 years)	Canada Foundation for Innovation	European Commission European Space Agency	com
	Tri-Council funders Polar Knowledge Canada	National Research Funders Relmont Forum	an e
	Private Sector	Private Sector	posi
	Philanthropic Foundations	Philanthropic Foundations	adv
Medium Term (5-10 years)	Canarie Compute Canada	Arctic Economic Forum	tern
Long Term (multi-decadal)	Government Departments with	Government Departments	whi
		with Foldi manuales	exis
	Government agencies depending upon Polar data	Government agencies depending upon Polar data	tern
			opp
	Operational agencies depending upon Polar data	Operational agencies depending upon Polar data	they

needed. The community is in an excellent position to advocate for longterm support while utilizing existing shortterm funding opportunities as they become available.

Figure 7. Potential sources of support for Polar data management over different time scales.

ACTIONABLE ITEMS AND PROGRESS TO DATE

To move forward on the development and implementation of a <u>national governance</u> <u>structure</u> for Polar data management in Canada the action items are:

1. Develop an overview of successful governance models in other contexts at home and abroad.

A clear governance structure that works to support these tasks is needed before a coordinated effort can be achieved. The workshop participants established the Canadian Polar Data Coordination Committee (CPDCC). (Appendix 1). The CPDCC is tasked to lead the discussion on governance issues and design of a governing body for the Canadian polar data community. The CPDCC will further identify collaborators to take up activities to address the remaining recommended actions itemized below. The CPDCC is intended to be short-lived and should conduct itself with respect to the following guidelines:

- Ensure that Indigenous people and organizations are integral to governance through representation, input and action;
- Ensure representation from the operational communities;
- Ensure representation from the academic research community
- Ensure representation from the Federal family;
- Develop a timeline for establishing a governance framework and define the commitment for those engaged
- 2. Define key principles and core values.
- 3. Define the community or collaborators.

To move forward on technological interoperability the action items are:

- 1. Conduct a gap analysis of existing interoperability plans and standards.
- 2. Prepare an inventory of existing efforts or an environmental scan.

The creation of an inventory or environmental scan of the "Arctic data ecosystem" is a large task. The National Snow and Ice Data Centre has been engaged in this activity – a review of the existing polar data landscape and the Research Data Alliance has a

working group that is constructing a similar inventory. The CPDCC should reach out to these groups to both help populate these efforts and complete the Canadian inventory.

3. Identify "low hanging fruit" for interoperability experiments/development of use cases.

To move forward <u>on engagement</u> and to more effectively leverage data use and expand the data user community, the action items are:

1. Identify and approach non-polar organizations and communities of practice in the data management world for expertise and support for improving engagement within the polar community.

2. Develop mechanism to support and build capacity among northern communities and organizations so that they may fully participate in data initiatives and similar; there is a recognition that many northern entities are stretched thin due to limited facilities and lack of personnel.

3. For future events, leverage technology to allow virtual presence and participation from a larger segment of the polar data community. Many groups are now doing this successfully, and comparatively inexpensively.

To move forward on the <u>development and implementation of data policies</u> the action items are:

1. Consult with data user communities to develop data standards that can be adopted across the management community and that are friendly to the user communities.

2. Adopt and adapt existing standards and develop where necessary policies around data access and ownership, keeping in mind intellectual property rights and the protection of sensitive information (see for example First Nations Principles of Ownership, Control, Access, and Possession (OCAP).

3. Create opportunities (workshops, etc.) to undertake use-case scenarios drawing upon the user perspectives.

Data policy development and implementation within Inuit Nunangat should be led by Inuit with support as needed from partners already engaged in data management and related activities. Among the entities that can engage here are the National Inuit Data Management Committee and the Inuit regional organizations. There is already movement forward on some policy considerations through Inuit partnerships in entities such as the CCADI, the Arctic Eider Society, and the Exchange for Local Observations and Knowledge of the Arctic (ELOKA).

To move forward on <u>sustained support</u> for a national, distributed Canadian data management infrastructure:

1. Create a standing committee or organized body to represent the interests of the polar data community as a whole. This body would take advantage of opportunities as they occur, specifically, preparing white papers, proposals and advocating on behalf of the data community.

2. Seek long-term, stable funding through preparation of a cost/benefit analysis of appropriate polar data management that allows a cogent economic and societal benefits argument for long-term support.

A ROADMAP FOR THE WAY FORWARD

The Canadian polar data community has a clear destination and cannot lose sight of those whose data needs should be served. Engagement with data management issues continues to improve, particularly with respect to the input and guidance from Indigenous organizations and the academic research community. The Canadian polar data community's vision requires meaningful partnerships to develop policies and systems for improving data management across academic, sectoral, cultural and jurisdictional boundaries. There is a desire to be equitable, diversified, and inclusive in moving forward. The community is committed to establishing a governance structure that will facilitate this and that will include all interested stakeholders and rights holders. The CPDCC will take the next steps in making this vision a reality.

APPENDIX I - CANADIAN POLAR DATA COORDINATION COMMITTEE

Arctic Data Committee (ADC)

Canadian Consortium for Arctic Data Interoperability (CCADI),

Canadian Cryospheric Information Network/Polar Data Catalogue (CCIN/PDC)

Inuit Tapiriit Kanatami (ITK)

Natural Resources Canada (NRCan),

Polar Knowledge Canada (POLAR)

Polar View (PV)

The CCADI is:



APPENDIX 2 - WORKSHOP PLANNING AND ADVISORY COMMITTEES

Planning Committee

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