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PRACTICE PAPER

The Northern Voice: Listening to Indigenous and Northern Perspectives on Management of Data in Canada

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The Canadian Cryospheric Information Network and Polar Data Catalogue (CCIN/PDC) provide: (1) a trusted archive to store data from Canadian cryospheric research and (2) a public access portal to this information. The CCIN/PDC has since expanded its collection to include data from health, ecological, social, and other sciences. Since its inception, CCIN/PDC has engaged Indigenous and northern Canadians to understand and meet their information needs. This paper describes three instances of such engagement and next steps for enhanced interaction and support.

First, feedback from northern and Indigenous communities led to the development of PDC Lite. Compared to the full-featured online PDC Search application, PDC Lite accommodates slower Internet speeds and allows one to search by particular northern communities. PDC Lite continues to be improved by input from the people that it serves.

Next, to facilitate discussion and strengthen collaborative relationships within the polar data community, CCIN/PDC co-hosted two major meetings in 2015. Emerging from both these events was a need to prioritize what has been termed *human interoperability* and the need to have Indigenous and northern community involvement at all levels of data management.

Future plans for CCIN/PDC include more effective partnerships in which we work with and listen to northern and Indigenous Canadians to better understand their requirements for data management services and expertise. Our ultimate goal is to provide, through collaboration with partners, data, information, and expertise that facilitate northern and Indigenous Canadians' access to publicly-archived data and enable and support management of their own data and resources.

Keywords: data management; Indigenous; Indigenous Knowledge; Northerners; Arctic; Canada

Introduction

Arctic research can be difficult business, from securing funding to venturing into remote areas with harsh climates, and the transport of expensive, often delicate, research equipment. Accordingly, the data that are collected during such challenging ventures are particularly valuable and deserve special handling. Do these data rest forever in the depths of personal filing cabinets, or are they only accessible via specialized or quickly outdated software programs? Or can the data be made accessible—and thus useful—to other researchers, policy-makers, and the public? Importantly, can the data be made accessible to the Arctic people who live on the land where the research took place?

These issues were on the mind of Dr. Ellsworth LeDrew in the mid-1990s, when there was growing environmental, economic, and social interest in Canada's Arctic regions and a wealth of Arctic data was beginning to accumulate. In addition, support was growing for the concept of open access to data (Science International 2015), which allows data to be explored and used in ways that may be beyond those for which it was originally intended. For Arctic data in particular, open access provides opportunities to make new

predictions and new discoveries related to climate and other changes occurring in the far north. These discoveries have direct impacts on the northern and Indigenous people who live in the Arctic.

In partnership with the Canadian Space Agency, Environment Canada (now Environment and Climate Change Canada), Natural Resources Canada, and Noetix Research Inc., Dr. LeDrew formed the Canadian Cryospheric Information Network (CCIN; https://ccin.ca/). CCIN began as a data archiving service for, and a public access portal to, metadata and datasets contributed by cryospheric scientists associated with CRYSYS (CRYosphere SYStem in Canada) and other research programs in Canada.

Over time, the archiving service expanded to include an educational website for the public which included snow water equivalent (SWE) maps for the Canadian Prairies and northern Canada, children's games, photographs and videos, an "Ask an Expert" service, links to newsletters and publications, and interactive visualizations of SWE and lake ice data that have been developed in partnership with the Global Cryosphere Watch of the World Meteorological Organization. Content for the website is guided by a Scientific Advisory Council composed of experts in cryospheric research and data management (Canadian Cryospheric Information Network 2015a).

CCIN continued to change in the early 2000s with the emergence of ArcticNet and the Canadian International Polar Year (IPY) program. ArcticNet is a Network of Centres of Excellence of Canada established in 2004. The goal of ArcticNet is to understand the impacts of climate change and modernization in the coastal Canadian Arctic (www.arcticnet.ulaval.ca). ArcticNet chose CCIN as a data repository for its research projects. IPY also chose CCIN as its dedicated data and metadata repository. To accommodate this influx of information, CCIN upgraded its data management capabilities and infrastructure. Through partnerships with Noetix and the Department of Fisheries and Oceans Canada, the resulting product was the Polar Data Catalogue (PDC; https://www.polardata.ca). When it was first launched in 2007, the PDC was a metadata-only "discovery portal" to facilitate exchange of information about datasets between researchers, northern communities, international programs, decision makers, and the interested public (Canadian Cryospheric Information Network 2015b). In 2011, functionality was added to archive and share data files to accompany the rapidly growing metadata collection. As of May 11, 2017, the number of metadata records in the PDC has reached 2,541. The PDC also holds over 2.8 million data files, including almost 28,000 RADARSAT images of northern Canada and Antarctica.

The primary goal of CCIN and PDC is to facilitate public access to polar data and information now and for years into the future. This includes making information available to Indigenous and northern Canadians who have expressed the desire to know more about the variety of research taking place near their communities. Often this information and data are difficult to access. As the CCIN/PDC system matures, we aim to strengthen partnerships with Indigenous and northern Canadians, so that we can better understand their data and information needs and improve the service and resources that we provide. This is particularly important as northern communities continue to experience environmental and social change. This paper describes three instances in which CCIN/PDC has engaged northern and Indigenous communities: development of the online PDC Lite application and co-hosting two major meetings related to management of polar data.

Methods and Results

Working with Northern and Indigenous Partners in Canada to Make Data and Information More Accessible

Our online PDC Lite application was developed as a direct result of feedback from northern and Indigenous users. A survey of northern Canadians, commissioned in 2010 by ArcticNet, revealed that users with low-speed Internet connections—which are very common in northern Canada—often experienced long wait times when using the PDC Data and Metadata Search application. In response, we built PDC Lite, which was launched in 2012 (https://www.polardata.ca/pdclite/). PDC Lite is up to 20 times faster than the full-featured PDC Search and has a different search interface focused on community-specific project investigation (Friddell, LeDrew & Vincent 2014a; Friddell, LeDrew & Vincent 2014b).

In 2015, our partnership with Inuit Qaujisarvingat (IQ), Inuit Knowledge Centre of Inuit Tapiriit Kanatami, led to an evaluation of PDC Lite. Based on feedback from partners at IQ and additional individual users, we updated the PDC Lite Search to improve the interface design, graphics, and text descriptions, including addition of local names and highlighting the four Inuit land claim regions in northern Canada. We are appreciative of the effort and time that the evaluators put into these activities, especially as these improvements to the PDC are beneficial to more than just our northern partners and users. In the future, we will continue to work with our northern partners and with northern community members to improve the PDC Lite to serve their specific needs for data and information.

A Place for Indigenous Knowledge in Polar Data Management

A number of northern and Indigenous communities are interested in preserving Indigenous Knowledge (IK; Engler, Scassa & Taylor 2013; Inuit Tapiriit Kanatami 2016; Scassa & Taylor 2013; Pearce et al. 2009; Pulsifer et al. 2011). IK is a 'cumulative body of knowledge and beliefs, handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment' (Scassa & Taylor 2017: 2). Defined in this way, IK is not just a collection of discrete pieces of knowledge; it is a knowledge system. We cannot expect that what is archived as IK is complete, does not need additional context or interpretation, and can be analyzed and quantified. IK may not fit comfortably within Western research regimes or metadata standards (Scassa & Taylor 2017). Thus, the archiving and access requirements of all research involving IK should be considered on a case-by-case basis.

IK is also known by the terms Traditional Knowledge, Traditional Ecological Knowledge, or Traditional Local Knowledge. We prefer the term Indigenous Knowledge, as the term 'Traditional' may imply knowledge and practices that were acquired only in the past and are thus seen as static (Pulsifer et al. 2011). The term "Local" can be interpreted as including knowledge other than Indigenous knowledge (Pulsifer et al. 2011) and is thus too broad for our purposes. Hence, we will use the term Indigenous Knowledge (IK) in this article.

In addition to preserving IK, people are increasingly working together to define research projects which answer both academic and societal questions and contribute to understanding community-based needs, changes, and challenges, to the benefit of everyone involved (Pearce et al. 2009). Two specific examples of such research projects are the Atlas of Inuit Sea Ice Knowledge and Use (Siku Atlas; Pulsifer et al. 2011), and the use of digital cartography in the Canadian north (Engler, Scassa & Taylor 2013). These relationships and the input gained from IK are crucial to provide data and information for decision making at different levels. This information is precious but can be sensitive, thus northern and Indigenous people want to preserve it, with appropriate protections, in repositories as close to home as possible (Inuit Tapiriit Kanatami 2016; Scassa & Taylor 2017). For data management systems to meet their needs, the concerns, requirements, and capabilities of all partners must be understood.

One project that has taken up the challenge of recording, storing, managing, and ethically sharing IK is the Exchange for Local Observations and Knowledge of the Arctic (ELOKA; www.eloka-arctic.org). The goal of ELOKA is 'to provide data management and user support to facilitate the collection, preservation, exchange, and use of local observations and knowledge of the Arctic' (Pulsifer et al. 2012: 273). However, there are a number of other program- and region-specific efforts with similar aims, such as the Geomatics and Cartographic Research Centre (GCRC; https://gcrc.carleton.ca) and the Circum-Arctic Coastal Communities Knowledge Network (CACCON; https://caccon.org), along with many individual scientists who undertake significant and effective outreach/engagement efforts as part of their research activities. Thus, rather than being the center for all IK data management, ELOKA is one node in a network of efforts (Pulsifer et al. 2012). ELOKA is one example of how relationships and collaborations can be fostered with northern and Indigenous communities who are interested in preserving and sharing IK. Numerous workshops hosted by ELOKA underscore the idea that network building with Indigenous people interested in IK and data management is a critical activity for improving our knowledge of the Arctic. Another finding is that the needs and desires of Indigenous people must be at the core of any IK data management program (Pulsifer et al. 2012).

The CCIN/PDC system was initially built as a data repository for cryospheric scientists to store and share their research on snow and ice. Thus, it was originally meant to store quantitative data from the natural sciences. Over the years, the PDC has greatly expanded its collection to include research on Arctic and Antarctic biodiversity and research from the social sciences, in addition to a variety of other topics. We look forward to working with northern and Indigenous communities so that we can support them in preserving IK.

Coordination and Advancement of Polar Data Management in Canada and Internationally

In 2015, CCIN/PDC, in collaboration with numerous partners, co-led two major meetings. These events aimed to (1) increase progress in managing polar data and (2) collaborate with northern and Indigenous partners.

The first event was the *Canadian Polar Data Workshop* (CPD Workshop), held in Ottawa, Ontario, Canada in May 2015. The goal of the CPD Workshop was to coordinate the growing polar data community in Canada and to develop and implement best practices and sustainability in data stewardship, including enabling Indigenous stewardship of their own data resources, particularly IK. The Workshop agenda was crowd-sourced

through a six-week national consultation on polar data, in the form of an online survey answered by individuals from 30 organizations. The Workshop was attended by 44 people and six more individuals joined remotely. Presentations were made on data management topics and challenges, including data sharing, access, preservation, interoperability, policy, funding, and partnerships. In addition, national coordination, including the necessity to include all interested stakeholders and rights holders at the very beginning of the process, and contribution to the international polar data community were discussed at length.

Other relevant outcomes of the Workshop included explicit acknowledgement that IK and some other northern and Indigenous data and information will need to be exempt from expectations of open data sharing, due to confidentiality or other concerns of sensitivity. Also, the Indigenous and northern participants in the Workshop as well as the national online pre-Workshop consultation indicated their interest in participating fully in the coordination exercise, and other participants acknowledged that relationships should be strengthened through more extensive collaboration with northern and Indigenous people and communities. The success of this ongoing national initiative will depend on improving *human interoperability* (Handley 2014), defined as the successful and ongoing exchange of information between human individuals and/or between organizations for them to operate effectively together, or improved human communication and collaboration. Workshop participants used this term purposefully and highlighted that human interoperability is especially important regarding the participation and leadership by northern and Indigenous people in managing Canada's polar data. Part of the process will involve ensuring Indigenous and northern Canadians are included and made to feel welcome, which can be facilitated by attendance at meetings through provision of funding support for travel as well as holding meetings in northern Canadian communities. A full report on the workshop is available (LeDrew & Friddell 2016). Workshop participants wished to continue the dialogue, thus a second CPD Workshop is scheduled for May 30–31, 2017 in Ottawa, Ontario, Canada.

The second event was the *Polar Data Forum II: International Collaboration for Advancing Polar Data Access and Preservation* (PDF II: http://www.polar-data-forum.org; LeDrew, Friddell & Alix 2016), held in October 2015 in Waterloo, Ontario, Canada. This international conference was attended by more than 110 data managers, researchers, students and early career researchers, Indigenous and northern people, policy and funding agency representatives, and others, from 18 countries. Funding was secured to bring seven people from Indigenous and northern communities and organizations to the Forum, to ensure in-person participation and input regarding northern and Indigenous perspectives. Given that Arctic research occurs in their backyards and can help northerners respond to the regional environmental, social, and economic changes which are impacting their way of life, Indigenous participation in national and international dialogue helps build capacity for northern communities to engage in, improve, and benefit from research; it also facilitates engagement of Indigenous and northern youth with the growing field of information science and data management.

The University of Waterloo Aboriginal Student Association opened the PDF II with songs and drums, and an Aboriginal Evening event included a local women's drum circle, a smudging ceremony, and locally sourced Indigenous foods. As with the CPD Workshop, notetakers for the Forum sessions recorded the themes and details that emerged from the discussions. Meeting themes were summarized from these notes by the PDF II Advisory Committee and had evolved from the themes of the PDF I held in 2013 in Tokyo, Japan. The new themes (Polar Data Forum Advisory Committee 2015) included:

- **Community building:** We need to better understand the nature of the polar data community. Who is doing the work? Where? What systems are they using? Improved communication, collaboration, coordination, and outreach are needed.
- **Data preservation and rescue:** Data preservation is key. Even current data are at risk of loss. Strategic data rescue programs must be developed, and preservation must be prioritized as a long-term investment and cost-saving measure.
- **Interoperability:** The ability to easily share data across systems and users is one of the most important priorities identified by the polar data community. To achieve interoperability, we need adequate resources, a certain level of standardization, and a connected community.
- **Adequate resources:** Making progress will require adequate financial, technical, and human resources.

Human interoperability is clear as a requirement for success. In particular, participants highlighted that incorporation of Arctic Indigenous perspectives is critical to the success of international polar data

management. This may be accomplished through support for Indigenous participation in polar data activities, including increasing capacity for self-management of Inuit data and IK.

Discussion and Next Steps

CCIN/PDC began as a modest data repository for Canadian cryospheric research. It is now Canada's primary source for Arctic and Antarctic data, holding thousands of metadata records, data files, and satellite images; it is a regular member of the International Council for Science World Data System (ICSU-WDS). The ICSU-WDS is a world-wide interdisciplinary "community of excellence" for stewardship and provision of scientific data. CCIN/PDC has also taken great strides to engage with northern and Indigenous people, from conducting user surveys, to re-designing online applications to meet northern and Indigenous needs, to hosting two large meetings in an effort to foster understanding and collaboration.

Our plans for enhancing future collaborations include increasing partnerships with northern and Indigenous organizations and people in Canada to make the PDC more useful to northerners and to meet their data management needs. Specific activities include:

- Listening to our northern and Indigenous partners to understand and meet their needs related to data management.
  - Using surveys and direct engagement to receive ongoing feedback on improvements to our websites and online applications, including the PDC Lite.
  - Adding language support for Inuktitut to the online PDC applications (PDC Lite, full-featured PDC Search, and the PDC Metadata and Data Input application).
- Enhancing access for northern and Indigenous partners to data and information.
  - Increasing outreach so that people can find the data and information they need.
  - Expanding direct metadata and data sharing through establishment of interoperability linkages with northern organizations.
  - Working with partners to design and build systems for visualizing and understanding data and tracking research in northern communities.
- Providing expertise and infrastructure, as needed and requested.

We value the input of our northern partners and look forward to further feedback to ensure we are addressing their needs.

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Competing Interests

The authors have no competing interests to declare.

References

Canadian Cryospheric Information Network 2015a *About us*. Available at: https://ccin.ca/home/about [Last accessed 5 October 2016].

Canadian Cryospheric Information Network 2015b *The Polar Data Catalogue*. Available at: https://ccin.ca/home/aboutpdc [Last accessed 5 October 2016].

Engler, N J, Scassa, T and **Taylor, D R F** 2013 Mapping traditional knowledge: Digital cartography in the Canadian north. *Cartographica,* 48(3): 189–199. DOI: https://doi.org/10.3138/carto.48.3.1685

Friddell, J E, LeDrew, E F and **Vincent, W F** 2014a The Polar Data Catalogue: Data management for polar and cryospheric science. *70th Eastern Snow Conference*, 113–126. Huntsville, Ontario, Canada.

Friddell, J E, LeDrew, E F and **Vincent, W** 2014b The Polar Data Catalogue: Best practices for sharing and archiving Canada's polar data. *CODATA Data Science Journal*, 13: PDA1–PDA7. DOI: https://doi.org/10.2481/dsj.IFPDA-01

Handley, H A H 2014 A network model for human interoperability. *Human Factors*, 56(2): 349–360. DOI: https://doi.org/10.1177/0018720813493640

Inuit Tapiriit Kanatami 2016 *Inuit Tapiriit Kanatami submission to the Naylor Panel for Canada's Fundamental Science Review*. Available at: https://www.itk.ca/itk-sumbission-to-the-naylor-panel-for-canadas-fundamental-science-review/ [Last accessed 8 May 2017].

LeDrew, E F and **Friddell, J** 2016 *Canadian Polar Data Workshop. Report prepared in partial fulfillment of deliverables required by NSERC Statement of Work: Canadian and International Polar/Arctic Research Data Management – Context and Avenues to Enhance Collaboration*. Waterloo, Canada: CCIN/PDC.

LeDrew, E F, Friddell, J E and **Alix, G** 2016 *Polar Data Forum II: International Collaboration for Advancing Polar Data Access and Preservation. Report prepared in partial fulfillment of deliverables required by NSERC Statement of Work: Canadian and International Polar/Arctic Research Data Management – Context and Avenues to Enhance Collaboration*. Waterloo, Canada: CCIN/PDC.

Pearce, T D, Ford, J D, Laidler, G J, Smit, B, Duerden, F, Allarut, M, Andrachuk, M, Baryluk, S, Dialla, A, Elee, P, Goose, A, Ikummaq, T, Joamie, E, Kataoyak, F, Loring, E, Meakin, S, Nickels, S, Shappa, K, Shirley, J and **Wandel, J** 2009 Community collaboration and climate change research in the Canadian Arctic. *Polar Research*, 28: 10–27. DOI: https://doi.org/10.1111/j.1751-8369.2008.00094.x

Polar Data Forum Advisory Committee 2015 *Second Polar Data Forum – Communiqué*. Available at: https://www.icsu-wds.org/files/PDFII_Communique_FINAL.pdf [Last accessed 13 October 2016].

Pulsifer, P, Gearheard, S, Huntington, H P, Parsons, M, McNeave, C and **McCann, H S** 2012 The role of data management in engaging communities in Arctic research: Overview of the Exchange for Local Observations and Knowledge of the Arctic (ELOKA). *Polar Geography*, 35(3–4): 217–290. DOI: https://doi.org/10.1080/1088937X.2012.708364

Pulsifer, P L, Laidler, G J, Taylor, D R F and **Hayes, A** 2011 Towards an Indigenist data management program: Reflections on experiences developing an atlas of sea ice knowledge and use. *The Canadian Geographer*, 55(1): 108–124. DOI: https://doi.org/10.1111/j.1541-0064.2010.00348.x

Scassa, T and **Taylor, F** 2017 Legal and ethical issues around incorporating Traditional Knowledge in polar data infrastructures. *Data Science Journal*, 16(3): 1–14. DOI: https://doi.org/10.5334/dsj-2017-003

Science International 2015 *Open data in a big data world*. Paris: International Council for Science (ICSU), International Social Science Council (ISSC), The World Academy of Sciences (TWAS), InterAcademy Partnership (IAP).

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