The Nunavut Permafrost Databank- centralizing Nunavut permafrost for northern decision-making

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ABSTRACT
The Government of Nunavut's Climate Change Section is developing a centralized Permafrost Databank that will house permafrost data for Nunavut by 2016. This databank will make permafrost data, in its various forms, more accessible to practitioners. The major components of the project include collecting permafrost temperature data from various sources, including governments, academia, and industry, and integrating it into an online interface. This databank is being designed for user-friendly accessibility and is intended for Nunavut researchers, government and community decision makers, as well as the general public. Due to the varied formats and sources of data, the databank will be developed as a geo-referenced map, linking to other online forums that contain key permafrost data, publications, or references. This project is not intended to duplicate existing work or databases, but rather to compile and centralize these sources into one centralize location. The Government of Nunavut is in the development phase of this project and welcomes feedback on its design and data sources before the Permafrost Databank is released in 2016.

RÉSUMÉ
La Section du changement climatique du gouvernement du Nunavut travaille à la mise sur pied d'ici 2016 d'une banque de données centralisée sur le pergélisol qui contiendra une vaste gamme de données pertinentes pour le Nunavut. Cette banque de données facilitera l'accès aux données existantes sur le pergélisol, sous toutes leurs formes, pour les praticiens ayant besoin de consulter cette information. Le projet vise à compiler les données relatives au pergélisol provenant de diverses sources, notamment des gouvernements, des universités et de l'industrie afin de les intégrer dans une interface en ligne. Cette banque de données sera d'accès convivial, et pourra être consultée par les chercheurs, les employés du gouvernement et l'ensemble de la population du Nunavut. En raison des sources et des formats variés des données, la banque de données sera créée sous forme de carte géoréférencée établissant des liens vers d'autres forums en ligne contenant des données, des publications ou des références sur le pergélisol. Ce projet n'a pas pour but de répéter les bases de données ou les travaux existants, mais de compiler et de regrouper les sources d'information dans un lieu centralisé. Le gouvernement du Nunavut est encore dans la phase d'élaboration de ce projet, et il accueillera avec plaisir les commentaires concernant la conception du site et les sources de données avant que la base de données sur le pergélisol soit lancée en 2016.

1 INTRODUCTION

Although global temperatures have risen by 0.8°C over the past 100 years, the Arctic has experienced average temperature increases of 1.5°C, with regional temperatures increasing between 1 to 3°C (Overpeck et al., 1997; Overpeck et al., 2005). This scientific evidence, combined with local reports by community members, hunters, and elders provide confirmation that Nunavut is experiencing impacts related to climate change.

Many of these impacts are significantly affecting certain aspects of Nunavummiut's daily lives in both negative and positive ways. For example, climate change could cause changes to traditional hunting routes to sea ice loss and snow melt. Climate change could alter existing transportation systems, such as air and shipping traffic, due to an increase in extreme weather events. Climate change could also have positive impacts to both the tourism and shipping industry due to more ice-free time. These are just some examples of ways that climate change is affecting Nunavut. Many more exist. For the purpose of this paper, the major impact that will be discussed is permafrost thaw and its effect on infrastructure stability.

1.1 Permafrost thaw in Nunavut and its effects on infrastructure

As temperatures continue to rise in Nunavut due to climate change, this will continue to affect the stability of permafrost (Smith et al., 2013). Permafrost is the subsurface ground material that remains frozen for more than two years (Nelson et al., 2002). As permafrost thaws, it loses the ice content and weakens the structure of the ground. This in turn can accelerate erosion of land, particularly in areas of ice-rich permafrost causing landslides, slumps, and other ground instability issues (The Government of Nunavut, 2013).

Along with the overall increasing temperature from climate change, which is causing permafrost instability, we must account for the natural freeze and thaw periods in the spring and fall. Indeed these natural freeze and thaw cycles are further exasperated by increasing temperatures from climate change.

The majority of Nunavut's infrastructure design has typically taken advantage of using this frozen permafrost in creating strong and stable foundations, which was meant to last long-term (The Government of Nunavut,

2012). These changes in permafrost makeup is impacting Nunavut's built infrastructure by creating instability in buildings, roads, airstrips, and other structures (LeBlanc et al, 2011). It is also causing engineers to re-evaluate how infrastructure is built in Nunavut and to update building and design practices to be more adaptable to changing permafrost. As can be seen in Figures 1 and 2, different types of foundations are commonly used in Nunavut; some are more sophisticated than others.

Figure 1. Infrastructure in Baker Lake, Nunavut that has foundational concerns

Figure 2. Screw jacks being used in Arviat, Nunavut

1.2 The Government of Nunavut's Climate Change Section

Climate change presents one of the more significant challenges facing Nunavummiut. "Addressing the causes of climate change and adaptation to its impacts are high priorities for Nunavut and the Government of Nunavut is currently engaged in a number of climate change initiatives with an emphasis on adaptation at the community level" (The Government of Nunavut, 2012, 4).

The Government of Nunavut's Climate Change Section, located within the Department of Environment, develops programs, policies, and partnerships that assist Nunavut in adapting to the projected impacts of climate change. This includes working closely with various partners, including Federal agencies, NGOs, research organizations, and all Government of Nunavut departments and agencies.

Another collaboration that is highly valued is the Pan-Territorial Adaptation Partnership, a network of climate change adaptation staff from across the three territories. Together as one northern voice, this group advocates for climate change adaptation at a pan-territorial level and have recently collaborated on several pan-territorial permafrost initiatives.

The Climate Change Section works to ensure that scientific research being done in Nunavut reflects the interests and priorities of the Government of Nunavut and Nunavut communities. It also seeks to promote research that is ongoing in the territory through various methods, including sharing Nunavut-specific climate change research through the Nunavut Climate Change Centre website, www.climatechangenunavut.ca.

It is important that information transfer to communities be provided in easily accessible, non-technical formats. It is for this reason that researchers are strongly encouraged to work directly with communities and/or the Climate Change Section when designing research projects at the onset of a project. This ensures that communities can be involved and consulted to shape the research that is being done in their own backyards.

1.3 Inuit Qaujimajatuqangit and climate change

Inuit Qaujimajatuqangit (IQ) is a body of accumulated knowledge of the environment and the Inuit interrelationship with the elements, animals, people and family (Government of Nunavut, 2015). In Nunavut, IQ is valued as much as western science and the Climate Change Section continues to highlight this importance to research partners and throughout the tools it develops. Figure 3 shows an engagement session in Arviat, where elders talked about changes they've seen to the landscape in and around the community.

2 OBJECTIVES

Much work is being done in Nunavut on permafrost mapping and characterization; however, the results of this research are often difficult to access and are spread across different locations. This results in no clear centralized location for permafrost data in Nunavut. Due to this challenge, there is a high risk of data loss and inaccessibility when this information is most needed by northern decision-makers. The Nunavut Permafrost Databank will address these concerns in order to centralize permafrost data in Nunavut.

The objectives of this project are to:

- Identify permafrost data sources from Nunavut (in current databases, offices, research centres, universities, communities, etc.);

- Conduct a review on existing databanks in other jurisdictions to provide insight into the Nunavut Permafrost Databank's design;
- Research existing data sharing agreements/ partnerships to provide insight into the development of the Nunavut Permafrost Databank and;
- Design and input available information into the databank.

This project is building on the foundations of the Nunavut Permafrost Monitoring Network (NPMN), first established in Nunavut in 2008 to collect baseline monitoring data at six permafrost monitoring stations across the territory. The NPMN was a collaboration between the Government of Nunavut, six municipal governments, and the Geological Survey of Canada (Ednie and Smith, 2010). Although this partnership does not formally collaborate in this manner anymore, there remains significant momentum in the territory for permafrost monitoring.

Figure 3. Discussing permafrost thaw at elders' meetings in Arviat

3 METHODOLOGY

The development of the databank has been centred around two main areas: sourcing data and developing the online databank. These two components are described in more detail in this section.

3.1 Databank Design

Within the design parameters, it was important to ensure that the databank be developed to be user-friendly. End-users were identified as government level decision makers (federal, territorial, and municipal), private developers, researchers, the resource development sector, and Nunavut community members. In order to incorporate these measures, it was important to discuss needs and wants with end-users and also those organizations that have produced similar types of databases.

A review of existing permafrost databases / mapping initiatives was conducted to: a) review the technology already being implemented in Nunavut, and b) determine whether there were any potential linkages between these existing platforms and the Nunavut Permafrost Databank. Some of these existing platforms that house Nunavut data include: Natural Resources Canada's GEOSCAN, Université Laval's Nordicanada, The Canadian Cryospheric Information Network, The Polar Data Catalogue, University of Calgary's ASTIS, the Circumpolar Active Layer Monitoring, and the Global Terrestrial Network for Permafrost. These sites all varied in the displaying function of information, but all contained either Nunavut permafrost data and/or metadata of Nunavut permafrost data.

Additionally, a review of Nunavut and northern-based online map applications was conducted in order to determine what has already been done, and what works well in Nunavut with the current bandwidth limitations that most communities face. Existing maps reviewed include: Aboriginal Affairs and Northern Development Canada's SID Viewer, Kivalliq Inuit Association Interactive Map, Nunavut Tunngavik Incorporated's Interactive Map, Nunavut Planning Commission's Interactive Map, Nunavut Water Board's Public Registry, the Environmental Impact Screening Committee Public Registry, the Environmental Impact Review Board, and the Mackenzie Valley Review Board Public Registry. Some of these interfaces are quite complicated and slow loading in Nunavut, and this was seen as a key take-away message in user-friendliness. As the Nunavut Permafrost Databank will be used by general Nunavummiut and other non-technical people, it must be accessible.

Developing the physical design of the databank required substantial research. It was determined early on that there would be different types of data that would not be easily comparable in a format like a static table. After acquiring feedback from stakeholders, it was determined that having a visual format was integral to overall accessibility and functionality.

3.2 Data sourcing

Sourcing data was separated into two distinct tasks: finding existing online data sources, and finding new sources of data not yet available online. To facilitate these searches, an online survey was developed to solicit stakeholders and determine what type of information is already available.

Questions were structured so that depending on the answer, the respondent would be prompted with more probing questions. For example, one question asks "*If your organization has collected permafrost data, is this information published online?"* If the answer is yes, the next question is "*Can we link to this data on the Nunavut Permafrost Databank?".* If the answer to this question is yes, the survey then prompts for the type of information

and the web address where the current information lies. If the respondent answers no, the next question is "*If your organization has collected permafrost data and it is not currently published online, is it because the data and/or information is a-private/proprietary, b-awaiting publication, c-sensitive, d-the data can be published online, we had not had time, or e-other?".* This probing method of questioning facilitated the identification of specific data sources.

At the time of writing this report, 240 requests for completion were sent to three main groups: government stakeholders (including municipal, territorial, and federal), industry, and academia. The largest group solicited was government simply due to having the most contacts in this group.

To date, 47 responses have been received, with the majority being from government stakeholders (66%) (as can be seen in Figure 4). 23% of responses have been from industry, and 11% have been from academic groups. The survey remains open, with reminders being sent out to those who have not yet filled it out.

Another method for finding permafrost data for Nunavut is by reviewing documents associated the environmental assessment and regulatory process. Environmental assessments often contain valuable baseline data for the proposed sites. Once a project has been approved, the company is mandated to submit various annual monitoring reports, some of which contain permafrost data. All of this information is made public through the Nunavut Impact Review Board, the body that coordinates the environmental review process in Nunavut. Searching through these documents initially has proved to be quite fruitful in sourcing permafrost data from several mine sites.

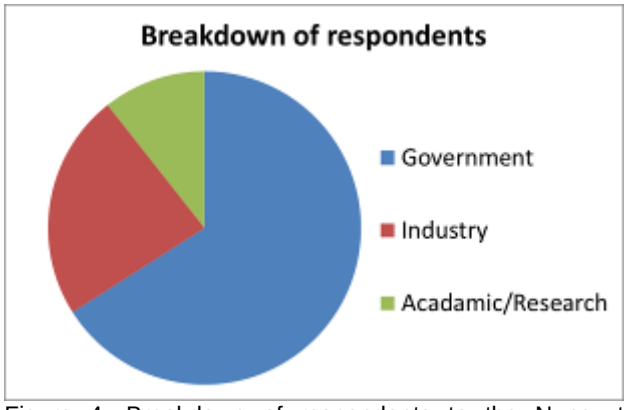

Figure 4: Breakdown of respondents to the Nunavut Permafrost Databank survey

A major factor that has been considered was ensuring that there would be no duplication with existing permafrost sites. Since much of this data currently exists on other sites, the main purpose of the Nunavut Permafrost Databank is to simply compile all these existing sources into one location by linking, and not re-publishing existing datasets.

Another item that required additional insight was whether or not to conduct analysis on any of the posted data. This could be useful for some of the raw datasets. It was determined that data would be posted as is with no further analysis or interpretation. Therefore, it is up to the end user to apply their own analysis if needed and bring their own level of expertise if further analysis is required.

4. EXPECTED RESULTS

Due to the different formats and sources of data, the databank is being developed as a geo-referenced map, linking to other online forums that contain key permafrost data, publications, or references. It will also have raw data currently not available through any other public forum. The databank will be hosted on the Nunavut Climate Change Centre website, at **www.climatechangenunavut.ca**. This site, which is maintained by the Climate Change Section, receives over 10,000 visitors annually and is the first site to show up in climate change and Nunavut google searches. Figure 5 shows a screenshot of a mock-up of what the databank will look like.

Figure 5. Draft screenshot of the Nunavut Permafrost Databank

The creation of the databank is a two year process, which is now in its final year. The first year involved research and initial data sourcing. The second year is focusing around databank design, collecting additional data, and integrating the databank into the Nunavut Climate Change Centre website.

As the Government of Nunavut is still in the development phase of this project, feedback is welcomed throughout this next year on a variety of areas including usability, functionality, and data collection.

The Nunavut Permafrost Databank will formally be launched online in its full capacity in March 2016. At this point, it will be promoted through networks including municipal, territorial, and federal government, academia, industry, and community.

5 DISCUSSION

Frequently there is a disconnect between knowledge holders and knowledge users in Nunavut that results in a lack of information being shared. This is quite often an unintentional result of lack of capacity, differing priorities, isolated communities, and sometimes even a simple oversight.

During the recent 2013 Pan-Territorial Permafrost Workshop, stakeholders indicated that they had difficulty acquiring critical permafrost data on a regular basis. This is problematic as data of this kind is necessary for making informed decisions in the north. Examples of where this data is needed at the Government of Nunavut level include:

- Engineers could incorporate Nunavut permafrost data into new northern infrastructure standards;
- Permafrost temperature data could be incorporated into hazard maps as an additional layer
- Territorial land use planners and municipal staff could use temperature data and trends to make more informed decisions on future development

The Nunavut Permafrost Databank provides the opportunity for everyone to have access to Nunavut permafrost data in an easily accessible format. With the immense capacity and information-sharing challenges experienced across the territory, the Nunavut Permafrost Databank is a major gap-filler for climate change knowledge sharing in the north.

6 CONCLUSIONS

Climate change, and more specifically, permafrost thaw, has presented Nunavut with many technical, engineering, social and cultural challenges. The changes and impacts that are occurring now are only going to continue into the future and we must be prepared to adapt to them. Having access to a wide range of data is imperative to allow for decision makers to incorporate climate change information into their policy and planning work. By centralizing Nunavut permafrost data, the Nunavut Permafrost Databank will help Nunavummiut, decision-makers, and researchers have better understand the impacts that are occurring in Nunavut so that they can take the necessary measures to respond and adapt.

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