

Customized, Multilingual, Topographic Prototype Maps of the Canadian Arctic

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Abstract. Completion of detailed 1:50K topographic maps of northern Canada and rapidly increasing availability of aboriginal geographical names provide unique opportunities to produce customized multilingual maps. Such maps can incorporate traditional knowledge to help revive the aboriginal cultures and to facilitate the communication and collaboration between "southerners" and "northerners". This paper describes an approach and methodology used to develop prototype customized maps and their main characteristics. As requested by users in the arctic communities, these maps include Volunteered Geographic Information (VGI), such as Inuit names, winter and summer trails, emergency cabins and prevailing winter and summer wind directions. Further, they incorporate an unconventional approach to hill shading and bathymetric data currently not included on standard Canadian topographic maps.

Keywords: Volunteered Geographic Information, Aboriginal Multi-script Toponyms, Traditional Inuit Knowledge, Integration of Bathymetric Data, Hill Shading

1. Background

Climate change and technological advancements have greatly impacted the Arctic region, causing rapid environmental and social changes and providing economic opportunities. The Canadian Arctic spans vast areas of Nunavut, the Northwest Territories (NWT), and the Nunavik region of Quebec. Two smaller arctic regions are located in Yukon and in Newfoundland and Labrador. However, this project was limited to selected arctic communities of Nunavut and the Northwest Territories. The Arctic is a barren land located above the tree line, with low precipitation and average summer temperatures below 10°C. Many areas are covered permanently with snow and ice. The Arctic has a very low population. There are only twenty-eight settlements in Nunavut and four in NWT's arctic region. The majority of the settlements have a population below 1000 inhabitants.

One of the goals of the customized mapping project (Siekierska 2011) was to meet the community engagement needs of the Geological Survey of Canada

(GSC) that is conducting geological research in the Arctic. The Geomapping for Energy and Minerals (GEM) phase I program was announced in 2008 to provide geo-science knowledge necessary for private sector exploration companies, to guide investment decisions and government land-use planning in the creation of parks and other protected areas. The continuation into phase II of the program is currently under consideration.

2. Needs and Opportunities

In response to the growing interest in the development of the Arctic and the necessity for collaborative, informed decision-making based on geospatial information, the Centre for Topographic Information, Earth Sciences Sector, Natural Resources Canada, has completed mapping of the arctic regions at the scale of 1:50K, previously not available for the far North. It takes approximately 350 maps at a 1:250K scale to cover the Canadian Arctic, which corresponds to approximately 5,600 maps at a 1:50K scale.

Beside the completion of the new topographic base maps, the increasing availability of Inuit place names became a major factor facilitating this project. The territorial governments are supporting the collection of Inuit place names through various research projects. In Nunavut place names are published by the cultural organizations, such as the Inuit Heritage Trust (IHT) [ihti.ca] and the Kitikmeot Heritage Society [kitikmeotheritage.ca]. These place names are published on 1:250K maps, although as this scale is not suitable to display all the toponyms, enlarged map insets are included. *Figure 1* shows an inset at 1:120K scale of a map of Pangnirtung published by the IHT. The Inuit names are shown in original syllabic script only. After official approval is obtained from the territorial authorities, the place names are stored in both Roman and syllabics versions in the Canadian Geographical Names Database [geonames.nrcan.gc.ca]. However, only the Roman script is used on federal topographic maps. Clear communication between Inuit and southerners requires the use of both scripts. Thus, the syllabics used for Inuit names should be accompanied by transliterated names in the Roman alphabet.

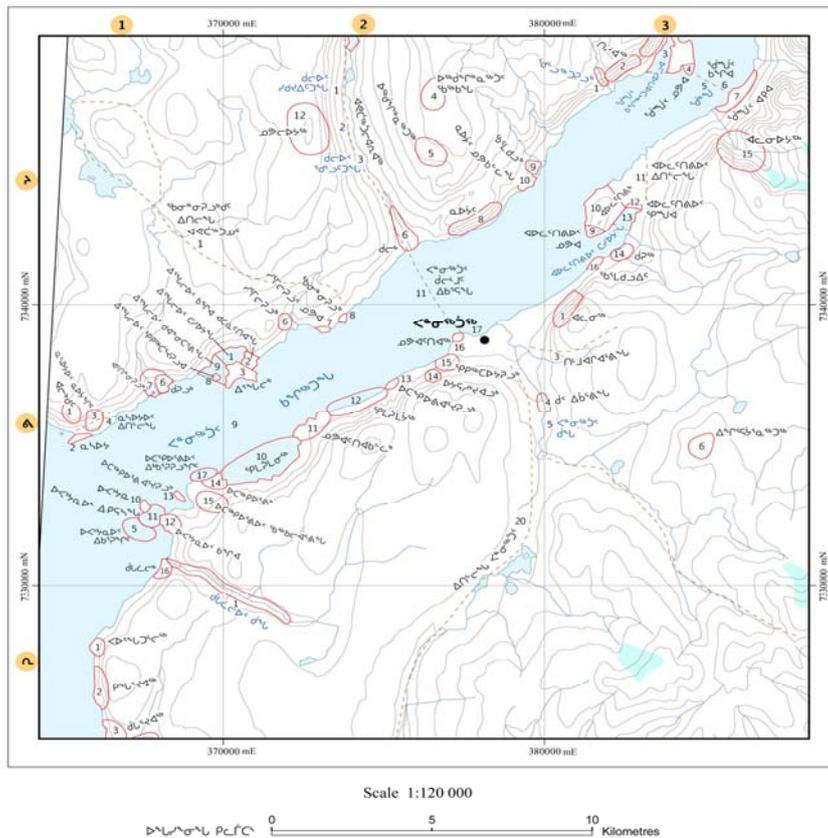


Figure 1. Map inset of Pangnirtung showing delineations of Inuit place names.

There are four official languages in Nunavut: Inuktitut – written in syllabics, is used in the eastern and southern part of Nunavut (Qikiqtaaluk and Kivalliq) and is the prevailing Inuit language in the Canadian Arctic. Inuinnaqtun, written in Roman characters, is used in western Nunavut (Kitikmeot), and English and French, the official languages of Canada. In NWT there are eleven official languages, including nine Aboriginal languages. In the arctic region of NWT, Inuit speak several dialects of Inuvialuktun, but with increasing mobility, and the impact of schooling in English, people increasingly communicate in English. However, the preservation of local languages has been recognized by the territorial governments and heritage organizations as a means to protect the Inuit culture. Traditional languages are being taught in kindergarten as well as in primary and secondary schools.

The clarity of maps is affected by the multiplicity of languages. According to national policy, only two languages are used on the map legend of Canadian Government maps and charts. However, on the customized arctic topographic maps, which are intended as a bridge between diverse users, the map legends are given in the four official languages for Nunavut, and in five languages for the NWT arctic regions.

The dilemma of post-colonial countries is notably summarized by the former toponymist of the NWT: *"Over many years, features on maps in Northern Canada were given names that were wrong - wrong according to people who lived there. There is an urgent need for these place names not only to be recorded, but also to be placed on maps in order that current and future generations continue to use the names and benefit from the knowledge of the Elders"* (Freeman 2002).

Another aspect that contributed to the initiation of this project is the need to record and preserve traditional knowledge. Besides the newly approved place names, the new base maps provide a good vehicle for recording traditional trails, hunting areas, and emergency cabins - all essential for survival in the harsh arctic environment. The extensive knowledge and understanding of the land, history and culture, has been transmitted from generation to generation through oral tradition. In the communities, the Elders interviewed by the project team were eager to share their knowledge of both the land and the local impact of climate change.

Lastly, all institutions conducting work on Inuit lands have an obligation to consult and engage local communities in any research or development work (Thomson & Boutilier 2011). The success in economic development depends on having collaboration between stakeholders. The customized, multilingual, multipurpose maps could become an important tool in engaging and involving people of various backgrounds and interests.

3. Methodology

The development of customized maps used a user-centric, activity-centric approach to serve users in the most effective way. The project had consultation built into every stage, focusing primarily on the Inuit groups and organizations.

Consultations were conducted in three culturally distinct regions of the Canadian Arctic: eastern and western Nunavut and northern NWT, and included interviews with community Elders, who remain the most respected people in the Inuit communities. The Elders usually are active members of the Hunters and Trappers Associations. Other people consulted included local government officials from the planning and land use departments, search and rescue organizations, as well officials from the educational institutions such as Nunavut Arctic College, high school principals and teachers.

Seven communities were visited by project members. In eastern Nunavut: Pangnirtung, Iqaluit and Igloolik; in western Nunavut: Cambridge Bay and Kugluktuk and in the Northwest Territories: Ulukhaktok and Inuvik. Additional consultations were carried out by GSC scientists during summer fieldwork conducted on the Cumberland Peninsula and Melville Peninsula (Nunavut) and on Victoria Island (NWT). *Figure 2* shows consultation on Victoria Island, in 2011.

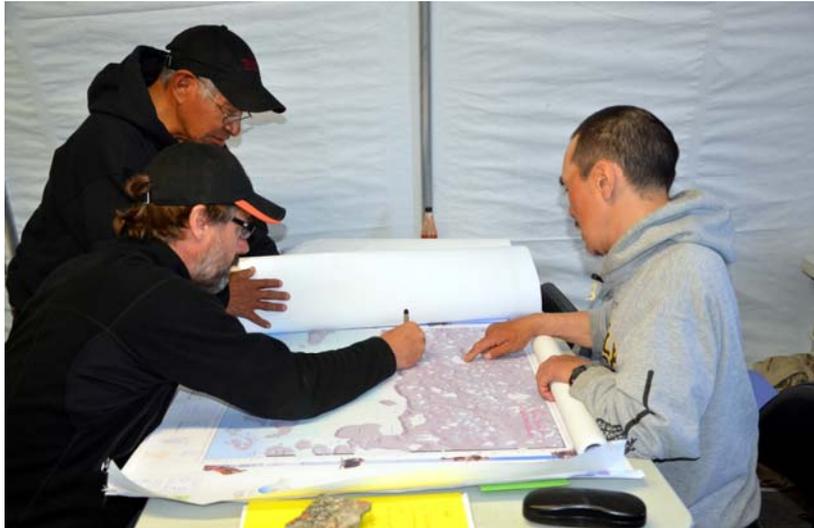


Figure 2. Consultation with Elders on Victoria Island

To ensure the consistency of interviews, survey questionnaires were used with reference to map content, information representation, and cultural identity. The topics covered related to geographical names, handling of multiple languages, inclusion of bathymetry, type of hill shading, depiction of cultural elements, ancillary information on map surrounds, current base map content and additional Arctic topographic features provided by VGI.

The consultation provided the informed basis needed for the design of the customized maps, the initiation of collection of traditional knowledge, as well as, the establishment of networks for potential collaborative mapping agreements.

4. Characteristics of Customized Maps

Based on in-depth consultation and thorough analysis of tabulated responses (Fung 2010), the following recommendations were made and adopted for the design of the customized maps. The maps should serve as a communication tool between the Inuit and the southerners, therefore, the use of two scripts, for those who do not read syllabics is mandatory. The maps should include special arctic features and bathymetric contours which are helpful for the safe navigation. The representation of terrain is enhanced by hill shading. An unconventional style of hill shading with natural southern illumination was recommended. The cultural map elements stimulate the interest of younger generations in preserving their history and culture.

Based on the objectives listed above, the customized arctic topographic map is produced by adding the traditional Inuit place names and unique arctic topographic features, such as winter and summer trails, emergency cabins and polynia (an open water feature surrounded ice) which currently are not included on the standard national topographic maps.

4.1. Inuit place names: original script and transliterations

The key element facilitating communication between southerners and northerners is portrayal of the Inuit place names in their original script, with transliteration into Roman characters, in the case of Inuktitut. This is a significant step forward as it acknowledges the existence of Aboriginal place names and makes them comprehensible to both northerners and southerners, while respecting the language and culture of the Inuit.

4.2. Unique arctic topographic features

Another key element of the customized maps is the addition of unique arctic topographic features that are not portrayed on the standard topographic maps. Those added to the customized maps include: snowmobile and All Terrain Vehicle (ATV) trails, emergency cabins, private cabins (which also serve as emergency shelters), polynia, abandoned airstrips and prevailing wind directions. The inclusion of these features on the maps is becoming essential for outdoor safety in the Arctic due to the rapid climate change. Consequently, an additional VGI category of symbols has been added for the “Special Arctic Features” collected, and standard symbols not relevant to the area have been removed. The special arctic features, together with the place names, constitute traditional Inuit knowledge and were provided by Elders during the consultations: see *figure 3*.



Figure 3. Special Arctic Features (VGI) added by Elders to the Repulse Bay map

4.3. Bathymetric information

Another significant feature of the customized map is the inclusion of bathymetric information. There is more water than land in the arctic region and many activities are conducted on the sea ice and all permanent settlements are located on the shore. Not surprisingly, the majority of map users requested the addition of bathymetric contour lines, as well as information on ice conditions. It was not possible to include the floe edge information due to the variability of its location from one year to another [sikuatlas.ca]. The only special sea ice arctic feature added was the “polynia” that has a relatively stable location from year to year.

4.4. Hill shading with southern illumination

The majority of people in the Arctic prefer the representation of terrain using contour lines enhanced by hill shading. Considering that the terrain is covered by snow for long periods of time and to ensure the readability of contour lines, a subdued style of hill shading was preferred by the users in the arctic communities. A unique, "associative representation" of hill shading with the natural light source from the south was recommended by the research geologists, see *figure 4*. This approach required breaking with traditional cartographic and graphic conventions that advocate the use of the light source from the northwest to give the best 3-dimensional effect. However, the abundance of blue colour used for the numerous lakes and rivers compensated for the possible optical misconception when using the southern light source.

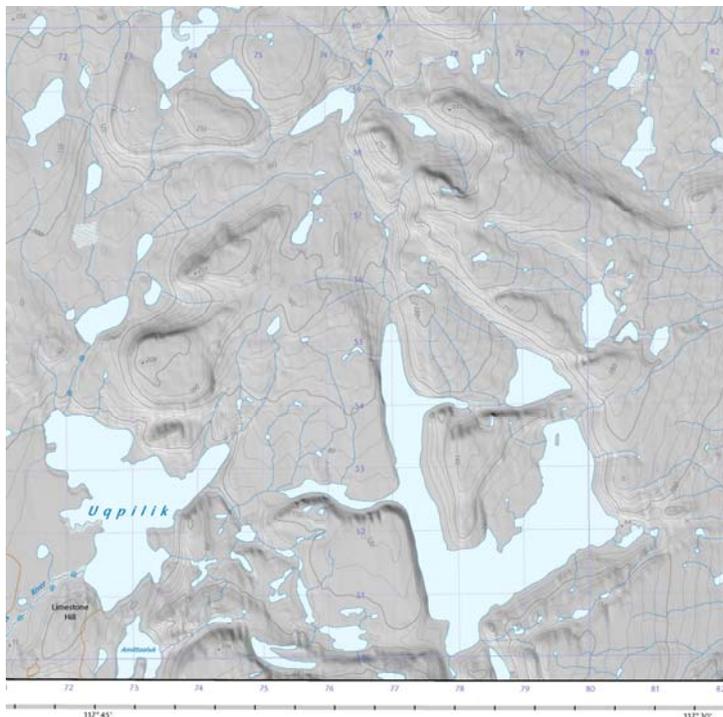


Figure 4 Detail of a customized map 1:50K of Uqpilik, Victoria Island, NWT, with southern illumination of terrain.

4.5. Cultural identity

The cultural identity of the Inuit has been portrayed on the customized maps through the use of illustrations embedded in the map frame and in the map title block. The map frame is a pictorial strip which depicts the prevailing winter landscape of the Arctic. The graphics were chosen, in consultation with the Elders, to reflect the culture, tradition and activities carried out by the Inuit on the land.

4.6. Multilingual map legend

Ancillary map information, which includes the map title, the map legend and technical map use data, is shown in languages spoken in the arctic regions of Nunavut and NWT, as well as in English and French, the official languages of Canada (mandatory for use in all federal government publications). This approach improves map usability and responds to the arctic region's unique cartographic requirements.

5. Issues and Challenges

The development of customized topographic maps is a complex process and several challenges were identified that will require further attention. In this paper three issues addressed are: the nature of Inuit place names, the integration of bathymetric data, and the addition of Volunteered Geographic Information (VGI).

5.1. The nature of Inuit place names

There are a number of characteristics associated with the Inuit naming of places that can challenge cartographers and administrators.

- Most Inuit place names are descriptive in nature, which can result in very long place names.
- Inuit names may or may not contain generic terms, but addition of English/French-language generics, while perhaps providing clarity to southerners, does not represent Inuit usage. Moreover, this practice may cause redundancy, for example, the name Kulik River, on the Pangnirtung map means River River.
- In many cases portions of a topographic feature are named, such as part of a river known to be good for fishing, or a mountain slope known to have a unique type of vegetation where certain animals could be found.
- There may be names for hybrid land-water features and places associated with particular activities, rather than "pure" landscape features, for instance, a place known to be good for hunting seals.
- Multiple names may exist for a feature, for example, an island may be described with various names as seen from different directions, or the same area may have different names depending on the variations in seasonal activities at the location. The Arctic is a vast region, where not so long ago, most Inuit people were leading a nomadic life, resulting in various names being given by different groups of people for the same place.

The particular approach of Inuit to naming places needs to be discussed with a view to the adoption of various standard toponymic rules. For cartographers, the biggest challenge is placing the names in such a way as to prevent ambiguity to the map user. In the customized maps produced thus far, there is frequent use of positional leaders to reduce difficulties in identifying the features named. For geologists, the links between place names reflecting traditional knowledge and the occurrence of geological formations is an interesting field of study.

5.2. Special arctic features: Volunteered Geographic Information

Mapping traditional knowledge requires selecting the most reliable information providers and a careful documentation of the source. In this project the main sources were Elders recommended by the Hunters and Trappers Associations. The original transcripts with the names of Elders, as well as the dates of interviews, were recorded and kept on file. Since many place names were hand written in syllabics the information provided will need additional verification before the customized map can be approved and published. Furthermore, errors and omissions on the topographic base maps can be corrected by local users.

The main discussion was generated by the use of place names still to be processed for formal approval. The temporary solution was to produce two versions of each map: one intended for publication with the approved place names; and the other, intended for engagement and consultation with the many community members, allowing for all the available names to be recorded. The second version of the map has a clearly visible disclaimer, alerting potential users that not all the place names have been approved for general use.

To ensure expedient production and publication of customized maps, functional networks need to be established for the collection and verification of specialized map information. Such a process requires collaboration between the various levels of government, heritage organizations and institutions. The collaborative approach to producing the customized maps will result in high quality products, responding to the needs of a wide range of map users.

5.3. Issues related to the inclusion of bathymetric information

Bathymetric data have been identified in the consultations as being desirable information for safety reasons, as the number of ships navigating through the Northwest Passage increases. This data is also useful for hunting and fishing activities. Currently Natural Resources Canada and the Department of Fisheries and Oceans (DFO) have a Memorandum of Understanding allowing the use of bathymetric data for this project. The Canadian Hydrographic Service (CHS) of DFO is responsible for bathymetric data for Canada. Currently detailed bathymetric data are available only for more frequently navigated waters and near to settlements. Therefore, additional open source data from the General Bathymetric Chart of the Ocean, database have been used for the customized maps. The GEBCO data do not have the same level of resolution as the CHS data, see *figure 5*.

Further technical issues of data integration are related to the use of different cartographic projections and different definitions of a coastline. The topographic base maps use the Universal Transverse Mercator and hydrographic charts use primarily the Mercator. Furthermore, in tidal areas, CHS bathymetric charts ensure the safety of navigation using the "Higher High Water Large Tide" (HHWLT) for shoreline definition. The topographic maps use average "Mean Sea Level" (MSL). Thus, to obtain a highly accurate integrated map certain transformations needed to be performed. However, considering that the customized maps are not intended to be used for precise sea navigation, a disclaimer was included.

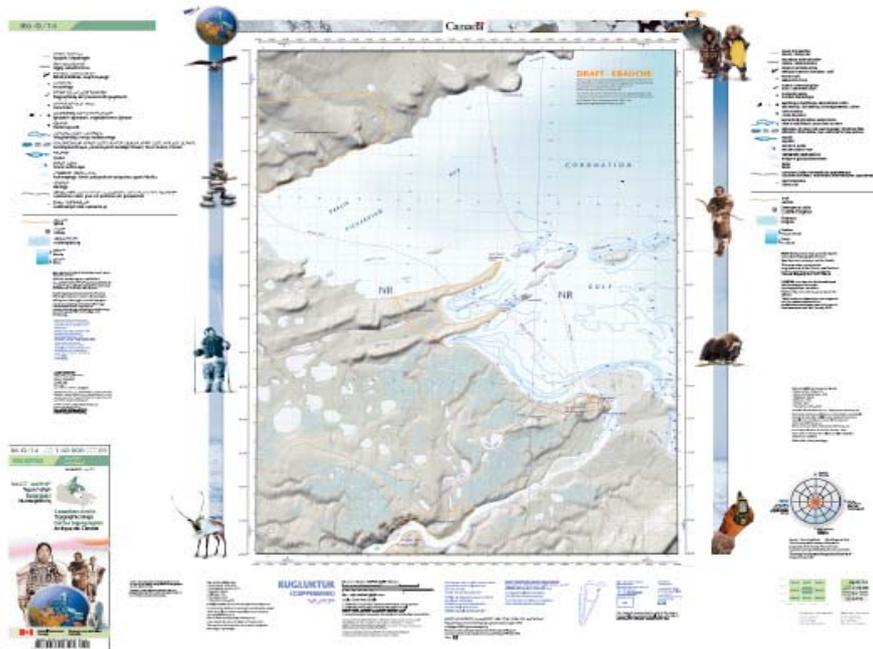


Figure 5. Map of Kugluktuk bathymetric information and hill shading

6. Conclusions

The customized arctic topographic maps have been accepted by the users in the arctic communities, by research geologists and by toponymists, as a very favourable development.

The Governments of Nunavut and NWT, as well as local governments, were very supportive and willing to share their data and to provide additional information. The Inuit Heritage Trust of Nunavut expressed particular interest in collaborating. Several Federal Government Departments, such as Aboriginal Affairs and Northern Development, Parks Canada and National Defence Canada are interested in the customized mapping project. Furthermore, the federal government agency that provides the research logistics in the Arctic, the Polar Continental Shelf Program, is interested in the development of community-centric customized maps. Moreover, the Canadian International Development Agency was planning to use the

customized map concept to highlight community “best practices” for their international collaborators. However, the most tangible endorsement of the usefulness of the customized topographic maps was the request of the Gwich’in First Nation (in the subarctic region of Yukon and the Northwest Territories) to have similar maps for their land settlement region. A contract was awarded by the Gwich’in Research Institute to a private company MDT Communications [mdtcommunications.com] to produce the Gwich’in Place Names Maps Series.

The mapping environment in the Canadian federal government has undergone major changes in the last few decades. Natural Resources Canada no longer supports survey teams to gather and compile land-related information for the purpose of creating and updating topographic maps. Instead, the topographic mapping centres have taken advantage of the technological advances and concentrated on providing mapping products from data collected by the provinces at large scales. The detailed scale mapping programs still do not exist in Nunavut and the Northwest Territories. However, the modern technology and willingness to share the traditional knowledge do facilitate the collection and publication of geospatial information and maps.

The customized maps produced based collaborative mapping principles will improve the quality and usability of topographic maps and information, contribute to the preservation of traditional knowledge, and facilitate the communication between the Inuit and all the people who live and work in the Arctic.

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