Inuit Knowledge and Geospatial Ontologies in Nunatsiavut

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Abstract

In a context of changing natural, social, political and economic environments in the Arctic, there is an urgent need to document and share the extensive and valuable knowledge held by Elders and other experts with local decision makers, younger generations, and with members of the scientific community trying better to understand pressures on these systems. Further, in the context of ongoing and impending new development, there is a need to capture and communicate changes in Inuit knowledge and use of the land. Geographic Information Systems (GIS) and other spatial data organization and representation technologies have been used for a variety of applications for, with, and by Indigenous groups in recent decades (e.g. land use planning, natural resource management, land claims negotiations, documentation and transmission of Traditional Knowledge to younger generations). Processes such as Participatory GIS (PGIS) and geospatial ontology research methods of capturing and representing Indigenous conceptualizations of spatial phenomenon can be empowering and create useful tools to illustrate and communicate Indigenous Knowledge (IK) and concepts of the environments which local people understand exceptionally well. When focused on current important cases, such as Inuit Knowledge of key species undergoing dramatic change (e.g. caribou), or land use mapping of currently changing, or threatened areas (e.g. lands likely to be impacted by industrial development) efforts of this nature have the potential to create tools with which to make local decisions about the environment and its resources, which better reflect local understandings and cultures while capturing and transmitting valuable information for current use. Using literature review, expert interviews and participatory mapping, this project is conducting a geospatial ontology exercise with expert knowledge holders in the Nunatsiavut Settlement Area. The long term goal is the development of a geospatial ontology application and interface (newly conceptualized land classification system with GIS representation) that complements existing GIS for use in land use planning, environment and development decision-making as well as Nunatsiavut Inuit Knowledge representation and transmission to a variety of audiences. This project is a partnership between the Nunatsiavut Government (NG), local knowledge holders and University based researchers. The short term results are expected to provide representations of Inuit Knowledge on key issues in support of decision making needs around land and development in the region while the longer term results are expected to provide evidence for a different and potentially more culturally-specific way of viewing and making decisions about land and landscape in Nunatsiavut and other Inuit regions.

Key Messages

- This project is developing a Nunatsiavut Knowledge based ontology of the land
- Based on Nunatsiavimmiut knowledge and conceptualizations of the land around one case community (Nain) this ontology will be used as the foundation for a new form of GIS platform for mapping and categorizing the land grounded in Nunatsiavimmiut Knowledge and relationships with the environment.
- This project is in its third year and has assembled a multidisciplinary team of experts in the areas of geospatial ontology, visual representations of geospatial phenomenon, Indigenous Knowledge documentation as well as Nunatsiavut knowledge holders with extensive experience and understanding of the land.
- Literature and archive reviews have been conducted, searching for Nunatsiavut ‘language and terminology’ of the land.
- Through content analysis of Our Footprints Are Everywhere (1977), visual concept maps have been produced to illustrate the written information related to two species – caribou and arctic char; the caribou map was completed this year upon which the ontology development is being initially based.
- Consultations with decision makers, government representatives and Nunatsiavut knowledge

holders are ongoing to refine the concept maps and to better understand the intended and desired use for the prototype and final platform at the regional and community scale; a workshop with knowledge holders and decision makers in February 2012 focused on these issues.

- Interviews and focus groups with knowledge holders and land experts in the region are being conducted to gather information on the Inuit ontology of the area and the relationships between the terms and concepts used.
- A sub-project on Inuit land use and perspectives on development in relation to the Voisey's Bay and proposed Quest Rare Earth Minerals sites has been started and is conducting mapping interviews with expert land users in communities.
- In support of an example to be explored for this project by Knowledge holders in the region, a review of Inuit Knowledge and science on the George River caribou herd has been conducted and prepared in a manuscript.
- Prototype technology has been developed to facilitate consultation with knowledge holders and broad dissemination of knowledge modeling results.

Objectives

- Document Inuit conceptualizations of land and environment categories and relationships (e.g. sensitive lands, critical habitat, culturally important sites and systems, etc) using expert priority cases identified by expert knowledge holders in one Nunatsiavut community (Nain) with the view of developing a Nunatsiavut ontology of the environment and land for the construction of a unique Nunatsiavut knowledge based GIS system.
- Through an interactive participatory GIS (PGIS) process, begin the development process of GIS representation of this land and environment conceptualization for one case Nunatsiavut community (Nain) and one or more specified case examples using this developed ontology.
- Verify and replicate this exercise in at least one other Nunatsiavut community and conduct a GIS based land classification exercise in the initial and replicate communities.
- Communicate findings on Inuit geospatial conceptualizations of land and the environment via workshops with regional decision makers, the research community via publications and conference presentations and regional youth via the summer student program in Nunatsiavut.

Introduction

Geographic Information Systems (GIS) and other spatial data organization and representation technologies have been used for a variety of applications for, with, and by Indigenous groups in recent decades (e.g. land use planning, natural resource management, land claims negotiations, documentation and transmission of Traditional Knowledge to younger generations) (Bocco et al. 2001, Duerden and Kuhn 1996; Laituri 2002; Tobias 2000). It is argued that through processes such as Participatory GIS (PGIS) and geospatial ontology research methods of capturing and representing Indigenous conceptualizations of spatial phenomenon, such initiatives can be empowering and create useful tools to illustrate and communicate Indigenous Knowledge (IK) and concepts of the environments which local people understand so well. Additionally, these efforts have the potential to create tools with which to make local decisions about the environment and resources which better reflect local understandings and cultures (Wellen and Seiber, 2012).

Conceptual ontology research in geography attempts to understand how people think about and organize geographic phenomenon (Agarwal 2005; Smith and Mark 2003). A prime goal of geographic ontologies is to make explicit the geographical categories embodied in a GIS database. Previous research in

this area with Indigenous groups has been conducted predominantly in more southern regions of the globe. It illustrates how people from different cultural and language groups use different categories to make sense of the geographic world, and that these different sets of categories do not map onto each other in a straightforward manner. Most conceptual ontology research has focused on Aborigine groups in northwestern Australia and the Navajo in the United States (Mark and Turk 2003; Stea 2007; Mark et al., 1997) with more recent work being conducted among Cree in James Bay (Wellen, 2008, Wellen and Sieber, 2012) and by Fletcher and others in Labrador with the Ashkui (Innu Cultural Landscape Unit) project (as in Furgal et al., 2006). Associated work in the Inuit context is represented in work by Laidler (2006) in her Inuit representations of sea ice formation and dynamics and linguistically in the Inuktitut terminology workshop held by Nunavut Tungavvik Inc in 2005 to which team member (CFurgal) was an advisor and participant.

In the context of environmental, economic and political change, a fundamental question at the centre of the Nunatsiavut Government dialogue is the issue of land use management and decision-making processes. It is vital that Inuit land use and, more importantly, Inuit Knowledge and values associated with land are at the core of this new way forward. This project, a partnership between the Nunatsiavut Government (NG), Nunatsiavut Inuit Knowledge holders and University-based researchers is conducting pilot Inuit geospatial ontology research. The NG is ideally positioned to take immediate advantage of the outcomes of the study and incorporate them into policy and legislation. The Nunatsiavut Government is currently at an early stage in its governance structure and even though this is a pilot study, it has been designed so that the outcomes are directly relevant to the priorities of the newly formed government. The Nunatsiavut Government will use the outcomes to help guide land use management processes as well as the development of environmental assessment and protection regulations and legislation in the context of climate change and modernization in the region. This project directly supports and informs future actions under the newly established Nunatsiavut Environmental Protection Legislation and Environmental Assessment Act.

The results of this study will also provide Inuit regions across the Arctic with a template and process to better incorporate Inuit knowledge based conceptualizations and classifications of land and environmental phenomena and cultural values into land management and development decisions.

Since holding a workshop in the community of Nain, the work under the project this year has focused on preliminary ontology development, definition documentation, verification and ‘use case’ (Nunatsiavut knowledge holder and user identified example) development concept mapping with several focus groups in the community of Nain, Nunatsiavut followed by a public and government consultation process. Expansion of this project and full representation through GIS development will take place in future years. This project is directly related to the needs of the Nunatsiavut Government and will have an extremely high impact on Nunatsiavut Inuit as well as the Nunatsiavut Government and its relationship with industry. The outcomes will feed directly into the land management process, as outcomes will be directly relevant to the development of regulations and legislation associated with environmental assessment and environmental protection.

Activities

For a detailed description of previous year activities, please see those reports. Work since the last project update has built upon the foundation achieved in previous years that worked to:

- Establish a strong working relationship with key Nunatsiavut decision maker and technical staff to identify and clarify short, mid and long term goals and opportunities for the project to best fit regional context and needs related to decision

making in the areas of environment, protection, and development.

- Complete an extensive literature and archival review to identify Nunatsiavut Inuit terminology (toponyms) conceptualizations and representations of land involving the identification and review of existing documentation (e.g. Our Footprints are Everywhere, 1977) specific to the region to identify key terms and concepts used to describe elements of land and 'environmental assemblages' (sensitive areas, critical habitat for key species, etc).
- Develop two detailed visual concept maps (on topics prioritized by participating knowledge holders and users) and conduct workshops and interviews to verify and validate them.

Since the last project update, work has consisted of the following:

- Using CMapTools software (ontology edition) and Protégé, Wilkes and Pulsifer continued to refine visual concept maps to better represent the complex relationships between the two caribou groups (G River and Torngat Mountains) and their surroundings, including food requirements, landscape needs, associated species, and the relationships between caribou and Inuit communities in the Nunatsiavut territory (Figure 1). Concept maps and a preliminary ontology were refined in preparation for the late winter 2012 workshop. Results of the workshop were used to further refine the models (see description below).
- Parallel to ontology development, 'use case' analysis was continued to guide how the ontology will be used in the geographic information system. The results of this analysis are being used by the development team to guide system development. A preliminary use case analysis was established in 2011/2012 and was further developed following the late winter 2012 workshop.

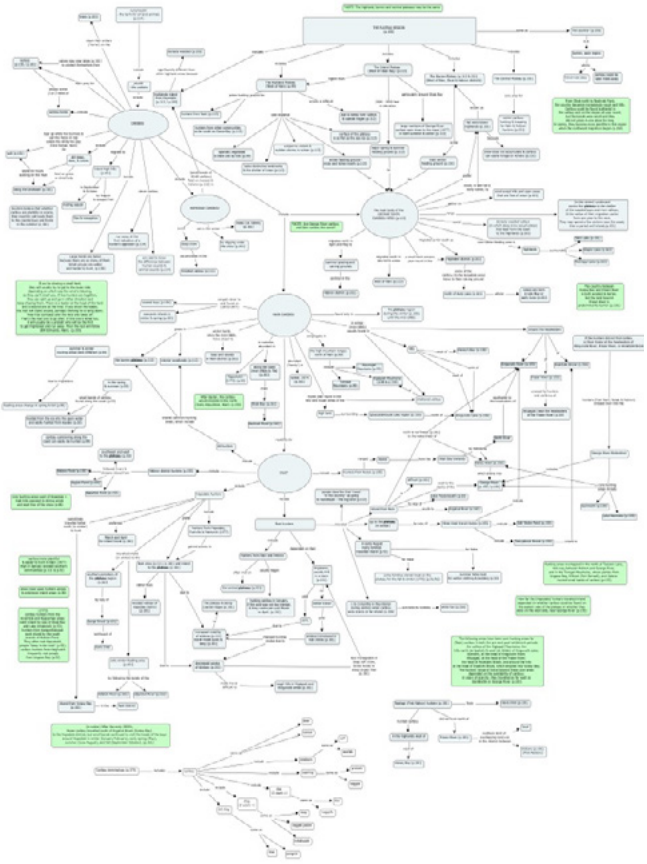

Figure 1: Visual concept map representing select references to caribou (including Inuit knowledge about caribou relationships) in the OFAE document, 1977.

- A project workshop was held in Nain, February 28, 29th, 2012. The purpose of this workshop was to help refine, using participatory methods, the concepts established through the content analysis and concept mapping carried out in the stage of the project , and to elicit options for participants to help decide the short term priorities (user cases) of the geospatial ontology project so that it would be of greatest immediate use to knowledge users and holders in the region. The caribou concept map was used as a preliminary model that was refined, expanded, and modified through discussions with community members and other stakeholders as a result. It is critical that this information is represented and communicated in a way that is true to its original cultural and traditional conceptualization and thinking rather

than simply 'fitting' Inuit knowledge (IK) into existing scientific or anthropological frameworks of seeing or understanding and therefore its construction and validation is a significant step forward in visualizing and representing Inuit Knowledge in the region on this topic.

- The workshop invited the participation of Nunatsiavut regional decision-makers (day 1) and local Nain harvesters (day 2). Project researchers and some participants attended both sessions.
- Through consultation with Nunatsiavut regional decision-makers and local Nain harvesters, the workshop was facilitated to share the work completed to date and to reach consensus on at least one key project focus for the coming year.
- Knowledge mapping was presented by project HQP James Wilkes as a method to visually represent currently documented Inuit knowledge and to help share knowledge and information between different people, departments, and disciplines. The presentation of the caribou knowledge map derived from Our Footprints are Everywhere illustrated the volume, complexity and detail of the Nunatsiavimmiut Knowledge system and showed the potential for further work using the knowledge mapping method.
- Project HQP Pulsifer presented a number of existing projects that use information technology to represent Indigenous knowledge. These projects were used as reference to facilitate and inform the establishment of requirements for an information system to support harvesters, community members, decision makers and others in Nunatsiavut.
- The workshop also enabled participants to envision how the resulting geospatial ontology will be used. Diagrams and other visual aids were presented to outline how the project results could be used to support GIS application development, though GIS may not be the only decided outcome of the project. We also explored how the geospatial ontology project could be used to link Inuit knowledge to ontologies being developed by other projects. Challenges faced during ontology development were also discussed and proposed solutions for future iterations of the process were presented.
- Three primary outputs were identified during the workshop: i) refinement of the Caribou knowledge map developed in previous years of the project. Specifically, highlighting concepts of customary law and local Inuit 'rules'. This will complement documentation of wildlife and land concepts already including in the existing concept map; ii) an analysis of overlaps in Western science and Inuit knowledge of caribou - contributions of science and contributions of Inuit knowledge; iii) an easy to use, Internet-accessible interface for accessing concept maps developed during the project and beyond. This tool would also be able to connect to instances of geographic features represented in GIS databases.
- The state of the local caribou herds was decidedly the most urgent environmental issue for the decision-makers and harvesters alike. As a health issue, wildlife management issue, economic issue, cultural issue, and pressing political issue, knowledge about caribou was identified as the chosen focus of the project. Questions were consistently raised about the declining George River caribou herd, as well as concerns that recent government consultations failed to adequately recognize Inuit knowledge in deciding quotas. As a result, caribou will become a key focus of the geospatial ontology project in its short term goal to raise recognition of Inuit knowledge in order to inform Nunatsiavut decision-making.
- Since the project workshop provided direction for initial ontology development, focusing on the issue of caribou as the example through which to develop an ontology of land and environment in the region, three activities have been the focus of work: 1) ontology development, 2) further caribou IK collection and review and 3) initialization of Inuit land use mapping sub project.

- Initiatives 1 and 2 flow directly from the recommendations and discussions at the late winter 2012 workshop. Initiative 3 has been added to this project opportunistically in association with a land use mapping project led by the project leads (C Furgal and T Sheldon) in response to the Quest Rare Minerals proposal for mine exploration and development near the Quebec-Labrador border inland of Voisey's Bay, Nunatsiavut.
- For initiative 2, HQP K Wilson has conducted a review and synthesis of the science and IK available on the George River caribou herd in support of the visual concept map shown in Figure 1.
- For initiative 3, Furgal and Sheldon have begun a contemporary Inuit land use mapping project involving participants in Nain, Hopedale and Makkovik to identify and understand land use and its significance to Inuit in the area inland of Voisey's Bay Nunatsiavut proposed as a roadway corridor form the proposed Strange Lake rare earth minerals development site to the port at Anaktalak Bay. This sub-project fits directly with the objectives of the geospatial ontology project and leverages significant in kind and cash funds and widens the practical scope and short term application of the current initiative at the same time.

Results

Platform Conceptualization and Development

- Further work with Nunatsiavut Government officials, harvesters and other stakeholders during the February 2012 workshop has confirmed that project participants are interested in an advanced production level information system over the long term, which may provide decision support for land classification type processes in the future. Although the implementation of such a system is beyond the scope of this project, we continue to apply a robust approach to overall design of system architecture to ensure that future development is not unnecessarily limited.
- This year's work introduced new ideas for system development including linkage of the information system to social network systems such as Facebook, and the possible development of a Smartphone or tablet based App to facilitate easier access to information systems by a broad audience.

Use Case Development

- The issue of caribou and understanding caribou as a view into IK on land and environment provided the impetus to search other existing IK on caribou in Labrador. A review and synthesis of caribou Inuit Knowledge available for the George River caribou herd in Labrador, in support of the visual concept map was done. It identified the lack of contemporary documentation of Inuit Knowledge on this species during its most recent decline and the need to conduct a more recent IK study.
- The review however did identify some critical information that was not being considered in decision making on the species currently.
- The comparison with the available science for the G River herd shows that the IK is predominantly in agreement with the science however provides some interesting insight into the existence of a potentially distinct group of Torngat Mountains caribou separate form the G River herd.
- The IK gathered will be used to help explain the current concept map (Figure 1) however it was identified that interviews with knowledge holders should be done to update knowledge on caribou in the area for the development of the ontology and final conceptual visualization of caribou knowledge in the area.

Use case analysis:

- The preliminary use case document developed in the first year of the project was refined base on the results of the February 2012 workshop. In this context a 'use case' refers to a detailed

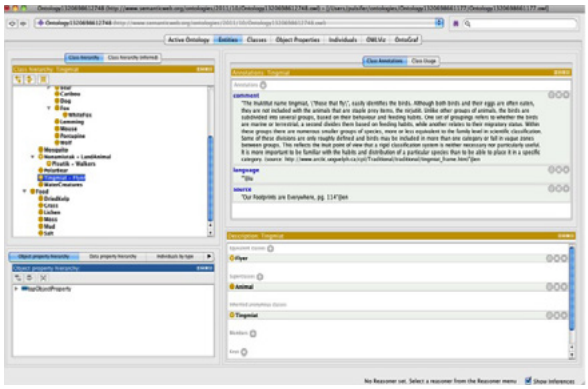

Figure 2. A preliminary workflow model developed through use case analysis based on results of project meetings and discussions.

description of a usage scenario or scenarios for an information system. Specifically, the use case defines the various people, system elements, information entities, and other components of the system and their interactions to achieve a certain goal (e.g workflow models Figure 2). Developing a use case is an iterative process that began in preparation for the February 2011 meeting held in Nain and will continue throughout the life of the project. While use case analysis is useful, efforts are made to avoid jargon when working with stakeholders who are not familiar with systems

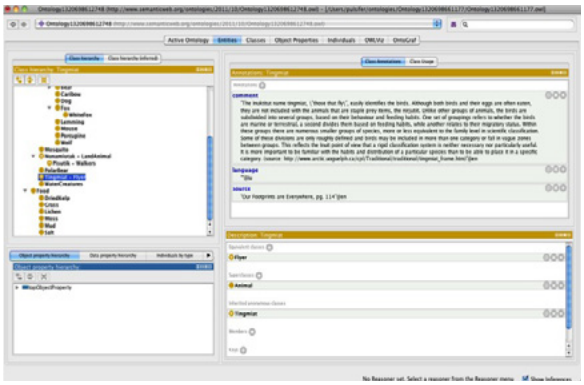

Figure 3. The Protégé ontology editor software is being used to develop the formal ontology. The editor facilitates to the process of establish classes, properties (relationships) and documenting 'individuals' (real world instances of a particular phenomenon). The ontology is annotated to indicate source of knowledge, native language of knowledge entities etc.

design. The process is being adapted using participatory methods that fit with the context.

- There continues to be strong interest and support for the project within the Nunatsiavut Government, as well as among community knowledge holders and land experts. Community participation at project consultation meetings has been very strong to date.

Formal Ontology:

- In the early stages of the project, concept maps developed through analysis of Our Footprints Are Everywhere provided a foundation for the

```
<Ontology xmlns="http://www.w3.org/2002/07/owl#"
    xml:base="http://www.semanticweb.org/ontologies/2011/10/Ontology1320698661177.owl"
    xmlns:rdfs=http://www.w3.org/2000/01/rdf-schema#
...
  <Declaration>
     <Class IRI="#Caribou"/>
  </Declaration>
<Declaration>
<Declaration>
     <Class IRI="#Flyer"/>
  </Declaration>
  <Declaration>
     <Class IRI="#Food"/>
  </Declaration>
...
 <EquivalentClasses>
     <Class IRI="#Flyer"/>
     <Class IRI="#Tingmiat"/>
  </EquivalentClasses>
.....
<ObjectPropertyRange>
     <ObjectProperty IRI="#eats"/>
     <Class IRI="#Moss"/>
  </ObjectPropertyRange>
...
<AnnotationAssertion>
     <AnnotationProperty IRI="http://purl.org/dc/elements/1.1/language"/>
     <IRI>#Tingmiat</IRI>
     <Literal xml:lang="iu" datatypeIRI="&rdf;PlainLiteral"></Literal>
```

Box 1. Using the Web Ontology Language (OWL), concepts are declared and linked using properties (relationships) and annotations that can be processed by software.

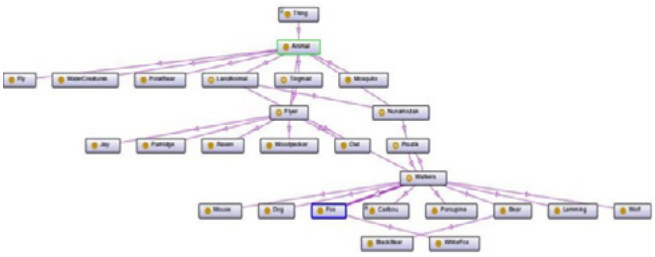

Figure 4. A visualization of a preliminary formal ontology based on concepts report in Our Footprints are Everywhere

development of a preliminary formal ontology. Figure 3 is a screen capture of the Protégé software being used to develop the ontology. Ultimately, the ontology is saved as machine readable text in a standardized format (OWL) (Box 1). Although in its early stages, the formal ontology developed provides the team with a strong foundation for further discussion and consultation with knowledge holders and other stakeholders. Like the CMap software used for general concept mapping, the Protégé editor provides visualization tools that can be useful for reviewing and validating the model with knowledge holders and other project participants.

Development of visualization tool:

- As presented, ontology development tools (i.e. CMap, Protégé) have been used to create preliminary concept maps and ontologies based on analysis of documents and the results of workshops. While these software packages provide powerful tools for semantic modeling, they are not ideal for use by a lay user.
- During the workshop held in Nain in February, 2012, a set of development tasks were defined in support of an overall objective of implementing an ontology visualization system that can be used by non-experts during the ontology review and validation projects. A number of system criteria were established during the meeting: i) a Web browser should be the primary access tool to ensure that the system can be accessed by a wide user-base. Although browser-based, the system will ideally support an "offline" mode for those with no or limited Internet connectivity; ii) the system can represent knowledge models created using the aforementioned ontology development tools and stored in standard formats such as the Web Ontology Language (OWL); iii) considering the limited technical development resources of the project, existing tools should be used as a starting point for development. To ensure that results are broadly accessible, open source software should be used and results should be released under an open source license; iv) visualization features will include the ability to annotate concepts and relationships, dynamically nest and expand hierarchically related concepts, link to source and other related documents, map or otherwise represent instances of concepts (e.g. Nain is an instance of the concept of Place).
- The first step in developing a tool was reviewing existing, open source visualization software packages. Several visualization tools were evaluated and tested. The criteria for selection included: standard based tool designed for the Web; a current and active development community; and built-in support for common geospatial data formats; ability to read formal ontology data formats (e.g. RDF, OWL).
- Although tools such as the JavaScript InfoVis Toolkit and JOWL seemed promising, these projects are not current or actively under development. The D3.js visualization tool was selected and used to develop the prototype presented (see https://github.com/mbostock/d3/wiki) . While the tool cannot directly read ontology data formats, all other criteria were met.

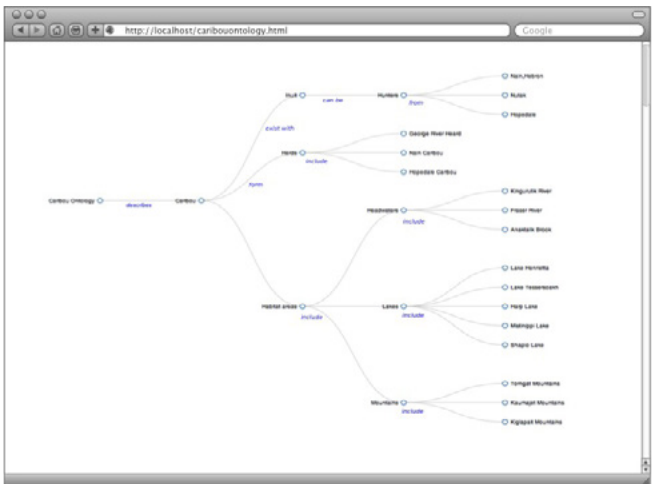

Figure 5. A Web-based visualization prototype has being developed to address the challenges of representing and broadly sharing a large, complex knowledge model that includes many relationships.

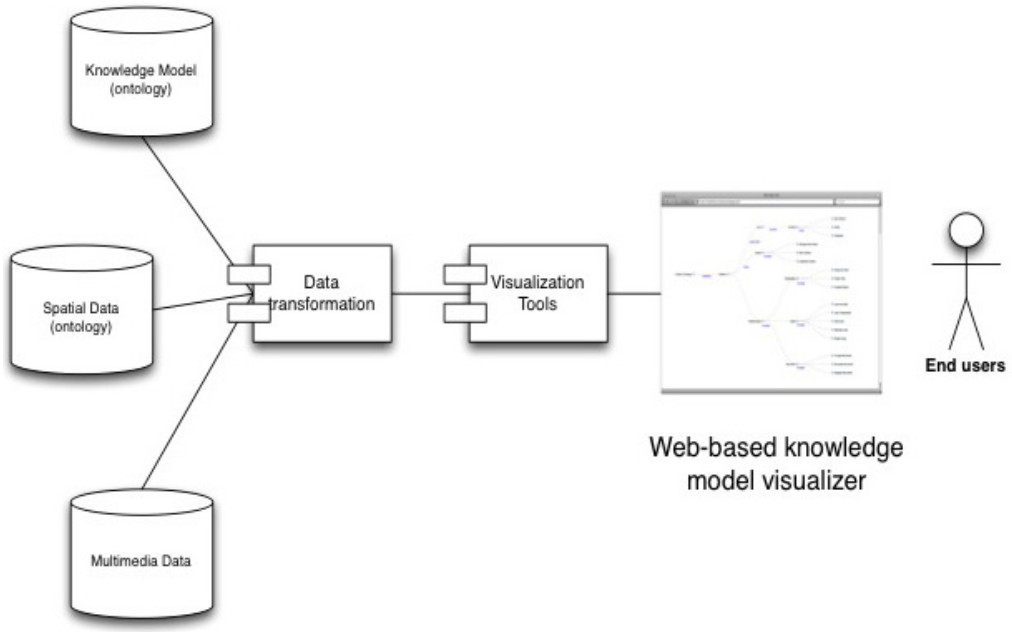

Figure 6. A production level visualization system will require a number of components including a data transformation engine that will be developed during the next phase of the project.

- Using the D3 software, a preliminary prototype was developed. Data generated from the preliminary ontology created earlier in the project were manually converted to the D3 visualization format. Several different types of visualizations were considered and tested (i.e. dendogram, interactive tree, radial tree). An interactive tree was deemed most appropriate for the knowledge model. A subset of the caribou ontology can be viewed in any standards compliant Web browser. To effectively manage the size and complexity of the model, users can expand and collapse branches to selectively represent different aspects of the knowledge model (Figure 5).

- Progress was made in developing an interactive visualization system, as a widely accessible Web application to share project results with a broad audience (Pulsifer et al. 2012). Figure 6 provides a high level representation of the architecture of the system under development. The prototype will be refined and additional system components developed. Review of the prototype by partners in Nunatsiavut is planned for the spring of 2013 and modifications will be made according to user feedback.

- Although existing open source packages are being used to reduce effort, software development is resource intensive. To maximize results, development partnerships are being established. Project personnel Pulsifer is part of the Semantic Sea Ice Interoperability Initiative (SSIII, http://nsidc.org/ssiii/, a research project developing a set of sea ice ontologies, including the development of knowledge models of Indigenous conceptualizations of sea ice. The SSIII project has visualization requirements similar to this project and some resources are available to further develop tools that will be released under an open source license and can directly benefit this project. Specifically, SSIII researchers are developing software that supports reading and writing of ontology data formats by the D3 tool. To support mapping requirements, a working partnership with the Geomatics and Cartographic Research Centre (GCRC) at Carleton University

is being established. The intention here is to use the advanced mapping functionality afforded by the Nunaliit software (http://nunaliit.org)

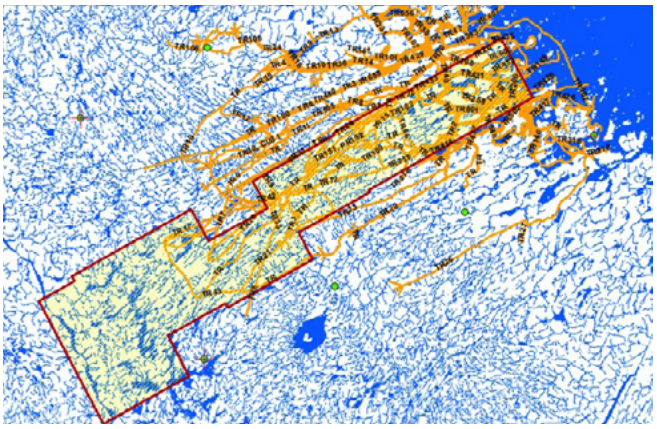

Figure 7. Draft compilation map of all travel routes documented in land use mapping initiative in relation to proposed mine and road development between Quebec-Labrador boarder and the port at Anaktalak Bay.

developed at GCRC. A formal agreement with GCRC is expected in March 2013.

Land Use Mapping:

- A contemporary land use mapping and perspectives on development project was started as part of this larger project this year in response to the potential proposals for a mine development and road project proposal from Strange Lake at the Quebec Labrador broader to the port at Anaktalak Bay.
- To date a total of 38 individuals have participated to 18 focus groups, totaling nearly 60 hrs of recorded map and audio data. Just over 4,200 features have been mapped by participants describing land use of the area and critical features of the land and environment (e.g. Figure 7).

Discussion

The importance of mapping land use and land 'formations' is a common discussion in the environmental management literature in regards to land use planning. Several authors identify GIS mapping as the favoured method of many Indigenous communities, industry and governments through which to make land use decisions. Additionally, the map biography method complements GIS by integrating oral history, perceptions of history and geographical knowledge, as well as travel routes and habitation (Usher, 2003). In this way, mapping assisted by the narratives of community members and their observations of the landscape can be critical for making sustainable land use decisions, according to Kendrick and Manseau (2008). They add that GIS cannot be used as a substitute for the narratives and cumulative experience of Indigenous knowledge holders, but rather as a tool to complement and to help represent IK holistically. The authors insist narratives and commentaries are key to applying spatial data to management. The current project brings together these two elements in one Inuit region of the Canadian North. It being together Indigenous knowledge and mapping or map visualizations for geospatial data to support decision making among Inuit communities and regions in the future. As a result it will make a contribution to the literature in the development of new spatial ontologies from an Inuit worldview and knowledge system as well as learning about the process through which this takes place and Inuit knowledge holders become involved.

Natcher (2001) writes that there are two reasons for mapping – land claims and resource conflicts. Such conflicts may include for example, the free entry system of mineral exploration, which highlights mining as the preferred land use activity (Hipwell et al., 2002). The 'highest valued use' concept of land, which is most often driven by short-term economic interests, is not 'value-free' and is often incompatible with Indigenous community perspectives (Paci et al., 2002). Our approach in this project is to develop an Inuit ontology such that conceptualizations of the land are based in Inuit understandings, views and perspectives of the environment. This is being

done through two use cases, one on knowledge and representations of knowledge on caribou and the land and the other on a contemporary case of a proposed development associated with Strange Lake and a road to Anaktalak Bay.

Literature also reveals a trend towards an Indigenous planning approach, as noted by Paci et al. (2002). Indeed, there are social, cultural, economic and ecological aspects of planning the landscape (Stevenson & Webb, 2003) and there is an increasing effort to understand this complexity at a greater level by working to integrate Indigenous concerns in land use planning (Houde, 2007). According to Wolfley, cultural values and diversity should be reflected in planning (as cited in Paci et al., 2002). For example, Simpson (2008) writes that traditional Nishnaabeg decisions about land use reflected a concern for the next seven generations. In these ways, it is evident that Indigenous models and visualizations of land use planning are founded upon Indigenous knowledge systems and view points and are very challenging to depict in current GIS and mapping languages and processes.

Conclusion

- Representatives from the Nunatsiavut Government and residents of Nain that are active land users would like to see an 'Inuit land classification" / "characterization" system be developed to support decisions from an Inuit knowledge perspective regarding development.
- This project is developing a Nunatsiavut geospatial ontology of the land in cooperation with researchers at the Inuit Knowledge Centre, Trent and Memorial Universities. Partnerships are being developed with Carleton University this coming year.
- The initial draft / prototype of the concept mapping exercise has been the focus of work in addition to future data gathering on one use case (Inuit Knowledge on caribou) with refinement taking place in an iterative manner. Work is focusing on development of the prototype with knowledge holders from Nain, Nunatsiavut.
- The addition of a contemporary land use mapping component is increasing the short term use of the project and its outputs for the Nunatsiavut Government and residents.
- This project will support current and future decision making processes by the Nunatsiavut Government in providing a different and perhaps more appropriate view of the land and its value/ importance to Inuit.
- It is expected that this project will make contributions to a growing Indigenous geospatial ontology literature as well in providing an Inuit example from the rapidly changing Canadian Arctic and information as to the engagement of Inuit knowledge holders and their interests in this process.

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Publications

(All ArcticNet refereed publications are available on the ASTIS website (http://www.aina.ucalgary.ca/arcticnet/).

Pulsifer, P., J. Wilkes, C. Furgal, T. Sheldon, R. Devillers, S. Nickels, 2012, Developing a Formal Ontology Representing Inuit Classification of Lands and Resources in Nunatsiavut, International Polar Year Conference, From Knowledge to Action, Montreal, April 2012, Poster

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