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The Arctic Council – Approach to Spatial Data?

Introduction

There are a number of different spatial data initiatives focusing on the Arctic in development or being discussed both within the Arctic Council (AC) and by other organizations. These various initiatives aim to either develop regional and circumpolar datasets or to provide a framework, which will allow for the efficient integration, access to and coordination of spatial data on the Arctic.

The purpose of this document is to review the various issues involved with regards to the AC and the development of Geographical Information (GI) or an Arctic Spatial Data Infrastructure (ASDI)[1].

1 Spatial data and the Arctic

With the current interest on climate change the Arctic has been subjected to intense scrutiny and as a result a wide array of data has been generated which is spatial in nature.

The approach to managing much of this data has largely been national or dedicated to specific issues. As a result many of the existing datasets are distributed throughout many organisations. They are often not integrated or coordinated and it is difficult to find an environment in which these diverse datasets can be combined and analyzed together.

There is a need for a dedicated ADSI, which would provide for the development of the necessary standards and framework to encourage more efficient integration of and access to these datasets. It would allow for more robust management and manipulation of data for both research and management purposes.

The first steps are slowly being taken towards realizing the need for such an ASDI. In August 2007 The First International Circumpolar Conference on Geospatial Sciences and Applications (IPY GeoNorth 2007) was held in Canada. One of its stated goals was to try and encourage the eight Arctic circumpolar countries to move towards a common ASDI. Other initiatives include:

- The AC (AMAP, CAFF and EPPR) is discussing the possibility of developing a common interface for access to spatial data.
- The Arctic Portal – has a mapping component displaying and serving various spatial layers on the Arctic
- UNEP GRID Arendal is developing a Digital Arctic Atlas
- See end of document for examples of other initiatives on spatial data and the Arctic

The Arctic as defined by CAFF

1. Benefits of GI / ASDI to the Arctic Council:

A coordinating instrument, which would allow for the integration and analysis of Arctic datasets on a circumpolar scale, is of enormous potential to the AC (Table 1). It would allow datasets to become more dynamic, relevant and usable for a greater variety of purposes and ends. It could provide tangible and direct benefits to the AC both in terms of furthering research, helping to improve internal data management and by offering a new means of outreach to a wider audience.

1 Spatial data Infrastructures (SDI) encompasses the policies, organizational remits, data, technologies, standards, delivery mechanisms and financial and human resources necessary to ensure the availability and access to spatial data - Global Spatial Data Infrastructure web site: www.gsdi.org

Research benefits

A central access point where diverse datasets/research activities can be viewed through a common interface offers the potential for achieving a more cohesive assessment of the current state of research. It could help focus attention on areas where it is needed or where research conclusions, agree, disagree or require further exploration. For example data on biodiversity levels which will be generated by the Arctic Biodiversity Assessment could be manipulated in a GIS to help locate gaps in data records and to highlight aberrations or unusual patterns in the data.

An AC GIS /ASDI could be extended to include other forms of information and systems e.g. AMAPs Project Directory. This would offer potential for further comparative analysis and modelling between diverse datasets. It would help reduce data redundancy and improve potential for data sharing. It could also help foster collaboration in developing framework data structures e.g. CBMP and SAON Observing networks

Integrating diverse datasets could allow for the extraction of more information i.e. the whole is more than the sum of its parts. Different kinds of information could be used more effectively, allow for the development of new data products, and for a more cohesive observation of trends and patterns e.g. via merging statistics with mapping. An example of how value could be added to an AC project can seen in the ArcticStat Circumpolar Database. The information contained in this database would be much more accessible and effective if it was represented in a graphical manner e.g. overlying data layers and exploring temporal variations.

IPY data Policy requires that in order to meet it's objectives of interdisciplinary and international collaboration and to ensure a lasting legacy IPY is committed to ensuring full, free and open access to IPY data. An Arctic GIS/ASDI offers a means of fulfilling such an objective

Outreach Benefits

A common GIS web portal could offer a practical way to make AC datasets more accessible to the general public e.g. converting scientific knowledge into a more user friendly format. Intuitive web-based software would allow the public to more easily visualize complex information. Similarly AC datasets could be made available to the scientific community in a more easily accessible manner via web mapping services and data downloads.

Administrative Benefits

An Arctic GIS / ASDI would provide a useful tool for decision and policy makers. It could offer the means to achieve a more cohesive overview of the nature, and potential of AC datasets e.g. data layers showing marine sensitive areas contrasted with information on shipping lanes and Oil & Gas activities. It offers the possibility through Cross border data integration to allow for regional planning, a service that could be of enormous benefit in helping to adapt and cope with the challenges presented by climate change. Cooperation and coordination between Working Groups (WGs) could be enhanced through the integration of their data in a common interface, helping to highlight points of overlap and areas for cooperation

Table 1: Examples of Benefits of GI /SDI to the Arctic Council

2. GIS Workshop - Tromso

There are two workshops on spatial data and the Arctic scheduled for early in 2008:

- Arctic GIS mapping initiative – Organised by UArctic and UNEP GRID-Arendal in conjunction with the Arctic Frontiers Conference in Tromso and to be held on the 23rd January
- Circumpolar Mapping – Organised by the EPPR and to and to be held in Horten, Norway between the 13 – 15th February

These workshops will bring together many of the parties involved in spatial data initiatives in the Arctic and provide an opportunity to hear their policies with regards to spatial data. They will contribute towards making an assessment of the coverage and quality of existing datasets and help assess the current status with regards to spatial data and the development of an ASDI.

These workshops should be viewed as the first step in an exploratory process in developing an ASDI. They will help inform how the AC should develop its own approach to Spatial Data. One of the primary aims should be to try and identify areas where activities overlap and identify where there is room for cooperation.

It might be helpful to ask participants in the workshops to prepare a brief submission describing their spatial data policy and what their plans are (Table 2). If it is possible to collect such information then it could provide a snapshot of the current status with regards to spatial data and the Arctic

1. What are their aims and objectives?
2. What spatial datasets do they possess (name and brief description)?
3. How dynamic are these datasets, are they static or updated regularly?
4. What time restraints are placed on these data?
5. How extensive are their spatial datasets i.e. do they have a circumpolar coverage?
6. Of what quality is the data contained in these datasets i.e. at what scale and accuracy was the data collected?
7. What are the sources for their spatial information i.e. how was it collected?
8. What user restrictions are placed on their data i.e. is it free for use or does it cost?
9. What standards are applied to their datasets?

Table 2: Potential questionnaire for participants?

3. Spatial data and the Arctic Council

The AC has been involved in various ways with cartography, GIS and spatial analysis. However these various initiatives have been conducted in isolation and there has been no attempt at harmonization or integration. EPPR, CAFF and AMAP are currently discussing the possibility of developing a common interface for access to AC spatial data. These could be the first tentative steps towards providing a framework to allow for data standardization and integration within the AC.

It is important to note that the AC not only has a reservoir of GIS and spatial information itself it also significantly has potential access through its member states to well developed and extensive national datasets. This provides the AC with the potential to be a driving force behind developing or helping to push towards an ASDI.

Examples of AC spatial activities include:

- The Circumpolar Arctic Vegetation Map (CAFF)
- Delimitation of Arctic extent (CAFF)
- Boreal Vegetation mapping (CAFF)[2]
- Circumpolar maps of natural resources at risk from oil spills (EPPR)

4. Next steps for the Arctic Council

The upcoming workshops provide a good starting point to assess the current state of spatial data in the Arctic. However in order for the AC to develop an effective

[2] This project has recently been funded by Nordic Council of Ministers – http:/www.caff.is/cfg

spatial data direction then it needs to consider both the data available and the form such a system would take.

4.1. Data Availability

In order to begin the process of assessing what exactly the AC possesses with regards to spatial information each WG should conduct a review of its spatial data. This should involve an assessment of their datasets under criteria such as[3]:

1. Positional accuracy
2. Attribute accuracy
3. Temporal accuracy
4. Logical consistency
5. Data completeness

The ability of member states through their National Spatial Data Infrastructures (NSDI) to contribute to an ASDI should also be assessed. Once these steps have been completed then it will be necessary to consider if these data are suitable to be analysed together. Are there significant differences of scale and quality, which would inhibit them from being, integrated e.g. the risk of errors due to misinterpretation?

4.2. System Design

There are two basic options for the design and architecture of a SDI for the AC:

1. *Centralised Data Structure*: All data is stored and maintained in a central database. The disadvantage of such an approach is that it places the responsibility on the AC to develop and maintain such a datasource and insure that it is consistently and properly maintained. This would require expensive software, database architecture and time commitments.
2. *Distributed data Structure*: The other alternative and one, which may be more cost effective and easier to maintain and develop, would be to develop a central data point (A metadata repository) where individual datasets would be delivered and accessed via Web Feature or Web Map Services (WFS/WMS).

   In order for such a distributed data structure to become a reality agreement would need to be reached on basic standards with regards to standards, quality and scale. This would then allow for these diverse data services to be integrated and displayed to the end user as one data layer.

   Users could access this data directly from their GIS software or via a GIS web portal[4]. This system would place the responsibility on individual data owners to maintain the data they provide.

   During these initial first steps towards defining a spatial data policy for the AC it is important that it should be started with a manageable objective, one which is achievable within a relatively quick time period. Once the concept has been implemented then it can be expanded and other information added as required.

5. Bibliography

Interactive Circumpolar Mapping Proposal, The Arctic Council – EPPR (October 2007)

Arctic Spatial Data Infrastructure (SDI) for Scientific Research, White paper, Discussion Draft (June 2004)

Geographical Information Science: An Introduction Bernhardsen, Thor (2002)

Recommendations for a Geographic Information Infrastructure to Support Arctic Research: Outcomes of the Arctic GIS Workshop, 22-24 January 2001, Seattle, Washington. Mark Sorensen, William F. Manley, Renée D. Crain, and Wendy K. Warnick. (eds.) The Arctic Research Consortium of the U.S. (ARCUS). Fairbanks, Alaska. 2001. 49 pp.

[3] Bernhardsen, Thor (2002) GIS: An Introduction – p215

6. Other Arctic Spatial Data Resources

Arctic Climatology Project - EWG Arctic Meteorology and Climate Atlas - http://nsidc.org/data/g01938.html

Arctic Research Mapping Application (ARMAP) -

http://www.armap.org/

ARCUS - http://www.arcus.org/gis/index.html

The Conservation GIS Centre - http://www.conservationgiscenter.org/maps/html/arctic_nwr.html

Barrow Arctic Science Consortium (BASC) http://ims.arcticscience.org/

Circumpolar Arctic Geobotanical Atlas (AGA) - http://www.arcticatlas.org/

CAFF - Circumpolar Arctic Vegetation Map (CAVM) http://www.geobotany.uaf.edu/cavm.

Circumarctic Environmental Observatories Network – Internet Map Server (CEON-IMS) http://www.ceonims.org/

First International Circumpolar Conference on Geospatial Sciences and Applications (IPY GeoNorth 2007) - http://www.arcus.org/gis/2001_Workshop.html

EPPR - Circumpolar maps of natural resources at risk from oil spills

Geographic Information Network of Alaska - Institute of the North Swath Viewer. http://ion.gina.alaska.edu/sv/

IFREMER/CERSAT Arctic sea ice drift maps

Joint U.S.-Russian Arctic Sea Ice Atlas - http://nsidc.org/data/g01962.html

National Ice Center - http://www.natice.noaa.gov/

National Snow and Ice Data Center http://nsidc.org/index.html

Recommendations for a Geographic Information Infrastructure to Support Arctic Research: Outcomes of the Arctic GIS Workshop. April 24, 2001 - http://www.arcus.org/gis/2001_Workshop.html

United Nations Environment Network (UNEP) - Arctic Environmental Atlas -http://maps.grida.no/arctic/

University of the Arctic (UArctic) http://www.uarctic.org/

Veco Polar Resources Maps of NSF-Funded Field Research in the Arctic http://www.vecopolar.com