

0. Introduction

This document has been prepared by the Secretariats of AMAP, CAFF and EPPR; it is not a 'proposal' but rather a paper to inform the SAOs of progress in work conducted in response to a Ministerial request, and to announce the intention to develop a proposal on harmonization of Arctic Council mapping/GIS activities. The document has been sent to all of the AC working groups for their consideration, but has not been approved by any of them.

1. Purpose of this Document

The purpose of this document is to inform the Senior Arctic Officials (SAOs) of progress to date with regards to discussions on how spatial information could be obtained, managed, maintained and delivered within the Arctic Council (AC) and how this could be conducted in co-operation with external parties. It will:

- Introduce Plans to present a more complete proposal to the AC in the fall 2008
- Outline the current 'vision' for collaborative activities among the AC WGs
- Consider how AC and AC Working Groups (WGs) could co-operate with external parties related to spatial information

This information paper is intended for review by all WGs of the AC, and also by agencies and organizations outside the Arctic Council which are involved in the development of circumpolar maps, quality control and use. Based upon the results of discussions between the WGs, the plan is to further develop this document and to submit a proposal for consideration/approval by SAOs at their meeting in the fall of 2008.

2. Background

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 fragmented and 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 strong need for a dedicated Arctic Spatial Data Infrastructure (ASDI), which would provide for the development of the necessary standards and framework to encourage and facilitate data sharing, 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. Other focus areas in the world are currently more advanced on this topic.

It is important for AC to be involved in the development of an ASDI, because all of the Arctic Council WGs are engaged to some extent in compiling information that can be presented on maps, and with spatial information. Several WGs employ Geographical Information Systems (GIS) as a tool for preparing maps, and in some cases for conducting more sophisticated spatial analyses on data. To date, the WGs have conducted this work largely in isolation, with the result that there has been duplication of effort, and mixed messages from maps from competing institutions and agencies. In addition, in order to produce deliverables, WGs have compiled information that logically could have been more efficiently provided by other groups if made available in a suitable format. Examples of AC spatial activities include:

- The Circumpolar Arctic Vegetation Map (CAFF)
- Circumpolar maps of natural resources at risk from oil spills (EPPR)
- Arctic oil and Gas activity (AMAP)

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. The AC has possibilities to create trans-national datasets. This provides the AC with the potential to be a driving force behind developing or helping to push towards an ASDI.

An Arctic GIS workshop in Seattle, USA in 2001, which attracted over 100 participants, concluded that cooperation on Arctic GIS and mapping could be facilitated by developing an Arctic Spatial Data Infrastructure (ASDI); this view was repeated at the IPY GeoNorth conference in Canada in August 2007, one of whose stated goals was to try and encourage the eight Arctic circumpolar countries to move towards a common ASDI.

Two recent workshops linked to the AC on the development of circumpolar maps have been held in 2008:

1. A dialogue meeting on possible cooperation between AC WGs and UArctic on the production of a circumpolar atlas, held in Tromsø, 23 January 2008
2. An AC workshop on circumpolar mapping, held in Oslo, 13 -14 February 2008

Both of these workshops were concerned with investigating the level of interest and readiness for cooperation between AC WGs and external partners on the development of circumpolar maps and a circumpolar spatial data infrastructure. In the workshop in Oslo in February 2008 examples of mapping initiatives were provided i.e:

- GIT Barents Project – <http://www.gitbarents.com/>
- Safety at Sea - <http://maps.safetyatsea.se/>
- UArctic – Digital Arctic Atlas¹
- Arctic Council's EPPR project - <http://eppr.akvaplan.com/intro/Intro.htm>

3. Framework for a common strategy for spatial data policy within the Arctic Council

The following section reflects the 'conclusions', arising from discussions during the meeting in Tromsø and the workshop in Oslo in 2008. As such, it represents the current 'vision' for an eventual common strategy for spatial data policy within the Arctic Council.

3.1 Strategic Vision

To support the establishment of an ASDI - a coordinating instrument – which would allow for data sharing, integration and analysis of Arctic datasets on a circumpolar scale, allowing datasets to become more dynamic, relevant and usable for a greater variety of purposes and ends. This would 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

¹ This is to be partly funded by an Oil company

outreach to a wider audience. The audience could be politicians, the public, mass media, scientists, Arctic council's workings groups, the global village etc. This would provide benefits related to:

- Research
 - A central access point
 - Best available science
 - Integrating diverse datasets
 - IPY legacy (An Arctic ASDI offers a means of helping to achieve such an objective)
- Outreach
 - A common GIS web portal
- Administrative
 - A useful tool for decision makers

3.2 The Arctic GIS/mapping community

It is vital to recognize from the outset that the Arctic GIS/mapping community is much 'bigger' than just the AC and its WGs. The WGs themselves, although they 'compile' and use spatial data, are not generally the primary sources or originators (owners) of such data. Inclusion of external partners, in particular data owners, is therefore a key component of any eventual AC strategy. It is also important that national data holdings become globally available.

The GIS/mapping community also comprises two basic sub-communities: *the professional GIS/mapping community* that are engaged full-time in cartographic and GIS related work, have access to resources and are familiar with GIS conventions and standards, and a *GIS/mapping user community*, that tend to make use of accessible (GIS) datasets as a basis for maps to which they then add their own data (value-added products) which can be even more useful than the original products.. National mapping authorities and university GIS departments are examples of the former; AC WGs and their co-workers in the general scientific community tend to be examples of the latter. The professional GIS community is the source of many of the underlying datasets that are used on all maps (coastline boundaries, elevation/bathymetry, hydrography, roads, settlements etc.)

3.3 GIS/mapping datasets and their maintenance

Maps such as those of interest to the Arctic Council tend to be comprised of two main types of information:

- **Underlying feature layers** such as coastlines, elevation/bathymetry, drainage systems, population centres, administrative boundaries, roads, railways, etc,
- **Thematic layers**, which include important base layers (e.g. permafrost distribution, vegetation, land-use) and an almost infinite number of more specialised themes e.g. locations of sites of significance to indigenous peoples, sources of contaminants, seabird colonies etc.

In addition, there are other types of content that can be added to maps such as satellite imagery, photos and links to other types of information resources. In general terms, data on *underlying feature layers* tend to be developed and maintained by the professional GIS/mapping community, i.e. primarily by the national mapping authorities, whereas datasets representing *thematic layers* tend to be produced by the 'user community', which includes,

for the most part, the AC WGs. Many of the 'thematic layer' datasets are produced on a project basis as 'one-off' snapshots of a specific situation.

Some GIS datasets are relatively static and unchanging. This applies to some of the *underlying feature layers*. Others, typically the *thematic layers* that are central to AC fields of interest are often of a dynamic character. Where such datasets are not routinely updated and maintained there are clear implications with respect to their suitability for presentation and/or use in combination with other datasets (i.e. temporal consistency). Similarly, where datasets differ significantly in terms of scale and quality, they are not suitable for integration without the risk of errors due to misinterpretation...

3.4 The need for standards

Agreement and adoption of standards is a pre-requisite to any strategy for GIS/mapping activities involving the combination of data from multiple sources. Strictly enforced standards are at the core of any ASDI. Use of standards is routine within the professional GIS/mapping community and represents best professional practices. The user community, however, is less familiar with some of these concepts and less disciplined when it comes to their application.

To date many such initiatives have been driven by Canadian, American, Australian or European efforts. The INSPIRE Directive (Directive 2007/2/EC of the European Parliament and of the Council of Ministers that entered into force in May 2007) intends to establish an Infrastructure for Spatial Information in the European Community (INSPIRE). This Directive includes specification of many, if not all, of the standards that would be relevant to an ASDI, based on internationally accepted (ISO) standards. The Open Geospatial Consortium (OGC) is also an important driver for geospatial & location based standards and services².

4. Spatial data and the Arctic Council

The main goal of a spatial data initiative under the Arctic Council would be to integrate AC activities into an overall ASDI and to ensure that relevant AC GIS/mapping activities are conducted in a way that is compatible with the standards and procedures employed by the wider community; thereby ensuring that AC WGs can benefit from work in the wider GIS/mapping community and vice versa.

The AC has been involved in various ways with cartography, GIS, digital databases and spatial analysis. However these various initiatives have been conducted in isolation and there has been no attempt at harmonization or integration. Coordination among the WGs with regards to the collection and development of spatial data has not been as effective as it could be. If we can achieve better coordination, then the AC WGs can save time, money and resources by pooling information and not duplicating tasks. Based on this EPPR, CAFF and AMAP through their secretariats are currently discussing the possibility of developing a common interface for access to AC spatial data. These could be seen as the first tentative steps towards providing a SDI framework based on data and technology standardization and integration within the AC. One issue that is currently unclear is the extent and nature of the GIS/mapping datasets that are available to/from the AC WGs.

A review of this information would be very useful to the process of developing a common Arctic Council strategy for GIS/mapping activities. In this context it is suggested that AC WGs be requested to provide relevant information on GIS/mapping datasets for which they are the

² A non-profit, international, voluntary consensus standards organization that is leading the development of standards for geospatial and location based services (<http://www.opengeospatial.org>).

owner and GIS/mapping datasets that are necessary/desirable for their work. This review would be conducted through a questionnaire which would involve an assessment of their datasets under criteria such as³:

- Positional accuracy
- Attributes and their associated accuracy
- Temporal accuracy
- Logical consistency
- Data completeness
- Data ownership and conditions of use
- Metadata
- Contribution to long-term sustainability of the Arctic and beyond

This information could constitute the first stage in the development of a catalogue of AC spatial data, i.e. metadata clearing-house that could be added to an appropriate Arctic spatial data inventory. Construction of such an inventory is one option for a product that might be considered as an AC deliverable at some point in the future and potentially also as a product that could contribute to the AC initiative(s) to maximise the legacy of the IPY.

The EPPR work-plan includes Interactive Maps and Environmental information from AC Programmes on the web. This work will, necessarily, involve a strong GIS/mapping component and require potential GIS data contributions from other WGs (e.g. AMAP – on oil and gas activities, PAME – on shipping activities, and CAFF on vegetation mapping, species distributions and vulnerability) and other parties. As such, this project represents an ideal opportunity to both test and realise an ‘Arctic Council’ internal cooperation on GIS/mapping.

5. Preliminary Conclusions and Recommendations

Clear messages arising from or repeated during workshop discussions included the following:

- There is a major need for an **Arctic SDI**, which would provide for the development of the necessary standards and framework to promote and facilitate data sharing, data documentation, 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.
- Development of a **Data Policy** must be an integral part of any ASDI strategy. Appropriate acknowledgement of data sources is essential in order to maintain the flow of data. Some data may be proprietary, subject to restrictions, provided under commercial arrangements. The Data Policy needs to accommodate all of these issues.
- The standards implemented through the American & Canadian Freedom of Information Acts and the European INSPIRE Directive should be considered as the basis for standards to be adopted under an ASDI. These standards have already been adopted in four of the Arctic countries. Other Arctic countries should compare INSPIRE standards with their national systems to evaluate compatibility.

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

- Primary high-quality datasets should preferably be produced and maintained as close as possible to the groups possessing the necessary scientific and technical expertise to do this work. In addition, any given dataset should be made available from a single location, so as not to increase the circulation of multiple copies in different states of update. If datasets are copied for distribution purposes, this should be based on 'mirror-sites' that are set-up to routinely update their copies to match those available from the primary sources. This can be technically realised through a **Distributed Data Structure** approach as, for instance, has been implemented in the Barents SDI.
- Maintenance of high-quality GIS/mapping datasets is probably the single greatest challenge to the successful implementation of an ASDI. There are numerous examples of initiatives, where resources made available for the development of systems are not matched by the resources necessary for their long-term maintenance. For gaining access to high quality and persistently updated background information, i. e. the underlying feature layers as described above, a close co-operation should be initiated with the national mapping authorities.
- Member states should assess the ability of their National Spatial Data Infrastructures (NSDI) – normally coordinated by the national mapping authority – to contribute to an ASDI. The Arctic Council could actively promote this, for example, by requesting the Chair of the Arctic Council to request contributions to AC GIS-mapping initiatives from National Spatial Data Infrastructures and mapping authorities. A first effort should be to express support for the proposal to use the existing Barents SDI as a platform for developing a circumpolar SDI – and thereby enable the Nordic mapping authorities to initiate discussions with their counterparts in the other AC member states on joint efforts for developing and managing an Arctic SDI.

On the basis of this, it is intended that a proposal for AC WG cooperation on GIS/mapping initiatives, as a contribution to the general Arctic SDI, will be prepared for submission to the fall meeting of the SAOs. Preliminary steps in the development of this proposal include:

1. Conducting a survey of existing data available within the AC WGs, and an inventory of datasets and metadata required/desirable to support AC WG activities, to identify gaps in existing information.
2. Proposing, for review by AC WGs and countries, data standards for adoption by all WGs in accordance with international standards for open access datasets
3. Considering options for open data access/sharing and secure data storage, including storage of legacy datasets belonging to the AC WGs.
4. Developing detailed proposals for implementing a project to update the Circumpolar Map of Risk based upon information from AMSA, OGA, CBMP, etc.
5. In co-operation with the Nordic mapping authorities – and with participation from other AC member countries – develop a proposal for an Arctic Spatial Data Infrastructure (including standards and data policy) for adoption by the AC and its WGs, as a component and aligned with other international SDI:s, including proposals for interaction with external partners (UARctic, national mapping authorities, etc.)