A Cybercartographic Atlas of Antarctica
An Initial Proposal and Conceptual Design

Executive Summary

This proposal is for the creation of a web-based Cybercartographic Atlas of Antarctica. The atlas will be produced in Canada by the Geomatics and Cartographic Research Centre (CCRC) of Carleton University in Ottawa. The Centre, in cooperation with national mapping organizations and researchers in several countries, and with involvement of the private sector, has been involved in the creation of a number of cybercartographic products over the last five years. These include: the *Canadian Geographic Explorer* (1995); the *Electronic National Economic Atlas of China* (1996); the *Queen Charlotte Islands Explorer* (1997); the *DataAtlas@China* (1998); and the *Atlas Cibernético del Agua en América* (www.atlaslatinoamerica.org) (2000). This latter web-based atlas was produced in cooperation with the national mapping organizations and universities in eight Latin American countries with funding from the Inter American Development Bank and the governments of Canada, Brazil and Mexico, and was coordinated by the Pan American Institute of Geography and History (PAIGH) in Mexico City. It is also available on CD-ROM.

The proposal for a similar Cybercartographic Atlas of Antarctic grows out of the Latin American experience and will involve cooperation with a number of countries interested in Antarctic research including Argentina, Australia, Bulgaria, Canada, Chile, China, New Zealand, Norway, the United Kingdom and the United States. This proposal was discussed by the Canadian Committee for Antarctic Research (CCAR), the organization responsible for coordinating all Canadian scientific research on Antarctica, and adopted as a formal CCAR project. The proposal was then presented by CCAR to the Scientific Committee for Antarctic Research (SCAR) Working Group on Geodesy and Geographic Information in Tokyo in June 2000, following which researchers from several countries indicated their continuing interest. In The Hague in September 2000 the Canadian delegates presented the project and it was noted for information by the Committee for Environmental Protection (CEP) of the Antarctic Treaty which stated to the Antarctic Treaty Consultative Meeting that this development "could supplement and be of assistance to the various information and databases presently used and assist the CEP in its work." The project will be discussed by the SCAR Working Group members in Siena in July 2001 and will be proposed as a formal SCAR Working Group project. During that same month Canada will report on progress with the project at the Antarctic Treaty Consultative Meeting in St. Petersburg, Russia.

Cybercartography is a term which was introduced at the International Cartographic Association Conference held in Stockholm in 1997 to describe a new form of interactive, multi-dimensional and multi-sensory cartography where the map is central to what is essentially a cartographic information system. It is different and distinct from a geographic information system (GIS) in

which maps are used, but are not central to the system. Cartographic information systems do, however, include many of the functionalities of a GIS as part of the system.

The theme of the Cybercartographic Atlas of Antarctica will be environmental characteristics and parameters and the cybercartographic approach is particularly well suited to the Antarctic region and of benefit to the understanding and management of Antarctic concerns and issues for a number of reasons:

- Antarctica is a region characterized by long distances and great disparity of scales of information and data with large areas where data are very sparse but with smaller areas of detailed information. A cybercartographic atlas can deal with both general information on a continental scale and larger scale vignettes on smaller areas on a wide variety of topics.

- Antarctica is a region of very slow but important natural dynamic change in many characteristics, but one of sensitive environments that are at least in part subject to dramatic or catastrophic alteration.

- Antarctica is a region where the interaction of physical, biological and human influenced characteristics and processes are of prime scientific and policy importance, and there is a growing need for a common method of assembling and portraying the information that comes from a wide range of studies and observations. Cybercartography is an excellent method for these purposes.

- Antarctica is a region where the available data and information comes from observations, measurements, and research by scientists and monitoring or survey agencies from many countries, using a variety of techniques, languages, standards and verification procedures. There is a need for a practical, flexible and economic means to assemble and display this information and to identify important gaps. A comprehensive interactive atlas, amenable to continental, regional or local scales and capable of superimposing the time dimension as well as overlaying both qualitative and quantitative data is a basic step in meeting this need.

The Protocol on Environmental Protection to the Antarctic Treaty calls, in its various clauses and annexes, for a capacity to assemble and display, in appropriate scales of space and time:

- Information on environmental characteristics

- Past, current or proposed activities and their impacts

- A means of monitoring and displaying changes, the results of response actions, and assessments of impacts for management or liability decisions

A comprehensive, interactive, multidimensional cybercartographic atlas will be an important tool for meeting these needs. The atlas will also provide the general public with a modern and up-to-date source of information about Antarctica in an interactive multimedia format.

There is a considerable amount of data available in machine readable form on Antarctica as well as a number of spatially referenced datasets. Of special importance is the On-line Atlas of Antarctic Research maintained by the United States Geological Survey, the extensive text, images, photographs and map data resources of the USGS Antarctic Resource Centre, and the resources of the British Antarctic Survey. The proposed atlas is amenable to, and will build on, these and other existing databases such as the Antarctic Digital Database, the RADARSAT Mosaic of Antarctica, and the Global Change datasets. It is not the intention to collect substantive new data but to bring together in a new multimedia form selected existing datasets. This will include experimental work with virtual reality to illustrate under-ice conditions and real time live web camera images. The proposal is to produce a continental atlas at a relatively small scale supplemented by a series of vignettes at larger scales on individual regions or topics. The Antarctic Peninsula will be one focus of the larger scale studies but other regions will be included depending upon interest and availability of data.

A first step will be to build an international team of specialists from countries and agencies interested in contributing to the project. The project will be coordinated by Canada and interest has already been expressed by Argentina, Bulgaria, China and the USA and by other members of the SCAR Working Group on Geodesy and Geographic Information. The Commission on Multimedia Mapping of the International Cartographic Association, the world body for cartography, has agreed to participate and offer technical advice. A workshop is planned for December 2001 in Puerto Madryn, Argentina to bring some of the major players together to discuss the content of the Atlas. Production of the initial version of the atlas is foreseen by December 2002.

The estimated funding required to produce the Atlas is U.S. $450,000 including an initial budget of Canadian $96,218 which is required to further develop the project between April and December 2001. The "Going Global" fund of the Canadian Department of Foreign Affairs and International Trade has indicated an interest in funding the start up phase and is currently considering a funding application. A final response is expected in July 2001.

Major questions which must be answered include the most useful scale and focus, audience and users, accessibility, format and control of data, the appropriate software and hardware to be used, and the creation of an effective and efficient system of updating and incorporating new information. Initial discussions on these issues were held at the USGS in Washington with the US representative on the SCAR Working Group, Dr. Jerry Mullins, and his colleagues in May 2001 followed by a teleconference between the USGS and the Canadian Committee for Antarctic Research. Canadian Scientists active in Antarctic research will advise on content issues in cooperation with colleagues on the various SCAR groups, including the Working Group on Geodesy and Geographic Information, on which Canada is represented.

The proposed management structure for the project involves a coordinating hub with a series of independent nodes and sub-nodes in participating countries. The details of the proposed management structure and the technical approach suggested is outlined in Appendix I. It is proposed that the existing USGS On-line Atlas of Antarctica Research function as a major node for map data. This will be facilitated by the fact that both the Geomatics and Cartographic

Research Centre and USGS On-line Atlas use ESRI software. It should be noted, however, that rather than insist on standardized approaches for all nodes it is proposed that "middleware" or "fusion ware" be used to allow nodes to transfer data to the coordinating hub. This will mean that existing data in a variety of different formats can be used without the effort and cost of conversion to a standard format. Sub-nodes which do not have the technical capability to present data in a geospatial format can link in with the nearest national node where the data can be prepared in an appropriate form. Organizations and individuals holding data on Antarctica who are not geospatial specialists could therefore contribute to the atlas. There are three key user groups, each with different needs:

- Antarctic scientists and researchers (SCAR)
- Antarctic managers and decision makers (CEP and Antarctic Treaty signatories)
- The general public

The design of the atlas must consider the needs of all three groups.

Sources of funding must also be identified to complete the project. Application for project start up funds has already been made to the Canadian Government and application for funding for the Puerto Madryn Workshop has been made to Argentinean sources. Given the distributed production structure proposed individual nodes may be able to fund elements of their participation, either in cash or in kind, as the project will utilize work already being done. Application for funding the hub will be made to Canadian research funding sources. This will include funding for the ongoing monitoring and update of the project on-line.

Useful experience, although in a different context, has been gained from the eight-country Latin American project mentioned earlier. The total budget for that project was Canadian $1.3 million. Initial seed funding was provided by PAIGH and major funding came from the Inter American Development Bank and the governments of Canada, Brazil and Mexico. The budget required for the Cybercartographic Atlas of Antarctica is more modest because much of the initial conceptual design and development of the Latin American atlas can be used as a base for the new proposal. Signatories to the Antarctic Treaty agree to share their datasets on Antarctica and these data are in theory available in the public domain. There are also good metadata descriptions available on many of these datasets, which was not the case with the Latin American project where metadata had to be created virtually from scratch and where data availability and access was a major problem.

An initial team of three individuals will be responsible for the further development of the project over the period April 2001 to December 2001. This will include: the project Principal Investigator, Dr. D. R. F. Taylor. Dr. Taylor is one of the world's leading cartographers and was President of the International Cartographic Association (ICA) for two four years terms. He is a member of the ICA Commissions on both Visualization and Multimedia Mapping and Co-Chair of the Advisory Committee to the National Atlas of Canada. He is Director of the Geomatics and Cartographic Research Centre; the Administrator/Coordinator, Ms. Barbara George; and Mr. Peter Pulsifer of Falconview Technologies who worked extensively on the Latin American project. Mr. Pulsifer is a Research Associate of the Geomatics and Cartographic Research

Centre. The team will be assisted by Dr. Daniel Vergani of CENPAT, Argentina who will have the major responsibility for the local organization of the Puerto Madryn workshop. A detailed budget is available for the start up phase together with an estimate for the overall project.

Proposed Budget

U.S. $450,000

APPENDIX I: Management and Technical Structure

Objectives of the Atlas:

1. Showcase research results.
2. Share data and information between researchers. Will facilitate collaborative research and provide a central repository for data and literature about Antarctica.
3. Facilitate the work of decision makers by providing timely and comprehensive data
4. Act as a method of communication to the public.

Methods:

- The Atlas will be an official SCAR Working Group on Geodesy and Geography Information project that will be produced and maintained with support from member nations and various funding agencies.
- The GCRC at Carleton University will produce and maintain the Atlas in cooperation with a number of other participants.

Conceptual Framework for Delivery Approach:

1. *Atlas Hub*: This will be the central site that integrates content and presents it to the target audience.
2. *Node 1*: This can be a self sustaining Atlas site (i.e. USGS) that establishes a connection to the hub so that content will be available to a large audience. The idea is to go beyond the traditional redirection of traffic via a link. The Atlas would support this approach as well as being able to integrate the node's data for other types of representation.
3. *Node 2*: This node represents a node that may or may not have map data. An example might be a metadata server, bibliography, library or a repository of geo-referenced (either by placename or some type of coordinate system) multimedia data.
4. *Sub-node:* For participants who would like to partner with those maintaining a node. Allows data sharing without the requirement for establishing infrastructure. Also provides the potential for value-added services by the node before moving to the hub.
5. *Combination Node/Sub-Node:* The model is flexible and therefore any participant can be partnered with a node i.e. someone geographically close to them, while at the same time, contributing content directly to the hub.
6. *Internal Node:* For those who would like to participate but do not choose to establish infrastructure (for whatever reason), content can be hosted directly on the hub.
7. *Middleware:* Ideally, all content would be in the same format and have the same geo-referencing system, however, this is an impractical expectation. To avoid data conversion, a middleware approach will be adopted that will convert data on the fly. Middleware is the software that will allow an application such as the Antarctic atlas to access the geospatial data in an appropriate format and georeferencing system.   Using this approach, neither the atlas managers nor the participants would need to convert data so that it could be included in the atlas. Databases can retain their original formats and therefore participation in the Atlas can have a minimal impact on the operations of those providing the data. In most cases, multimedia content will not require conversion as most of the formats are supported (directly or through the use of plug-ins) by the content delivery software (i.e. Web browser).

- Ideally, all content will have some type of metadata to facilitate retrieval by users.
- Potentially implement the Z39.50 protocol to allow for direct access to libraries and FGDC metadata servers.
- Participants can move from sub-node to node at will or vice-versa.

Example

(See attached figure)

A practical example of the model above [this should not be presented in the final draft as it is an example only] :

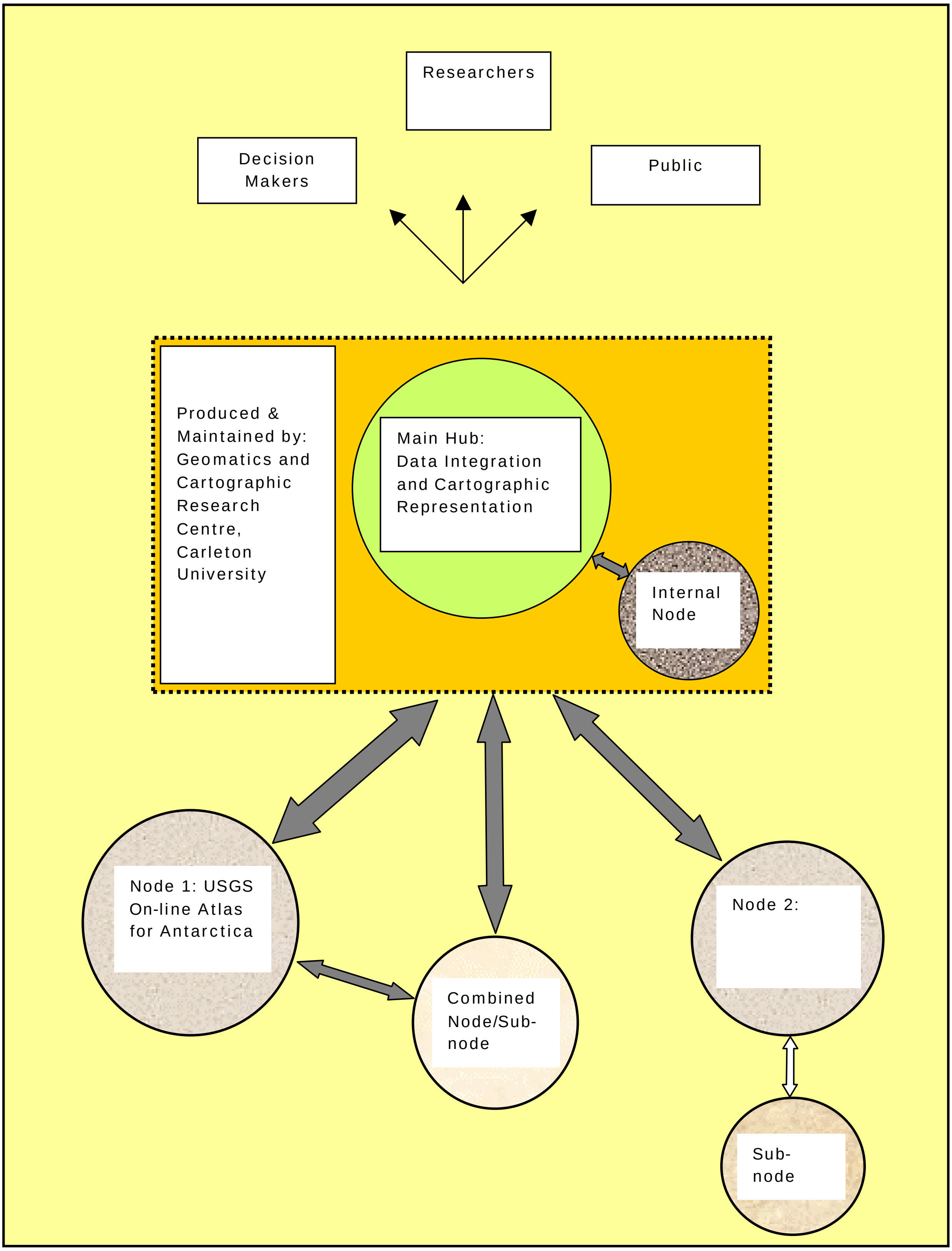
Atlas Hub: The Geomatics and Cartographic Research Centre responsible for coordination, production and maintenance

Node: USGS On-line Atlas for Antarctica

Sub-Nodes: China

Node/Sub-Nodes: i.e. Canada acts as a node, however on some projects acts as a sub-node on a collaborative project with the USGS by providing processed RadarSat data from the Canadian node directly to the USGS node (thus acting as a sub-node). More value added takes place and ultimately the result is delivered to the Atlas via the USGS node. This type of approach would likely work in the other direction also. i.e. Canada uses USGS data as a base for a project and then delivers to the Hub.

Internal Node: Bulgaria


Researchers
Decision Makers
Public
Produced & Maintained by: Geomatics and Cartographic Research Centre, Carleton University
Main Hub: Data Integration and Cartographic Representation
Internal Node
Node 1: USGS On-line Atlas for Antarctica
Combined Node/Sub-node
Node 2:
Sub-node