A CYBERCARTOGRAPHIC ATLAS OF ANTARCTICA

An Initial Proposal and Conceptual Design

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This proposal emerged as a result of cooperation among eight Latin American nations and Canada in the preparation of a Cybercartographic Atlas of Latin America. This Pan American Institute of Geography and History project, funded by the Inter-American Development Bank, was completed in June 2000. The Atlas appears on the world wide web at <www.atlaslatinoamerica.org>. An interactive CD-ROM version will also be available. Argentina was an active participant in the creation of the Atlas, the theme of which is water and sustainable development. The overall theme is supplemented by a series of case studies prepared by each nation. These more detailed "vignettes" include studies of the Mapocho River Basin in Chile, the Valley of Cusco in Peru, etc. and are at much larger scales than the overall atlas. In addition to the Continental Atlas, each of the eight nations involved is creating a national atlas at a larger scale on CD-ROM and a number of these, such as those for Chile and El Salvador, are already complete. Metadata clearinghouses were established for spatial data following a modified version of the FGDC standards and two gateways, one in Mexico and one in Brazil, were established. A continental atlas in tactile format was created for the blind. Dr. Daniel Vergani of Centro Nacional Patagonico and his colleague MSc. Zulma Stanganelli were both involved in the atlas project and are preparing a vingette for La Puna. Dr. Vergani has had extensive Antarctic experience as a biologist and proposed the creation of a Cybercartographic Atlas of Antarctica utilizing the same hardware and software already in place for the Latin American Atlas. The proposed Antarctic Atlas is therefore built upon the experience developed over the last three years and the training provided through the workshop held for this purpose in Puerto Madryn in 1999. The structure and conceptual basis of a continental atlas with vignettes on different areas or themes utilized for the Atlas of Latin America will be adopted for the proposed Antarctic Atlas.

A comprehensive Atlas of the Antarctic region at the beginning of the 21st century would be a fitting commemoration of the centenary of the surge of geographical, scientific and explanatory interest at the close of the 19th century and the beginning of the 20th century which was given impetus by the International Geographical Congress in 1895 resulting in a number of expeditions from Britain, Belgium, Germany, Sweden and France. Although in the public eye and from the point of view of the sponsors some of these expeditions were rivals, in their preparation and scientific work there was a remarkable degree of international cooperation and sharing, and nearly every expedition of the "classical period" of Antarctic exploration included experts from different countries. The creation of the Atlas would require a cooperative effort in terms of data sharing by a number of key organizations and national actors. The experience gained in creating the large team of participants for the Latin American Atlas and the need to involve up to 20 agencies in each of the eight participating countries will be useful in this respect. The proposed atlas will be produced by the Geomatics and Cartographic Research Centre at Carleton University in Ottawa.

Cybercartography

The term "Cybercartography" was introduced in a keynote address to the International Cartographic Association Conference in Stockholm in 1997. It encompasses a series of technological and organizational elements:

- The application of cartography to a much wider range of topics
- The utilization of an increasing range of emerging media formats and telecommunications networks such as the Internet and the World Wide Web
- The development of a multi-dimensional cartography using multimedia formats as an integral part of an information package rather than a stand alone product
- Cybercartography is highly interactive and engages the user in new ways
- In organizational terms Cybercartography sees new partnerships being created among national mapping agencies, research centres, the private sector, non-governmental organizations and educational institutions
- Cybercartography products are likely to be compiled by teams of individuals from very different disciplinary and professional perspectives working together

The approach incorporates elements of Geographic Information Systems (GIS), especially a variety of functionalities, but it is an essentially Cartographic Information System based on the map as the primary interface. In many GIS the map is seen simply as an output or display device.

Objectives

The main objectives in creating a Cybercartographic Atlas of Antarctica are:

- To integrate the extensive existing knowledge base, both current and historical, of Antarctica and present it in any easy to use multimedia format based on the map. The Atlas will be Web based and will be aimed at a variety of users including the scientific community, political and administrative decision makers and the general public. Different interfaces will allow both sophisticated and less sophisticated users to interact with the Atlas in an appropriate manner.
- To present a holistic and integrated view of a variety of topics such as climate change, fisheries, human impact, tourism, ecology, etc.
- To create an interactive framework through the Atlas to better understand the importance of Antarctica in terms of sustainable development as perceived both by developing nations and post-industrial societies, and of the global environment
- To foster and facilitate increased cooperation among the different agencies involved in scientific research (e.g. SCAR and SCAR subsidiary groups, CCAMLR, IWC and various national Antarctic programs), to aid in logistics and planning (e.g. COMNAPS/ SCALOP), governance (e.g. Antarctic Treaty/Committee on Environmental Protection) and private sector operators (e.g. IAATO) concerned with

Antarctic matters. The need for greater rationalization of information exchanged through the Antarctic Treaty System has been recognized and both COMNAP and the United States presented working papers on this topic at ATCM XXIII in 1999. The proposed atlas will be web based and will contribute to the exchange or information utilizing the internet which is seen as a key element by many signatories to the Antarctic Treaty.

Methodology

The production of the Atlas will utilize the same methodology utilized for the Cybercartographic Atlas of Latin America. The software and hardware are already in place and are both functional and operational. Currently ESRI software is the software of choice and MapObjects has been used to create the existing web atlases. It is planned to have two identical platforms, one in Ottawa and one in Puerto Madryn. It is recognized that software and hardware are advancing rapidly and the half life of knowledge is very short. Although the conceptual design of the Atlas will remain constant the choice of software and hardware may change to reflect technological advances. The Laboratory of the Geomatics and Cartographic Research Centre at Carleton University will be the location at which the atlas will be produced.

Antarctica is fortunate in having an excellent series of geographically referenced digital databases in both raster and vector formats. The first digital topographic database of Antarctica published on CD-ROM in 1993 under the auspices of SCAR was a milestone in Antarctic mapping. There is also an excellent RADARSAT database, the Mosaic of Antarctica , at 125m resolution and discussions are underway with the Canada Centre for Remote Sensing (CCRS) to utilize this database and to work in partnership with CCRS in this respect. The database is now available at moderate cost. BAS Mapping and Geographic Information Centre (MAGIC) participated in the preparation of the international Antarctic Digital Database (ADD), a collaborative international project. There is also an excellent, although incomplete, Antarctic Digital Database in vector format at the Scott Polar Research Institute at Cambridge, and maps and datasets available on line through the GRID-ARENDAL facility in Norway. The Atlas of Antarctica Project of the USGS has a comprehensive collection of maps, charts, satellite images and photographs in the public domain. There is also a series of digital maps of Antarctica produced by the CIA. There are at least two GIS based projects: VALMAP, a GIS for Physical Features in the McMurdo Dry Valleys; and a new proposal for the development of a GIS for King George Island by the Wuhan Technical University of Surveying and Mapping in China where an initial meeting will take place in July 2000.

The choice of the best database or databases to use will be made in cooperation with partner agencies and working with SCAR's WG-GGI. Existing databases on Antarctica are not fully interoperable. There are both technical and organizational challenges in the production of the Atlas. The technical problems in this respect, although not insignificant, are perhaps not as great as the problems, not insurmountable, of bringing together systems that have evolved under different policies and different jurisdictional and operational systems. The approach to these problems will be a consultative and cooperative one. It is not the intention of the proposed atlas to duplicate effort. Initial contact has already been made with China to discuss cooperation on the proposed King George Island GIS and a response has been received indicating their desire to cooperate. Contact has also been made with the Antarctic Information Program in the United States to seek cooperation and collaboration. It is planned that all of the major existing cartographic

and GIS projects related to Antarctica will be consulted as the project develops. Approval in principle for cooperation has been reached with Dr. Joel L. Morrison, Director of The Center for Mapping, The Ohio State University in Columbus, Ohio.

The conceptual design must take both administrative and technical issues into account and will be based on the experience gained during the development of the Cybercartographic Atlas of Latin America.

Content

The content for the Atlas must be defined to respond to the needs of the users and a workshop is planned for December 2001 in Puerto Madryn, Argentina to finalize the content. It is expected that the key actors, including members of SCAR's WG-CCI, will be invited. A funding application to Argentinean authorities for the support of this workshop is already in progress.

In preparation for the Puerto Madryn Workshop and for the production of the Atlas contact will be made with a number of key Antarctic international organizations involved in issues such as Climate Change, Resource Management (CCAMLR EMM program), IWC Working Groups and the Environment (The Antarctic Treaty/Committee on Environmental Protection). The input to content of all of these players will be important. A major source of information on available data and contacts is the United States Antarctic Resource Center web page: http://USARC.USGS.GOV/

Much of the information content for the Atlas already exists in digital format and much is available from existing web sites on line. What is required is a different organization and presentation in an integrated fashion using the web and the powerful analytical and communication capabilities of cybercartography. Some material will be available for the continent as a whole but much will be area specific or even specific to individual locations. Initial concentration will be on the sector defined by latitudes of 60o - 90oS and 30o - 85oW but other areas will be included as case studies if data of particular interest is available.

Theme of the Atlas

Ice is the dominating contextual reality in Antarctica and a great deal of information on it is available in digital form. Water is a vital natural element and a central theme for ecological management as it interconnects natural resources, the environment and human activities. It regulates the balance of the global ecosystem as defined by the existing relationships among the biosphere, the atmosphere, the lithosphere and the hydrosphere. Ability to include and portray ice in all its characteristics, processes and effects will therefore be a unique feature of the Atlas of Antarctica, and will determine its scientific, environmental, operational and political importance.

Sea ice is a particularly important element in this complex equation. It is highly variable and reflects seasonal and longer term variations in climate. Sea ice covers seven percent of the ocean surface and has a significant influence in reducing the total solar energy absorbed by the earth's surface. It is a major variable affecting the heat transfer from oceans to the atmosphere and thus has an important influence on the global circulation of both the atmosphere and the oceans. As, on an annual average, about two thirds of the

sea ice of the world occurs around Antarctica, the Atlas must give particular attention to this phenomenum.

The characteristics of the oceans around the Antarctic Continent and the sea ice are complex. The northern limit for sea ice varies greatly on a seasonal, yearly, decadal and longer basis, influenced by and itself influencing variations in weather and ocean currents. There is a definite average western drift of sea ice close to the continent around many parts of the Antarctic coastline, and a countervailing easterly flow in most of the off shore areas as part of the circumpolar circulation of the Southern Ocean. Microwave satellite sweeping systems, which began in the 1970's, have revealed many of the complex dynamics of the distribution and dynamics of the ice cover such as the irregularities in its boundaries. The extent of the ice is greatest in September and least in February although there is considerable annual variation and inter-regional differences in ice cover. In recent years there has been a significant decrease in the extent of the ice cover.

Although ice is a central contextual reality for the Atlas, the major theme of the Atlas will be the integration and presentation of existing data on Antarctica from a variety of different perspectives. This will allow new forms of more holistic analysis to complement the somewhat reductionist approach currently in place. These analyses will have important implications for understanding the conditions for biological productivity and the characteristics of critical habitats and abundance of living resources.

There are excellent scientific data from a variety of different disciplines available in digital form with some material in downloadable form from web sites, especially in the U.S.A. These data are relevant to a number of policy, environmental impact, and management issues. The proposed Atlas will provide a framework in which these issues can be considered in a more integrated and interactive fashion.

At present five subsystems are proposed for the Atlas:

- A geographical context subsystem
- An environmental subsystem
- A socio-economic subsystem
- An environmental impact subsystem
- An evaluation subsystem

Within each of these subject subsystems general presentations will be complemented by case studies. A portrayal of the tourist sites and activities in the peninsula area may be very useful. For example, the geographical subsystem might provide information on changes in sea level or of the extent of the ice shelves; the environmental subsystem the evidence pertaining to climate change; or the socio-economic subsystem might portray the expansion and usage of tourist destinations and their effects, etc.

The details will be refined in consultation with the major players over the next year and finalized at a workshop in Puerto Madryn planned for early December 2001. Some initial ideas which are being explored include a study of King George Island in the South Shetlands where the human impact has probably been the most intense of any part of the Antarctic given the number of scientific bases there and the concentration of both scientific activities and tourism. A meeting is planned in Wuhan, China to discuss creation of a GIS for King George Island and cooperation and contribution to the cybercartographic atlas is expected in this regard. Contact with those involved has already been made and agreement in principle for cooperation has been reached. Another possible topic relates to

the proposal put to the Antarctic Treaty Consultative Committee in 1999 to prepare an Antarctic State of the Environment Report. New Zealand is involved in a pilot project of the Ross Sea and this would provide an excellent vignette for the Atlas. Initial contact has been made with New Zealand to explore cooperation in this respect.

Timelines and Budget

Timelines

The Atlas has been endorsed in principle by Atlas CCAR.

July 2000	Consideration of the Atlas concept and possible endorsement by WG-GGI and possible endorsement by SCAR General Assembly
July 2000	Application for funding for the planned Puerto Madryn workshop and for preparatory work if the concept of such as atlas is approved by SCAR
July 2000-December 2001	Discussion and development of approach and content of the Atlas with key players including the holding of the Puerto Madryn workshop. Identification of funding sources to produce the Atlas.
December 2002	Production of the Atlas and launching of the World Wide Web. Once it is established provision must be made for its maintenance and update.

Budget

At this stage a detailed budget has not been developed as much will depend upon how many partners choose to participate and on the design of the final project. The budget for all aspects of the Cybercartography for the Americas Project was US $942,000. This included the purchase of hardware, software and the expenses for creating a team of 15 Latin American trainers and the organization of eight national training workshops in addition to the actual production of the atlases. For the Antarctic Atlas the costs will be more modest. Depending upon the extent of the content which will be decided in consultation with the users the total cost of the project should not exceed US $300,000. Production of the final version of the Atlas will be in Ottawa but preparatory work will also be done in Argentina.

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