

## REPORT ON ANTARCTIC GEOGRAPHIC DATA INTEGRATION PROJECT (AGDI) 1998 - 2000

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At XXV SCAR meeting in Concepcion, July 1998, the Working Group agreed to the following work program for AGDI:

**Goal:** To facilitate availability of integrated fundamental GIS datasets (including surface elevation, bedrock elevation, bathymetry, coastline and features) over Antarctica, through liaison with other programs and international agencies, for use by global change researchers and other scientists.

### Objectives:

1. Project Plan:
  - small information paper and associated graphics to explain the project.
2. Specifications:
  - (a) finalise data product requirements, in consultation with GLOCHANT;
  - (b) develop data product standards, based on ISO TC211 and Global Mapping.
3. Projects:
  - (a) promote specifications to key agencies and projects;
  - (b) support integration of fundamental datasets, as appropriate.

### REPORT ON PROGRESS SINCE XXV SCAR

1. A four-page information brochure on AGDI has been produced and printed – see attached. A large poster on the project has been produced and displayed at the Coordinators meeting in Heppenheim, Germany as well as by Janet Thomson at the International Symposium on Antarctic Earth Sciences in Wellington, NZ in July 1999. Approximately 95 brochures were distributed at the ISAES symposium. The poster was also displayed at the West Antarctic Ice Sheet (WAIS) workshop, held in Virginia, USA on 16-18 September 1999.

2(a). The data product requirements were part of general discussions on AGDI at a meeting of Australian Antarctic scientists held in Hobart, Australia on 13 May 1999.

The meeting altered the focus of the project slightly with a distinction being made between those researchers who wish to access the raw data for modelling purposes (generally in a small and contained region) and those who would like standardised, integrated data on a continental-wide scale provided for them. Glaciologists, for example, may - depending on the type of research they are conducting - alternate between modelling in small areas (like the Amery basin) and running the same models over a continental-wide dataset.

As a result of the Hobart meeting the aims of AGDI were revised to the following:

- To define a standard data model for Antarctic geographic data - to enable integration of fundamental GIS datasets.
- To promote the data model and facilitate the availability of data through the creation of “data libraries” containing all and the best available fundamental data. [These libraries will be accessible from the AGDI web site and metadata records held in the Antarctic Master Directory.]
- To create a standardised and integrated 1:5 Million scale product containing all six fundamental GIS datasets. The product will be made available on the web and on CD-ROM.

There has been an extensive upgrade of the AGDI web site to include the information in point 2. Data libraries for all 7 fundamental datasets are available at: <[www.scar-ggi.org.au/geog/agdi/intro.htm](http://www.scar-ggi.org.au/geog/agdi/intro.htm)>

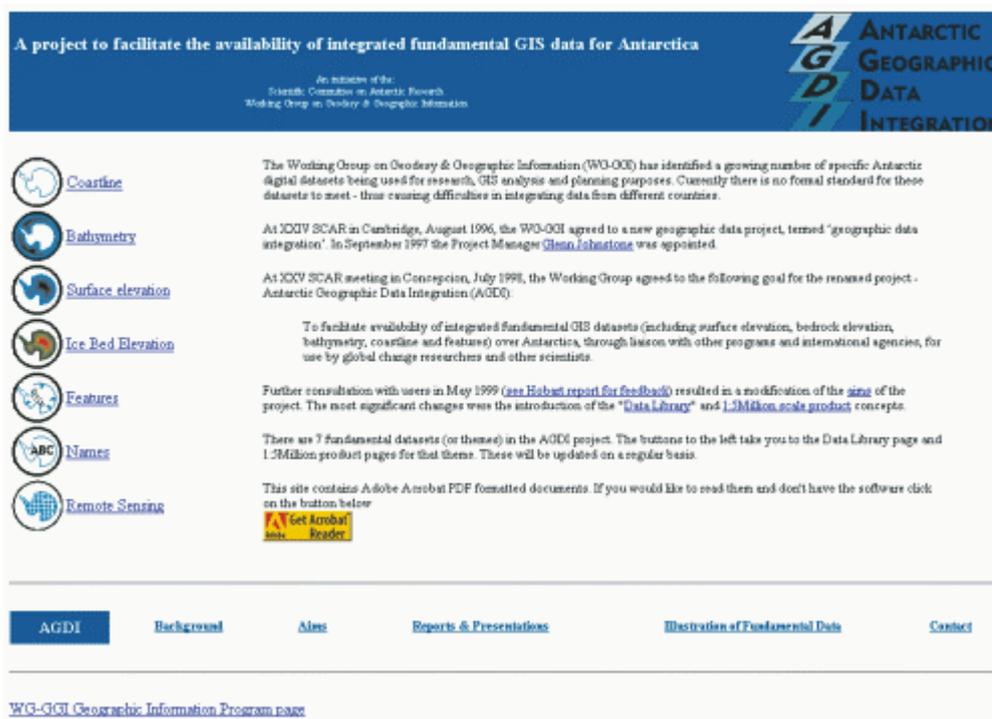


Fig. 1: AGDI Home page on the Internet

2(b). The draft specifications for the 1:5 Million product have been drawn up – see Table attached.

The Global Map specifications have been forwarded to Janet Thomson – who has created the 1:1 Million scale Antarctic data required for the Global Map project. Given that both vector and raster data, in the 1:5M data product, will only have a small number of feature codes to be compliant with the Global Map specification the actual task of creating the AGDI 1:5M product should in theory be fairly straight forward.

ISO TC211 standards are still being worked upon – with a number of AGDI-nominated standards being at either the Committee Draft stage or Draft International Standard stage. The table below summaries the status of the ISO projects the AGDI project is interested in:

Standard	Level Reached (at June 2000)
Reference Model	Text for approval as Draft International Standard
Profiles	1 <sup>st</sup> Committee Draft
Spatial Schema	3 <sup>rd</sup> Committee Draft
Temporal Schema	Text for approval as Draft International Standard
Feature Cataloguing Methodology	Text for approval as Draft International Standard
Spatial Referencing by Coordinates	Text for approval as Draft International Standard
Quality	Text for approval as Draft International Standard
Metadata	3 <sup>rd</sup> Committee Draft
Imagery & Gridded Data	Technical Report to ISO for publication

Table 1: Status of ISO TC211 projects at 19 June 2000  
 Source: ISO TC211 web site  
 <<http://www.statkart.no/isotc211/pow.htm>>

3 (a) and (b). Promoting specifications to key agencies began in May 1999 with the meeting in Hobart and has continued with visits in July 1999 to the IHO, British Oceanographic Data Centre (who produce the digital GEBCO atlas) and BEDMAP.

It is useful for members to have an understanding of the status of the 7 fundamental dataset projects being considered for inclusion in the 1:5 Million scale product. These are outlined below and are also available from the AGDI web site. Project leaders and their organisations responsible for each fundamental dataset are identified.

## UPDATE ON FUNDAMENTAL DATASETS

### BATHYMETRY

#### General Bathymetric Chart of the Ocean (GEBCO) - Dr Meirion Jones, British Oceanographic Data Centre

There has been considerable contact, since XXV SCAR, with a number of organisations around the world responsible for gathering and storing digital bathymetric information south of latitude 60° South.

The web page <[http://www.scar-ggi.org.au/geog/agdi/lib\\_bath.htm](http://www.scar-ggi.org.au/geog/agdi/lib_bath.htm)> shows the extent of digital bathymetry holdings the Project Manager has been able to identify for the Data Library component of AGDI.

Talks with the International Hydrographic Bureau (IHO) revealed that there is limited digital data held by the IHO and what they do have is large scale and concentrates on the heavily trafficked routes into bases, particularly around the peninsula region. The preferred strategy for this project is that AGDI will use the digital version of the General Bathymetric Chart of the Oceans (GEBCO) dataset for the bathymetric component of the project along with other data from IHO members and any other sources - where necessary. The GEBCO Digital Atlas (GDA) is maintained by the British Oceanographic Data Centre (BODC) on behalf of the IHO and the Intergovernmental Oceanographic Commission (IOC) of UNESCO. Formal clearance from BODC and the IHO to use the digital data for AGDI will be required.

In the past 2 years there has been a lot of work done by British Antarctic Survey turning the GDA contours into polygons for tinting - primarily this has meant joining broken lines. The GDA has been put together as a digital *cartographic* product and therefore to make the contours GIS-compatible (ie. topologically structured) has meant many months of work. How this information will be fed back into the next version of GDA has not yet been determined.

There has been some concern expressed by BEDMAP about the accuracy of some GDA data for the purposes of ice-sheet modelling out to the continental shelf area. The AGDI Project Manager spent some time in mid-1999 contacting a number of organisations regarding their holdings of bathymetric data.

Data have been gathered from Raytheon Polar Services Company (formerly Antarctic Support Associates [ASA]) from the USA; the Japanese National Oil Company, through the Japanese Geological Survey; and to a lesser extent the Southern African Data Centre for Oceanography [SADCO] and the Royal South African Naval Hydrographer [HydroSAN]. The aim of gathering these data is to eventually integrate this into a version of the GEBCO Digital Atlas.

The AGDI Project Manager has successfully gathered cruise information and soundings data for the Nathaniel B. Palmer – US NSF research vessel from 1992 to 1999.

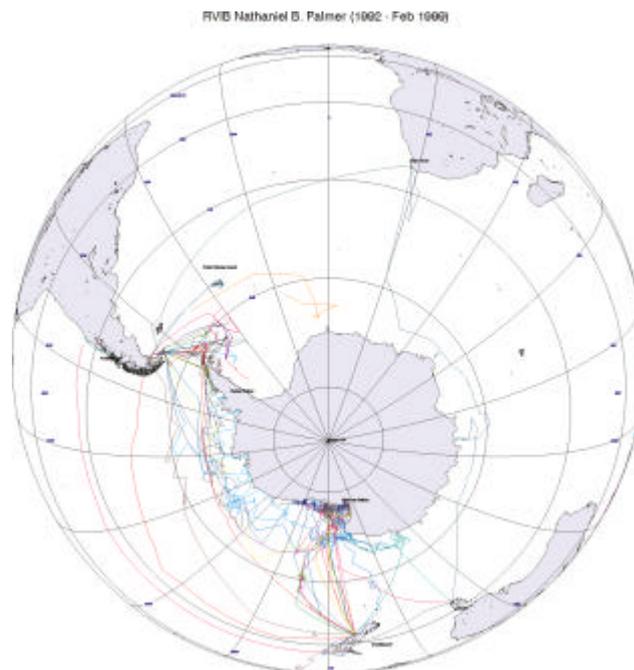


Fig. 2: Nathaniel B. Palmer cruise tracks south of 60° South 1992 - 1999  
Source: Jim Holik, Manager, Marine Science, Raytheon Polar Services Company  
<<http://www.polar.org/marine/index.html>>

The Japanese National Oil Company (JNOC) has delivered data from their cruises to Antarctica from 1980 to 1998 in MGD77 format. This has been passed onto BEDMAP to assist in the compilation of gridded bathymetric data and to enhance the GEBCO data BEDMAP are already using.

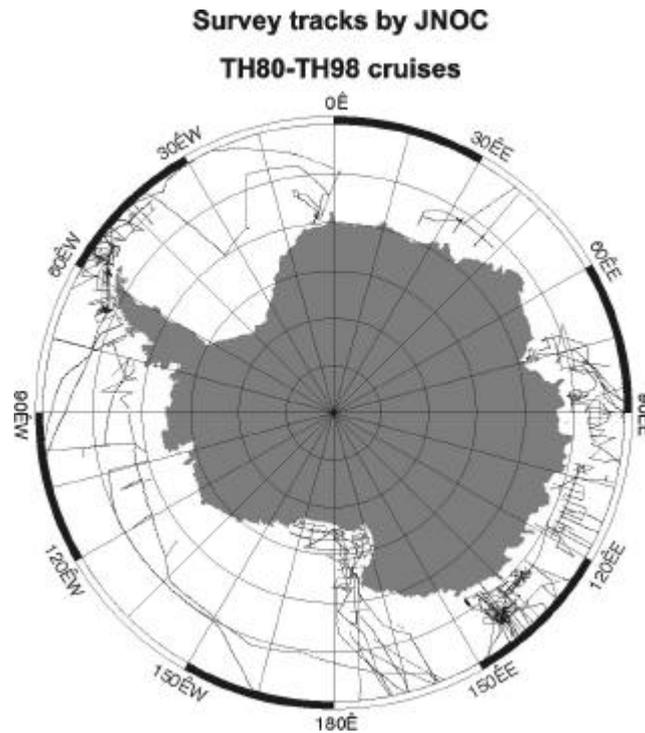


Fig. 3: JNOC cruise tracks south of 60° South 1980 - 1998  
Source: Takemi Ishihara, Japanese Geological Survey  
email: <tishi@jgs.go.jp>

The Southern African Data Centre for Oceanography (SADCO) has a web site <<http://morph.csir.co.za:8080/sadco1/sadinv>> where users can access bathymetric information from a data inventory.

SADCO have supplied the Project Manager with some of the cruise track data for those voyages south of 60° South. It will take some time to retrieve all the information from SADCO's inventory as it has to be done voyage by voyage for more than 200 voyages into Antarctic waters.

Further information on SADCO can be found at <<http://fred.csir.co.za/ematek/sadco/sadco.html>>

The Hydrographic Service of the South African Navy (HydroSAN) have a lot of data, however, the sounding data is embedded in other oceanographic data and is difficult to retrieve. They are hoping to write a Fortran program that will unlock most of the sounding data. This may be some time off as resources are limited.

There was a proposal put to the SCAR Executive Meeting in Goa, India, in September 1999 for SCAR funding to assist with the compilation and integration of a number of these datasets. The aim was to assist both the BEDMAP and AGDI projects in producing a better digital bathymetric dataset in the Antarctic region. It was hoped this funding would provide a boost to both projects digital datasets. Unfortunately the funding application was unsuccessful and the work has had to be put on hold.

## SURFACE ELEVATION

### **RADARSAT Antarctic Mapping Project (RAMP) - Dr Ken Jezek and Dr Hongxing Liu, Byrd Polar Research Centre, Ohio State University**

A continental mosaic and an orthorectified (or georeferenced) image dataset are the primary aims of the project. The Digital Elevation Model (DEM) – a secondary product being generated to aid in orthorectifying the SAR images – has now been completed and is available for use.

The RAMP DEM combines topographic data from a variety of sources to provide topographically consistent coverage of all of Antarctica and represents a substantial improvement in horizontal resolution and vertical accuracy over previous digital elevation models, particularly in mountainous and coastal regions.

A primary data source was ERS-1 satellite radar altimeter data from April 1994 to March 1995. Other data include airborne radar data, detailed cartographic data from the Antarctic Digital Database, and large-scale topographic maps from the U.S. Geological Survey (USGS) and the Australian Antarctic Division. These data were collected from the 1940s to present, with most collected during the 1980s and 1990s. Data for the 1 km and 400 m DEMs are provided in ARC/INFO GIS, binary, and ASCII formats. Data for the 200 m DEM are in ARC/INFO format only.

Data access is unrestricted and housed on the National Snow and Ice Data Centre's FTP server. NSIDC recommend that users register with them because registered users of the RAMP DEM data automatically receive e-mail notification of product updates and changes to processing.

Detailed documentation can be found on the NSIDC web site: <[http://nsidc.org/NASA/GUIDE/docs/dataset\\_documents/radarsat\\_antarctic\\_mapping\\_project\\_digital\\_elevation\\_model\\_dataset\\_document.html](http://nsidc.org/NASA/GUIDE/docs/dataset_documents/radarsat_antarctic_mapping_project_digital_elevation_model_dataset_document.html)>

Other information on the RAMP DEM can be found at the NSIDC web site: <<http://nsidc.org/NSIDC/CATALOG/ENTRIES/nsi-0082.html>>



Fig. 4: Analytical Hill-shading of Antarctic DEM.  
Source: Dr Hongxing Liu, Byrd Polar Research Centre  
<http://polestar.mps.ohio-state.edu/~liu/research/dem/dem.html>

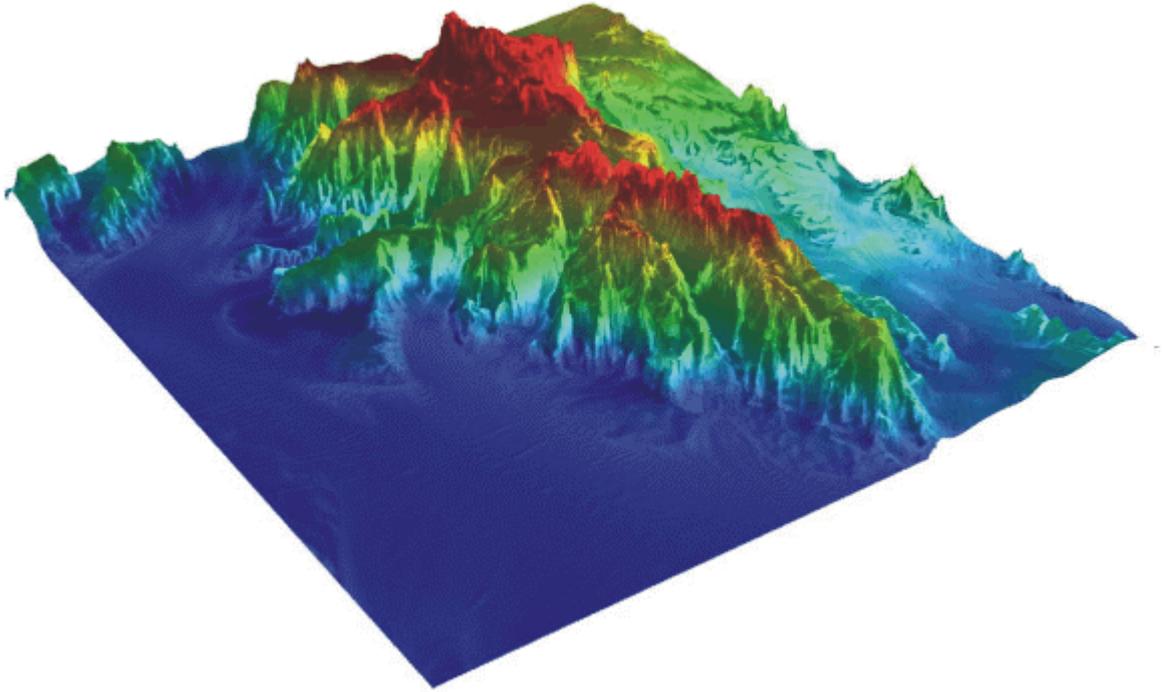


Fig. 5: 3D perspective view of Lennox King Glacier, Antarctica, using the RAMP DEM and SAR imagery.  
Source: Dr Hongxing Liu, Byrd Polar Research Centre  
<<http://polestar.mps.ohio-state.edu/~liu/research/visual/visual.html>>

One of the next most important steps for RAMP is to upgrade and improve the DEM so that the ortho-corrected mosaic is of a higher quality. Paul Cooper from BAS has already identified new datasets that could be used to improve the DEM. He has also found a few parts of the DEM that contain artefacts that will require correction.

## ICE BED ELEVATION

### **Antarctic Ice Bed Mapping Project (BEDMAP) - David Vaughan and Matt Lythe, British Antarctic Survey.**

Data describing the thickness of the Antarctic ice sheet collected on surveys undertaken over the past 50 years have been brought together into a single database comprising over 2.5 million observations of ice thickness collected from more than 100 separate expeditions conducted by 12 countries since 1951. These data have allowed the compilation of a number of seamless digital topographic models for the Antarctic continent and surrounding ocean. These include grids representing:

- ice-sheet thickness over the ice sheet and shelves,
- water-column thickness beneath the floating ice shelves,
- bed elevation beneath the grounded ice sheet, and
- bathymetry to 60° South including the areas beneath the ice shelves.

These grids are consistent with a recent high-resolution surface elevation model of Antarctica. While the digital models have a nominal spatial resolution of 5 km, this may not be strictly justified given the original data density over all parts of the ice sheet.

The 2.5 million observations cover approximately 80% of the 13.98 million square km total area of the continent with a mean density of one point per 5.5 km. Although some areas, notably parts of Wilkes Land, Queen Mary Land and southern Dronning Maud Land still have only limited coverage, the number of data points in BEDMAP is two orders of magnitude greater than the only comparable compilation, the SPRI Folio 'The Bedrock Surface of Antarctica' published in 1983.

The datasets do however provide an unparalleled vision of the geosphere beneath the ice sheet and a more reliable basis for ice sheet modelling. The total volume of the Antarctic ice sheet is calculated to be 25.4 million km<sup>3</sup> while the total sea-level equivalent, derived from the amount of ice contained within the grounded ice sheet is 57 million km<sup>3</sup>, comprising 52 million km<sup>3</sup> from the East Antarctic ice sheet and 5 million km<sup>3</sup> from the West Antarctic ice sheet. The gridded data sets can be obtained from the project leaders.

A map summarizing the work of the BEDMAP Consortium has just been printed and will be displayed at XXVI SCAR; it shows the subglacial bed/seabed elevation model for the entire area south of 60° South.

A summary of the data sets in BEDMAP, a list of contributors, as well as several maps describing the coverage and density of data may be viewed on the BEDMAP web site at

<http://www.antarctica.ac.uk/bedmap/>

There is also a prototype search facility of the BEDMAP database available at:

<http://www.antarctica.ac.uk/aedc/bedmap/DataSearch.html>

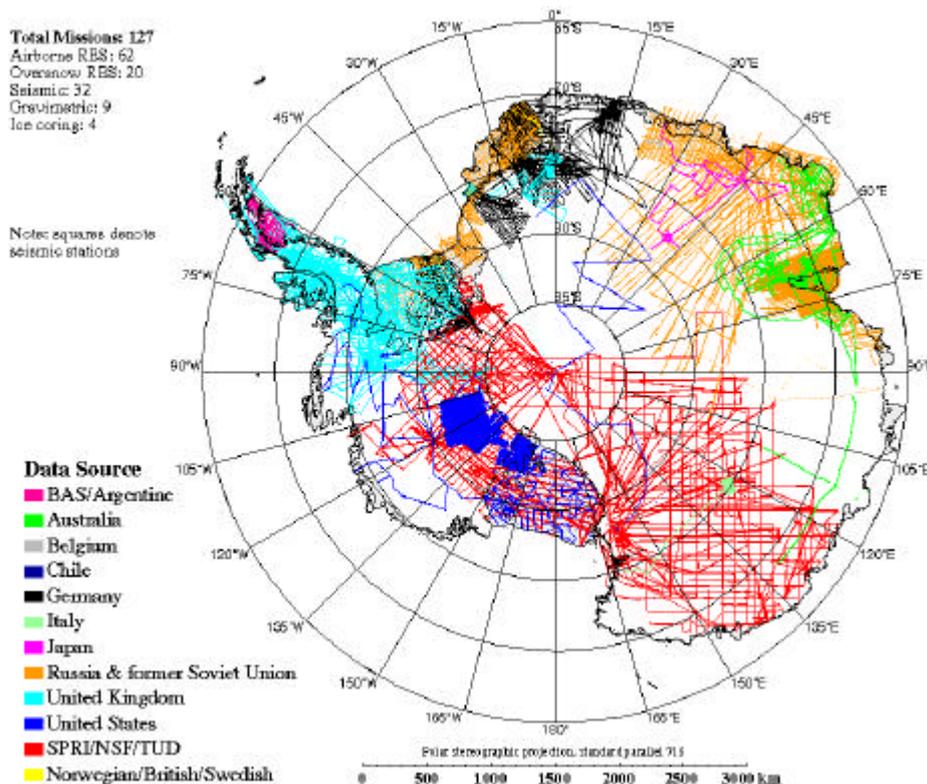


Fig. 6: BEDMAP Data Coverage at 6 January 2000

Source: Matt Lythe, British Antarctic Survey

[http://www.antarctica.ac.uk/aedc/bedmap/database/bedmap\\_coverage.html](http://www.antarctica.ac.uk/aedc/bedmap/database/bedmap_coverage.html)

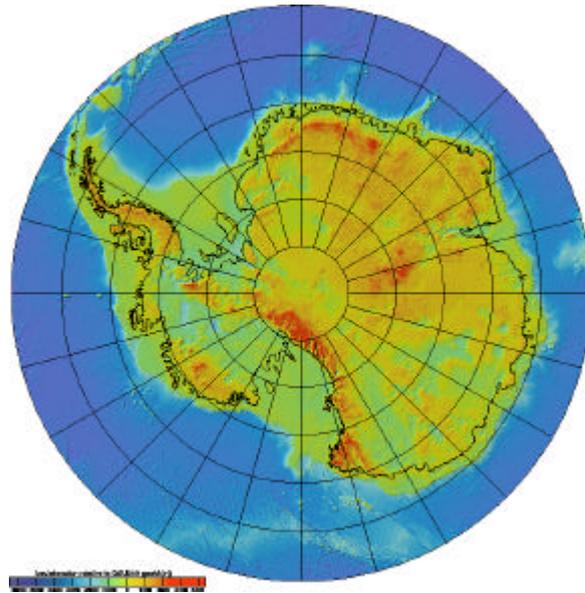


Fig. 7: BEDMAP Bed Elevation example.  
Source: Matt Lythe, British Antarctic Survey  
<<http://www.antarctica.ac.uk/aedc/bedmap/examples/>>

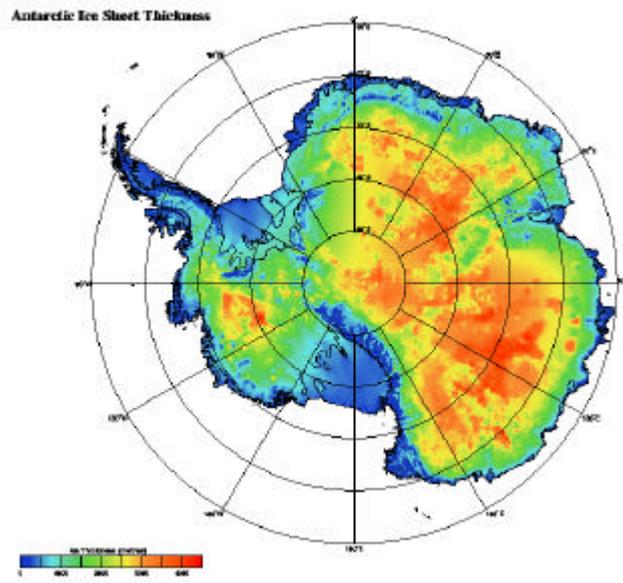


Fig. 8: BEDMAP Ice Thickness example.  
Source: Matt Lythe, British Antarctic Survey  
<<http://www.antarctica.ac.uk/aedc/bedmap/examples/>>

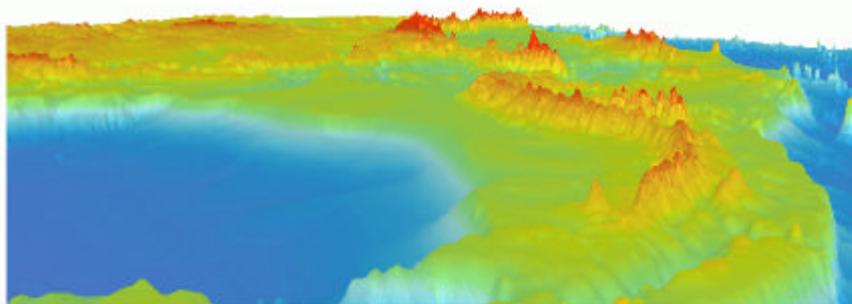


Fig. 9: BEDMAP perspective example.  
Source: Matt Lythe, British Antarctic Survey  
<<http://www.antarctica.ac.uk/aedc/bedmap/examples/>>

## COASTLINE

### **Antarctic Glaciology and Coastal Change Project (AGCCP) – Richie Williams, USGS, Woods Hole & Jane Ferrigno, USGS, Reston**

On 19 and 20 October 1999 at USGS Woods Hole, Massachusetts, there was a meeting of the AGCCP with Jane Ferrigno, Janet Thomson, Jerry Mullins, and Cheryl Hallam. The purpose of the meeting was directed at compiling three 1:500 00 scale map sheets of the Antarctic Peninsula, using multiple image datasets and historical data to delineate ice fronts, ice walls, grounding line, other glaciological features, etc. They hope to collaborate with Joern Sievers, as he has compiled an excellent georeferenced Landsat TM image mosaic of most of the area of interest. Cheryl Hallam, who is responsible for the Antarctic Digital Atlas of the U.S. Geological Survey, has been appointed as a technical advisor and collaborator on the Antarctic Peninsula effort.

At the time of writing, due to a lack of communication from the project leaders and technical advisor, it is unclear as to the state of digital data production for AGCCP.

Currently AGCCP is not a SCAR WG-GGI endorsed project. The AGDI Project Manager has been in contact with Richie Williams to find out if AGCCP would like this endorsement – with a positive answer. This issue should be a point of discussion during XXVI SCAR.

### **Antarctic Digital Database – Janet Thomson (BAS)**

"The main achievement of the work has been the significant improvement of the data in the contour layer for regions north of 80°S, using a DEM derived mainly from ERS-1 data and ADD Version 1.0. In addition, data omitted from the glacier margin, flowline and rock outcrop layers have been incorporated, as have new ice front locations. Data have been captured at a variety of scales and the whole dataset has been generalized to 1:1 000 000 scale. Further generalization datasets (at 1:5 000 000 and 1:10 000 000 scales) will be prepared after XXVI SCAR. Scale0 and Scale1 datasets, Version 3.0, will be released on the ADD web site in July 2000."

*[Also see separate ADD report in the agenda papers prepared by Janet Thomson]*

## FEATURES

### **Antarctic Digital Database – Janet Thomson (BAS)**

*[Also see separate ADD report in the agenda papers prepared by Janet Thomson]*

A request was received in late April this year regarding the availability of any other Features datasets that SCAR or non-SCAR people might be working on. Features include buildings, automatic weather stations, aircraft landing strips, etc. Does any member know of any projects collecting this type of information, either localised area or continental-wide?

## NAMES

### **Composite Gazetteer of Antarctica – Roberto Cervellati and Chiara Ramorino (ENEA)**

*[See separate CGA report prepared by Roberto Cervellati and Chiara Ramorino]*

For further information see the CGA web site: <[www.pnra.it/SCAR\\_GAZE](http://www.pnra.it/SCAR_GAZE)>

## REMOTE SENSING

This new theme was added after discussions held at the WG-GGI Project Coordinators meeting in Heppenheim, Germany in July 1999.

There are many projects in Antarctica that use remotely sensed data. Those people interested in viewing what remotely sensed data sources for Antarctica are available from the AGDI Data Library should visit: <[www.scar-ggi.org.au/geog/agdi/lib\\_surf.htm](http://www.scar-ggi.org.au/geog/agdi/lib_surf.htm)>  
One project that is current and useful to researchers is outlined below.

### **RADARSAT Antarctic Mapping Project (RAMP) - Byrd Polar Research Centre, Ohio State University**

Antarctica has never been fully mapped from space at high resolutions. The RAMP project is a collaborative effort between the U.S. National Aeronautics and Space Administration (NASA) and the Canadian Space Agency (CSA), to completely map the Antarctic with RADARSAT-1. Such continental-wide coverage was not possible with existing or previous space borne high resolution sensors because of their orbit inclination and/or field of view capability. The RADARSAT satellite was rotated 180 degrees in yaw to allow the radar to image to the left of the satellite track instead of to the right, and to steer the radar beam up to cover the South Pole. This manoeuvre was performed between September 9 and 11, 1997. The mapping of Antarctica with high resolution RADARSAT images began on September 26 and was completed October 14.

NASA and CSA have now reached agreement on providing a 125 m version of the Antarctic Mosaic to the general public.

Several versions of the mosaic are available on the Byrd Polar FTP site <<ftp://iceberg.mps.ohio-state.edu/>>, username is *anonymous*, password *your name*, and go to the */pub/MOSAIC* directory. The 125 m data is 16 bit raw raster format. Other products are 8-bit .tiff files.

The Scientific Visualisation Studio at Goddard Space Flight Center have created a comprehensive web site containing a lot of information about the project and a number of .tiff image composites. These are freely available on the internet starting at:

<<http://svs.gsfc.nasa.gov/imagewall/antarctica.html>>

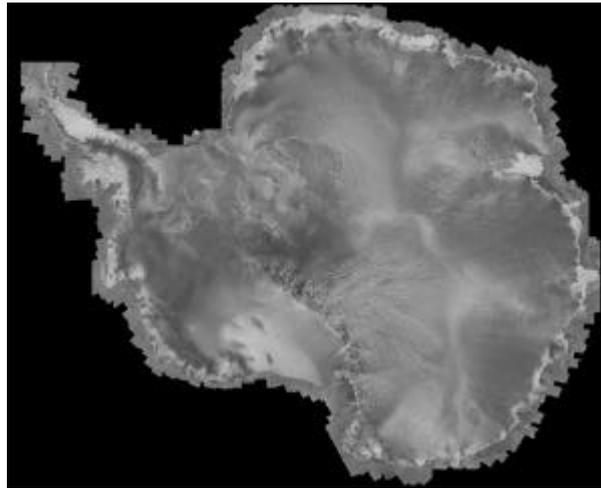


Fig. 10: RADARSAT mosaic of Antarctica.  
Source: <<http://radarsat.space.gc.ca/info/AMM/menu.html>>

## **FUTURE WORK PROGRAM**

Both the WG-GGI Chief Officer and AGDI Project Manager believe the project has, to date, achieved most of the goals set at XXV SCAR. Over the last 2 years there has been considerable progress made by a number of institutions and individuals in completing a number of fundamental datasets, particularly the RAMP DEM and BEDMAP datasets. The bathymetry dataset is poised to have an upgrade, data has been gathered - with the possibility of more on the way - and the only aspect lacking is adequate funding to employ an experienced GIS operator to integrate these data.

It is now time to take stock and revise the project based on a need to provide a 1:5M scale data product to the SCAR community and others interested in Antarctic research and Antarctica in general. The options developed so far are presented below.

### **Options for future development of AGDI**

1. The Australian Antarctic Division (perhaps in cooperation with the Antarctic CRC) could take on production of the 1:5M product (a CD-ROM containing the 7 fundamental data layers) ready for distribution at XXVII SCAR in 2002. This could be conducted in a similar style to the BEDMAP project - with a Database Manager and overall Project Manager.
2. The project could be downscaled - with the 1:5M product being dropped. However, there would be the continuation of the Data Libraries on the AGDI web site.

These options are still being considered and form the basis for discussion at the meeting.

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Glenn Johnstone  
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Antarctic Geographic Data Integration project

Attachments: AGDI information brochure

30 June 2000